+ +

LAPAROSCOPIC APPROACH TO ACUTE ABDOMEN

Consensus Development Conference of the Società Italiana Chirurgia Endoscopica e nuove tecnologie (SICE); Associazione Chirurghi Ospedalieri Italiani (ACOI); Società Italiana di Chirurgia (SIC); Società Italiana Chirurgia d'Urgenza e Trauma (SICUT), Società Italiana Chirurghi dell'Ospedalità Privata (SICOP) and the European Association for Endoscopic Surgery (EAES)

Ferdinando Agresta [1], Luca Ansaloni [2], Luca Baiocchi [3], Carlo Bergamini [4], Fabio Cesare Campanile [5], Michele Carlucci [6], Giafranco Cocorullo [7], Alessio Corradi [8], Boris Franzato [9], Massimo Lupo [10], Vincenzo Mandalà [10], Antonello Mirabella [10], Graziano Pernazza [11], Micaela Piccoli [12], Carlo Staudacher [13], Nereo Vettoretto [14], Mauro Zago [15], Emanuele Lettieri [16], Anna Levati [17], Domenico Pietrini [18], Mariano Scaglione [19], Salvatore De Masi [20] ; Giuseppe De Placido [21], Marsilio Francucci [22], Monica Rasi [23], Giorgio Scaramuzza [24], Angelo Lino Del Favero [25]

1. Dept of General Surgery, Presidio Ospedaliero, Adria (RO) – Italy
2. Dept of General Surgery, Ospedali Riuniti, Bergamo (BG) - Italy
3. Dept of Medical and Surgical Sciences, Surgical Clinic, Brescia University, Brescia - Italy
4. Dept of General, Emergency and Mini-invasive Surgery, Universitary Hospital of Careggi, Florence, Italy
5. Dept of General Surgery, Ospedale di Civita Castellana (VT) - Italy
6. Dept of Emergency Surgery – IRCCS San Raffaele – Milan, Italy
7. Dept of General, Emergency and Transplantation Surgery - A.O.U.P. Paolo Giaccone, Palermo, Italy
8. Dept of General Surgery - Regional Hospital Bolzano, Italy
9. Dept of General Surgery, San Giacomo Apostolo Hospital, Castelfranco Veneto (Treviso), Italy
10. Dept. of General and Emergency Surgery. A.O. OO.RR. Villa Sofia – Cervello Palermo Italy…
11. 2^ Dept of General, Laparoscopic and Robotic Surgery, Azienda Ospedaliera San Giovanni Addolorata, Rome, Italy
12. Dept of General Surgery, Nuovo Ospedale Civile S. Agostino- Estense - Baggiovara - Modena , Italy
13. Dept of General Surgery, Istituto Scientifico Universitario San Raffaele, Milan, Italy
14. Laparoscopic Surgery Unit, Az. Osp. M.Mellini, Chiari (BS), Italy
15. Dept. General and Emergency Surgery - Istituto Clinico Città Studi - Milano, Italy
16. Department of Management, Economics and Industrial Engineeering, Politecnico di Milano, Italy.
17. Clinical Risk Manager, District of Pavia Hospital, Pavia, Italy
18. Institute of Anesthesiology and Intensive Care - Catholic University Medical School
Rome, Italy
19. Department of Diagnostic Imaging, Pineta Grande Medical Center, Castel Volturno (CE).
20. Azienda Ospedaliera-Universitaria Meyer, Florence, Italy
21. Dept of Gynaecology and Obstetrics, “Federico 2^” University, Naples, Italy
22. Dept of General Surgery, Azienda Ospedaliera " S. Maria " Terni.
23. Registered Nurse, Surgical Operative Theatre coordinator, Bologna, Italy
24. For the Cittadinanzattiva – Active Citisenship
25. CEO ULSS7 della Regione Veneto, Pieve di Soligo (TV), Italy

Scientific Committee of the Consensus:
F. Agresta (promoter and organizer),
L. Baiocchi,
A. Corradi
E. Lettieri (Health Technology expert),
M. Lupo,
G. Pernazza;

Panel – Experts:
L. Ansaloni,
C. Bergamini,
F.C. Campanile,
M. Carlucci,
G. Cocorullo,
B. Franzato,
V. Mandalà,
A. Mirabella,
M. Piccoli,
C. Staudacher,
N. Vettoretto,
M. Zago .

Rapresentatives:
M. Rasi
for the IPASVI – the Italian National Federation Nursing Council;
S. De Masi
for the ISS – Italian Health Institute;
A. Levati and D. Pietrini
for the SIAARTI – Italian Society of Anaesthesiology, Analgesia, and Intensive Care;
Giuseppe De Placido
President of the SEGI (Italian Society of Gynecological Endoscopy) on behalf of SIGO (Italian Society of Obstetrics and Gynecology);
M. Francucci
for the SIMM – Italian Hospital Managers Society;
M. Scaglione
for the SIRM – Italian Society of Radiology;
A.L. Del Favero
for the Federsanità – Italian Federation of Local Health Districts and Municipalities;
G. Scaramuzza
for Cittadinanzattiva - Citizenship

Reviewers: A. Fingerhut and S. Uranues for the E.A.E.S. and S. Garattini Istituto Mario Negri – Italian Cochrane Center

Presented at the 19th International Congress of the European Association for Endoscopic Surgery (EAES), Torino, Italy, June 2011

Introduction

Acute abdominal pain, defined as any medium or severe abdominal pain with duration of less than 7 days, is a common presentation in surgical department, both in primary care and secondary referral hospitals.

Each year about 450 females and 180 males per 100.000 are hospitalized for acute abdominal pain, the most common causes being non-specific abdominal pain (15.9-28.1%), acute biliary disease (2.9-9.7%), and bowel obstruction or diverticulitis ([1]).

In the last twenty years the role of laparoscopy in emergency surgery has increased continuously.

In 2006 the EAES published ([2]) its consensus statement on laparoscopy for abdominal emergencies, concluding that *"…available evidence clearly demonstrates the superiority of a laparoscopic approach in various emergency situations, but laparoscopy offers less and or unclear benefit in other acute conditions…Because the EAES updates its guidelines regularly, such data are also important before stronger recommendations can be issued. On the other hand, in those fields for which there is good evidence, laparoscopic surgery has been shown to be highly beneficial…."*

Almost five years have passed since the EAES guidelines publication, and the Scientific and Educational Committee of the SICE (Società Italiana per la Chirurgia Endoscopica), affiliated with the EAES, decided in January 2010, to revisit the clinical recommendations for the role of laparoscopy in abdominal emergencies in adults, its primary intent being to update the EAES indications and supplement the existing guidelines on

specific diseases and to attain the following objectives:

1. establish the preferred diagnostic procedures, selection of patients – if applicable – and the suitability of the laparoscopic approach responsible for acute abdominal disease settings;
2. assess the indication, morbidity, length of hospital stay, costs and recovery time from laparoscopic treatment for acute abdominal settings;
3. define the optimal practice in laparoscopy for each abdominal emergency and provide recommendations that reflect good practice.

For the purpose of the Consensus, the definition of emergency surgery includes unplanned surgical cases, both urgent and non-urgent, that arrive at a hospital through a variety of pathways. The timeframe for indication of urgency includes all unplanned cases requiring surgery within seven days.

Methods

Consensus Development: In order to better analyze the existing "evidence" on the subject, other Italian Surgical Societies have been invited to join the SICE in the Consensus choosing a panel of 12 surgeons expert in emergency surgery – both laparoscopic and open. The involved scientific societies represented the entire italian surgical community (**Società Italiana Chirurgia Endoscopica e nuove tecnologie (SICE) – Italian Society of Endoscopic Surgery; Associazione Chirurghi Ospedalieri Italiani (ACOI) – The Italian Society of Hospital Surgeons; Società Italiana di Chirurgia (SIC)- The Italian Society of Surgery; Società Italiana Chirurgia d'Urgenza e Trauma (SICUT)- The Italian Society of Trauma and Emergency Surgery and the Società Italiana**

Chirurghi dell'Ospedalità Privata (SICOP) – The Italian Private Hospitals' Surgical Society. The Consensus has been held under the Auspices of the EAES.

Today it is generally agreed that a multidisciplinary panel is critical to achieve both guidelines and recommendations.

Therefore, besides Surgeons and the Promoting Committee, Radiologists (SIRM: Italian Society of Radiology), Anesthesiologists (SIARTI: Italian Society of Anesthesiology, Analgesia and Intensive Care), Gynecologists (SIGO: Italian Society of Gynecology and Obstetrics), Epidemiologists, Nurses (IPASVI: – the Italian National Federation Nursing Council), Health-services researchers, Hospital Administrators (Federsanità: Italian Federation of Local Health Districts and Municipalities), Health Managers (Società Italiana Medici Manager – SIMM - Italian Hospital Managers Society), Health Care Regulators (Istituto Superiore di Sanità – ISS and The Italian National Health Institute) were also involved. A patient's association was also invited and participated (Cittadinanzattiva Active Citizenship).

No pediatric surgeon was involved in the panel because only adult emergency surgery was taken into consideration.

For each disease previously analyzed by the EAES, three experts summarized independently the current state of the art, and their conclusions were made available to the entire panel. Ventral hernia surgery was added as a specific new topic and a paragraph on n anesthesiologic considerations was also included.

In November 2010 the panel met in Rome for 2 days to discuss each chapter according to the Delphi method, producing a key statement with a grade of recommendations (GoR) followed by a commentary to explain the rationale and the level of

evidence behind the statement. All key statements were formulated according to a 100% consensus obtained within the whole group. Next these statements were presented to the audience of the Annual congress of the EAES in June 2011 and then the draft document has been published on the web sites of all the involved Italian Surgical Societies for two months. Comments both from the audience and from the web were collected and partly included in the manuscript. The final version of the guidelines was approved by allthe members of the panel.

Literature Searches and Appraisal: The Oxford hierarchy for grading clinical studies according to levels of evidence (LE) was used to facilitate comparison with the previous EAES consensus. The primary objective of the search was to identify all clinical relevant randomized controlled trials (RCT). However, other reports, population based outcomes studies, case series and case reports were also included. Studies containing severe methodological flaws were downgraded. For each intervention, the validity and homogeneity of study results, effect sizes, safety and economic consequences were considered.

A systemic review based on comprehensive Literature research was made on Pubmed

Limits Activated: Humans, Clinical Trial, Meta-Analysis, Practice Guideline, Randomized Controlled Trial, Review, English, All Adult: 19+ years, published in the last 5 years.

Search details: ((("laparoscopy"[MeSH Terms] OR "laparoscopic"[All Fields]) AND ("condition-specific key word "[MeSH Terms] OR " condition-specific key word"[All Fields])) AND ("humans"[MeSH Terms] AND (Clinical Trial[ptyp] OR Meta-Analysis[ptyp] OR Practice Guideline[ptyp] OR Randomized Controlled Trial[ptyp] OR Review[ptyp]) AND English[lang] AND "adult"[MeSH Terms] AND "2005/1/1"[PDat]:

"2010/11/25"[PDat])].

After that, limits regarding language, age, publication date and study type were removed, and full texts from all the abstracts were used based on specific criteria. The papers have been selected and classified on the basis of highest level of evidence, design of the study, and most recent publication.

Cross-link control was performed with Google Scholar and Cochrane library databases.

According to the Health Technology Assessment Programme Manual (2001) [3] clinical recommendations are defined as *"systemically developed statements to assist both the practioner and patient decisions in specific circumstances…Guidelines are viewed as useful tools for making care more consistent and efficient and for closing the gap between what clinicians do and what scientific evidence support…"* Therefore we do agree with what it is reported in the SIGN[4] and SNLG[5] manuals: *…clinical guidelines do not rob clinicians of their freedom, nor relieve them of their responsibility to make appropriate decisions based on their own experience and according to the particular circumstances of each patient. It is stressed that the standard of care required by Law derives from customary and accepted practice rather than from the imposition of practices through clinical guidelines…Guidelines are indented as an aid to clinical judgment not to replace it…"*

Disclosures: There was no Commercial Sponsorship for this Consensus as no one of its members has any financial or other conflict of interests.

This Consensus development guidelines have been reviewed in draft form by independent expert referees: Prof. Uraneus and Prof. Fingerhut for the EAES, and the methodology, by Professor Silvio Garattini for the Istituto Mario Negri – Italian Cochrane Center

The authors thank Mrs Janette Hanney from UK for the linguistic review of the manuscript.

Results

Acute cholecystitis

Patients with acute cholecystitis should be treated by laparoscopic cholecystectomy (GoR A). Severe (gangrenous, empyematous) cholecystitis and advanced age do not preclude the indication for laparoscopic cholecystectomy (GoR B). Surgery should be performed as soon as possible after the onset of symptoms (GoR A). Early laparoscopic surgery should be offered also to elderly patients (GoR B). In patients with severe co-morbidities, conservative treatment or percutaneous cholecystostomy, followed or not by early or delayed surgery, may be alternatives in order to reduce surgical or anesthesiological risks (GoR C).

Diagnosis of acute cholecystitis relies on a combination of local clinical signs, systemic signs of inflammation, and imaging findings. Very similar sets of criteria with almost 100% specificity have been suggested in the EAES guidelines of 2006 ([2]) and in the Tokyo Consensus Meeting Guidelines ([6]): both can be used in clinical practice.

The safety of laparoscopic cholecystectomy for acute cholecystitis has been shown in several studies. The EAES consensus statement published in 2006([2]) discussed the evidence from two randomized trials LE1b ([7],[8]) and several comparative studies demonstrating faster recovery and shorter hospital stay in favor of laparoscopy. A recent USA population-based research outcome study, conducted over a six-year period (LE2c)([9]), indicated that laparoscopic cholecystectomy was associated with lower morbidity, lower mortality, and shorter hospital stays than open cholecystectomy.

The argument that the better outcomes of the laparoscopic cholecystectomy patients may be due to the medical staff's attitude towards expectation of faster recovery rather than to true physiopathological changes (expectation bias). The only trial including a blind assessment of outcomes (by concealment of wounds both to patients and postoperative care staff) ([8]) showed very similar postoperative outcomes in both groups, but still demonstrated a shorter postoperative hospital stay for the laparoscopic group. Moreover recent randomized studies evaluated the influence of surgical trauma on systemic inflammation and immune response in acute cholecystitis demonstrated that a laparoscopic approach caused less surgical trauma and immunosuppression (LE1b)([10],[11]).

The question arises as to whether laparoscopic surgery is indicated for severe cholecystitis (gangrenous, empyematous or perforated). In a recent review of prospective and retrospective series (LE2a)([12]), local postoperative complications were not found to be increase: laparoscopic cholecystectomy can be considered an acceptable indication for severe cholecystitis despite a threefold conversion rate. Subtotal cholecystectomy appears to be an acceptable alternative solution in cases of intense inflammation and increased risk of damage to Calot triangle structures (LE2a)([13]).

Another subgroup that deserves a separate analysis is the elderly population. The number of elderly patients with acute cholecystitis has been increasing over the years and earlier reports suggested a higher conversion rate for laparoscopic cholecystectomy in the elderly([14]) and also increased morbidity. However it is very difficult to extrapolate data from series involving both acute and chronic gallbladder disease ([15], [16]) or those comparing younger versus older patients ([17], [18]) because acute biliary disease appears to be more severe in the older patients and overall prevalence of co-morbidities is higher. Several prospective

and retrospective comparative studies examined laparoscopic versus open surgery for acute cholecystitis in elderly patients suggested a reduction in the length of hospitalization ([19],[20],[21]), with morbidity either unchanged ([19]) or improved ([20],[21],[22])(LE2b).

The optimal timing of surgical intervention in acute cholecystitis is a major issue. Randomized controlled trials comparing early versus delayed open cholecystectomy have found that early surgery was associated with a lower complication rate and a shorter hospital stay ([23],[24],[25],[26]). However, earlier reports suggested an increased risk of conversion and intra-operative complications such as bile duct injury, if early treatment of acute cholecystitis was carried out by laparoscopic cholecystectomy ([27],[28]). Since the late 1990s, several studies have compared early versus delayed laparoscopic cholecystectomy. In particular seven papers([29],[30],[31],[32],[33],[34],[35]) have been examined in 5 meta-analysis (LE1a) ([36],[37],[38],[39],[40],[41]). Six of those seven papers were RCTs (LE1b) but one of the systematic reviews ([38]) included a non-randomized study (LE2b) ([34]). One further RCT (LE1b) was not included in any systematic review because it was published at a later date([42]). The definition of time interval for early or delayed surgery varies among the studies taken into consideration: surgery is considered “early” either 4 or 7 days after the onset of symptoms, while delayed treatment is defined as 6-12 weeks after index admission. In one of the studies ([32]) the group of delayed treatment included patients operated on after resolution of symptoms, or within five days if the symptoms failed to resolve; those patients would be considered in the “early” group in the other trials; this study was not included in 3 out of 5 systematic reviews. Despite these methodological issues, all studies reach the same conclusions: early treatment reduces total hospital stay and does not increase complication or conversion rates (LE1a). 17.5% (range 13.9-25%) of patients included in the delayed surgery groups required urgent surgery during the interval

period, for failure of conservative treatment or for recurrent symptoms after discharge. In this subset the conversion rate was 45%. These data could promote the trend towards early surgery.

Despite the large number of studies addressing the issue of laparoscopic cholecystectomy in the elderly, only one retrospective trial examined the results of early versus delayed treatment in the aged and it found no outcome difference between the two groups ([43]). A recent study examined a sample of the USA Medicare Claims Data System and found that 75% of patients aged 66 years and older, admitted as emergencies to an acute care facility for a first episode of acute cholecystitis, were treated by early cholecystectomy (71% laparoscopic and 29% open)([44]). The widespread use of early laparoscopic cholecystectomy in elderly patients, at least in the U.S.A., confirms that most surgeons are confident in performing early laparoscopic surgery for acute cholecystitis even in an aged population. Furthermore, the same outcome analysis showed that lack of definitive treatment during initial hospitalization in the elderly is associated with 38% gallstone-related readmission rate over the subsequent 2 years (with only 9.5% of patient undergoing an elective outpatient cholecystectomy), compared with 4.4% in patients who underwent early treatment (LE2c).

Several alternatives have been proposed for emergency treatment in high risk septic patients unfit for emergency surgery: conservative treatment (LE1b)([45]),tube cholecystostomy followed by early laparoscopic surgery (LE1b)([46]), (LE4)([47]), or by delayed open surgery (LE4)([48]), and cholecystostomy not followed by surgery (LE4)([49]). A systematic review of 53 papers on cholecystostomy as an option in acute cholecystitis (LE2a) found no evidence to support the recommendation of percutaneous drainage rather than early

emergency cholecystectomy even in critically ill patients, and actually suggested that cholecystectomy seems to be a better alternative for treating acute cholecystitis in the elderly and/or critically ill population ([50]).

Two cost-utility analyses were published. One of them, performed in a prospective randomized trial, found no significant difference in the cost or outcomes of early laparoscopic cholecystectomy versus delayed treatment, with the latter favored by the incremental cost per additional Quality Adjusted Life Year (QALY); however patients operated on for biliary colic were included in the trial ([51]) (LE1b). A model-based economic evaluation used data from a Cochrane review ([39]) to estimate costs and outcomes, showed that early surgery was less expensive and results in better quality of life than delayed treatment ([52])(LE1b).

A randomized clinical trial of traditional dissection with electrocautery versus ultrasonic dissection demonstrated that operative time in laparoscopic cholecystectomy performed for acute cholecystitis is significantly shorter when ultrasonic dissection is used([53])(LE1b). A prospective observational study confirmed this finding and showed a reduction in conversion rates for acute cholecystitis patients operated on laparoscopically with ultrasonic dissection([54])(LE2b). A randomized trial is being conducted on this topic to clarify these observations([55]).

We could not find any trial comparing results of conventional laparoscopic surgery versus single access surgery for acute cholecystitis. A randomized trial of early mini-laparoscopic versus conventional laparoscopic surgery has shown no significant difference between the two techniques in conversion rates, mean duration of the operation, hospital stay and major complications; however, the study was not based on intention to treat and the

converted cases were excluded from the results([56]) (LE2b).

Acute pancreatitis

In mild gallstone-associated acute pancreatitis, laparoscopic cholecystectomy should be performed as soon as the patient has recovered and during the same hospital admission (GoR B). In severe gallstone-associated acute pancreatitis, laparoscopic cholecystectomy should be delayed until there is sufficient resolution of the inflammatory response and clinical recovery (GoR B). Apart from cases in which an emergency ERCP is indicated, in case of common bile duct stones, clearance should be obtained by preoperative ERCP or by laparoscopic removal of bile duct stones during cholecystectomy (GoR A). When pancreatic necrosis requires treatment for clinical signs of sepsis or multiorgan failure that do not improve despite optimal therapy, a step-up approach, consisting of percutaneous drainage, followed, if necessary, by minimally invasive retroperitoneal debridement, should be undertaken. Open surgery should be reserved to patients non-responding to minimally invasive treatment (GoR B). The abdominal compartment syndrome should be managed by prompt laparostomy or fasciotomy; laparoscopy is formally contraindicated in these cases (GoR C).

A number of guidelines have been published on the management of acute pancreatitis (AP), including those produced by the Italian Association for the Study of the Pancreas ([57]). However, only the guidelines of European Association for Endoscopic Surgery, published in 2006, ([2]) address specifically the laparoscopic management of AP.

Acute pancreatitis is a frequent condition ([58],[59]), presenting with a wide spectrum of clinical situations. Assessment of severity is mandatory, and it is usually performed by APACHE II score or CT scan (LE2b) ([60], [61],[62]).

In gallstone pancreatitis, laparoscopic cholecystectomy is indicated to prevent disease recurrence. In mild pancreatitis, cholecystectomy should be considered as soon as the patient has recovered and during the same hospital admission, while in severe pancreatitis cholecystectomy is delayed until there is sufficient resolution of the inflammatory response and clinical recovery (LE2b) ([63], [64], [65], [62], [66], [67], [68],[69]).

When common bile duct (CBD) stones are suspected, confirmation with endoscopic ultrasonography (EUS) or magnetic resonance cholangiography (MR) should be obtained whenever possible ([70],[71]). EUS or MR allow detection of CBD stones with sensitivity and specificity both of over 90%, preventing the risk of complications due to unnecessary bile duct exploration ([72]). If the diagnosis of CBD stones is confirmed, it can be managed either by preoperative ERCP ([73]), laparoscopic CBD clearance during cholecystectomy (laparoscopic or combined laparo-endoscopic "rendez-vous") ([74],[75]) or at the next best opportunity. Two meta-analyses showed no differences when preoperative ERCP was compared to intraoperative removal of CBD stones ([76],[77]) (LE1b). The choice of treatment should be determined by local expertise, since laparoscopic CBD exploration requires a significant surgical skill.

Radiological drainage and/or surgery are indicated to treat infected pancreatic necrosis with clinical signs of sepsis, and sterile pancreatic necrosis with multiorgan failure that do not improve despite maximal therapy ([57]). The treatment of necrosis should be delayed by at least 14 days from the onset of pancreatitis ([57],[78]). When surgery is indicated, a laparotomic necrosectomy can be

performed, but less invasive approaches have recently been gaining surgical attention. The laparoscopic debridement can be done by infracolic ([79]) or retroperitoneal approach ([80], [81]); transgastric endoscopic pancreatic necrosectomy has also been reported ([82]). Two recent prospective studies (one single-arm ([83]) and one randomized ([84]) suggest that the presence of a well-demarcated necrosis can be treated using a step-up approach whenever possible (LE 1b). The first step should be percutaneous drainage, followed, if necessary, by minimal invasive retroperitoneal debridement. Open surgery should be the last step, to be performed in cases where more conservative treatment has failed. This strategy has been associated with a significantly lower morbidity (diabetes, incisional hernias) and lower new-onset multiple organ failure when compared to open surgery as first step ([84]).

The only indication for early surgery in acute pancreatitis is the presence of a compartment syndrome ([85], [86],[87]), which should be managed by surgical decompression (laparostomy or fasciotomy) (LE 4); laparoscopy is formally contraindicated in these cases.

Acute appendicitis

Patients with symptoms and diagnostic findings suggestive of acute appendicitis should undergo diagnostic laparoscopy (GoRA) and, if the diagnosis is confirmed, laparoscopic appendectomy (GoRA).

More than 25 years after the first laparoscopic appendectomy (LA)([88]) technical aspects and outcomes are still debated, despite recent guidelines([89,90]). Preoperative ultrasound study in addition to clinical examination and CT in equivocal cases (LE 2b), seem to lower the negative appendectomy rate and missed perforations([91,92]). LA can be considered the gold standard in pre-

menopausal women (LE 1a)([93]), and it is feasible in the elderly (LE 3)([94]), obese (LE 3)([95]), and men, even if advantages over open appendectomy (OA) in the latter group are not demonstrated (LE 1b)([96]). Complicated appendicitis can be approached laparoscopically, with significant improvement of the surgical site infection rate (minor advantage following Clavien's criteria)(LE 3a)([97,98]). Thorough peritoneal lavage (>6-8lt) and aspiration is recommended in complicated appendicitis (LE 5) in order to minimize abscess formation rate([99]). The reported increase in post-operative intraabdominal abscesses([93]) is probably due to initial experiences and has not been confirmed by more recent reviews (LE 2a)([100]). Despite evidence that considers LA safe in pregnancy([101]), advantages are minor (less pain, less infections, less early deliveries) if compared to the risk of fetal loss, which has an LE 2 evidence of being greater than with OA([102]). Removal of a normal appendix in the presence of other diseases at exploration is not recommended. If no other disease is encountered and appendix apperars “normal”:

1. Remove if there is preoperative history of appendicular colicky pains and pre-op exams (US or CT) reveal suspected faecalith or fecal impaction in the appendix (LE 4)([103]);
2. Morbidity of appendectomy does not significantly exceed that of the explorative laparoscopy. If the practice's rate of abscesses is minimal, then appendectomy is advised in order to prevent recurrent pain and readmission (up to 13% and 9%) and to gain the “endoappendicites”, which account for 11-26% of normal appendices at pathologic examination (LE 5)([104]).

Regarding appendiceal stump closure, stapling reduces operative time and superficial wound infections (LE 1a)([105]), but since there is no evidence to prove a lower rate of deep abscess with the use of staplers, higher costs influence the choice toward loop-closure. Cochrane protocol results (stapler vs loop, primary

outcome deep abscess rate) are awaited([106]), nevertheless attention must be paid to training results in the two methods apart from comparative costs; in fact LA is mostly performed by young and less experienced surgeons during late afternoon or nighttime, therefore an easier and technically standardized method such as the mechanical stapler might prove to be advantageous (LE 5).

Three port appendectomy is still the gold standard. Various positions and trocar size might be used (in young women umbilical and two suprapubic trocars might result in better cosmetic results (LE 5) ([107]). Needlescopy should be applied only in selected and non complicated cases due to its higher rate of conversions and prolonged operating room time (LE 1a)([108]). Trocar incisions should follow Langer's lines to achieve better cosmetic results (LE 5)([109]). Single port appendectomy is still inferior to the standard three port technique (LE 3b)([110]). NOTES appendectomy (via natural orifices) is admitted only in strictly controlled clinical and experimental protocols([111]). Fast track procedures in the post-op care of LA should be studied and implemented (LE 5)([112]). Costs should not be the determining factor in favouring open or LA, unless there is a routine application of costly technology, due to the surgeons' choice (LE 2a)([113,114]). The panel believes that technique standardization is of utmost importance to improve the quality of future trials regarding LA and also for teaching and training purposes (LE 5)([89,115]).

Gynaecologic disorders

When gynaecologic disorders are the suspected cause of abdominal pain, diagnostic laparoscopy should follow conventional diagnostic investigations, especially US (GoR A), and, if needed, a laparoscopic therapy for the disease should be performed (GoR A).

A close cooperation with the gynaecologist is strongly recommended (GoR A). Diagnostic laparoscopy should follow other non-invasive diagnostic investigations in ectopic pregnancy (GoR B), adnexal torsion (GoR C), pelvic inflammatory disease (GoR B) and haemorrhagic ovarian cysts (GoR D). In endometriosis diagnostic laparoscopy can be considered the gold standard as diagnostic investigation (GoR A).

Laparoscopic therapy should be performed in ectopic pregnancy (GoR A), adnexal torsion (GoR A), endometriosis (GoR A) and haemorrhagic ovarian cysts (GoR B). Other less invasive procedures should be performed in pelvic inflammatory disease (GoR A).

The recommendation of close cooperation with the gynaecologist in the setting wherever available in the field of gynaecological emergencies was reported in the previous EAES Guidelines without any further supportive evidence.

The most common diagnoses encountered in female patients with acute lower abdominal and/or pelvic pain are ([116]): ectopic pregnancy (EP), adnexal torsion (AT), endometriosis, pelvic inflammatory disease (PID) and haemorrhagic ovarian cysts. Many acute gynaecological diseases can be approached safely and effectively by laparoscopy with the aim not only to correctly diagnose, but also to treat them (LE 4) ([117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128]).

In gynaecological emergencies, transvaginal and conventional ultrasound (US) with the aid of a pregnancy test can formulate a differential diagnosis in a high percentage of patients (LE 3b)([129]). CT and MR scans are very rarely useful (LE 2b)([130, 131, 132, 133]). However, diagnostic laparoscopy (DL) is better than US (LE 2b)([134, 119, 117, 123, 125, 128]) and may lead to the modification of an incorrect

preoperative diagnosis in up to 40% of cases (LE 4)([135, 119, 123, 125, 136]). Early DL results in the accurate, prompt, and efficient management of acute abdominal pain particularly in general practice, where it reduces the rate of unnecessary laparotomy and right iliac fossa gridiron incisions and increases the diagnostic accuracy (LE 4) ([117, 118, 120, 121, 122]). In particular DL has been proved to reduce the risk of a negative appendectomy when appendicitis is suspected, with a stronger effect in fertile women, mainly due to the correct diagnosis of gynaecological disorders (LE 1a)([137,138]).

Ectopic pregnancy (EP) is a potentially life-threatening condition. Approximately 1/100 pregnancies are ectopic, with the embryo usually implantied in the fallopian tube. Some EPs resolve spontaneously, but others continue to grow and lead to rupture of the tube. Risks are higher in women with damage to the fallopian tubes due to pelvic infections, surgery, or previous EP([139]). In women in early pregnancy presenting with acute pelvic pain and/or vaginal bleeding, a diagnosis of EP should always be considered. Current diagnosis of tubal EP involves a combination of transvaginal US and measurement of serum human chorionic gonadotropin (hCG) concentrations. In the vast majority of cases, a pregnancy test can exclude the diagnosis in cases with only minor symptoms. However, accurate and early ascertainment remains problematic, and there are often delays in making the diagnosis and implementing treatment. Further difficulties are encountered because serial hCG determination cannot accurately distinguish arrested intra-uterine-pregnancy from tubal EP. Although laparoscopy can be occasionally required to confirm the diagnosis of EP, it has to be pointed out that this is a procedure that is not without risk to the patient. On the other hand in women in early

pregnancy presenting with acute pelvic pain and/or vaginal bleeding with inconclusive diagnosis of EP after hCG concentrations and US, a diagnostic laparoscopy should always be considered to exclude EP (LE 5) ([128,140]).

In the management of tubal EP there are 3 options: surgery, medical treatment and expectant management. These options should be evaluated in terms of treatment success (i.e. complete elimination of trophoblastic tissue), financial costs and future fertility. Laparoscopic salpingectomy should be performed in cases of ruptured tubal EP. In cases of unruptured tubal EP, a tube-preserving operation (laparoscopic salpingostomy) should be considered. Hemodynamic instability is a contraindication for laparoscopy. In EP an alternative non surgical treatment option in selected patients with low serum hCG concentrations is medical treatment with systemic MTX. Expectant management cannot be adequately evaluated yet (LE 1a)([141, 142, 143, 139]). In particular, in patients with EP, laparoscopic surgery should be undertaken because its total cost is less (LE 1b)([144]). It is fast, and fertility outcome is comparable to laparotomy. Furthermore, sick leave and hospitalization are shorter and adhesion development is minor compared to laparotomy (LE 1b)([145, 146, 147, 148, 149]).

The diagnosis of ***adnexal torsion (AT)*** is missed in half of the cases. After excluding pregnancy, a transvaginal US is mandatory to exclude ovarian cyst formation. In cases with persistent pain and/or if a larger cyst is seen on ultrasound, a diagnostic laparoscopy may be performed to exclude AT (LE5)([128]). Since AT is an organ-threatening disease, when this condition is supposed, urgent surgical intervention is indicated. Despite the ‘‘necrotic’’ appearance of the twisted ischemic ovary, detorsion is the only procedure which should be performed at surgery.

Adnexectomy should be avoided as ovarian function is preserved in 88% to 100% of cases([150]). The laparoscopy procedure for ovarian conservation is recommended to treat patients with AT owing to its shorter hospital stay, fewer postoperative complications and ovarian preservation. (LE 2b)([151, 152, 153]). When ovarian cysts are found during diagnostic laparoscopic, they should be treated laparoscopically (LE 1a)([154, 155, 156]). Laparoscopic surgery was also reported to be superior compared to open surgery for resecting other types of ovarian cysts (LE 1b)([157]).

Endometriosis can cause dysmenorrhoea, dyspareunia, non-cyclic pelvic pain and subfertility. The estimated prevalence of endometriosis in the general population is 1.5% to 6.2%, but in women with dysmenorrhoea, the incidence of endometriosis is 40% to 60%, and in those with subfertility it is 20% to 30%.

Symptoms and laparoscopic appearance do not always correlate. Pain is usually chronic and recurrent, but some patients present with acute symptoms ([158]). In comparison with the histopathology, laparoscopy alone showed 97.7% sensitivity, 79.2% specificity, 72% positive predictive value and 98.4% negative predictive value. (LE 2b)([159]). Surgical treatment may be indicated in some patients and may be performed as an open procedure or laparoscopically, although no trials have compared the two approaches (LE 5)([160]). More evidence is available on the comparative effectiveness of laparoscopic excision versus conservative treatment of endometriosis. Although these studies included elective rather than emergency patients, their results indicate that laparoscopic excision results in clear and patient-relevant advantages as opposed to conservative treatment (LE 1a) ([161, 162, 163]).

Pelvic Inflammatory Disease (PID) describes the clinical features of sexually transmitted pelvic infection ranging from acute salpingitis to salpingo-oophoritis and ultimately tubo-ovarian or pelvic abscess, which may lead to both sub-fertility and tubal EP.

Laparoscopy has demonstrated that PID is the cause of non-specific-abdominal-pain (NSAP) in young women in 13% of patients (LE 1b)([164]). Laparoscopy is considered the definitive diagnostic modality and is useful to exclude other pathologies, which may be present in approximately 20% of patients (LE 4)([165]) but it should be pointed out that it is invasive and not suitable for routine clinical practice especially in the primary care setting. Microbiological specimens should be taken to guide antibiotic therapy (LE 3b)([166]).

In women of reproductive age tubo-ovarian abscess is one of the most common types of pelvic abscess. Tubo-ovarian abscesses are classically treated with broad-spectrum antibiotics. In about 25% of the cases this approach fails and surgical intervention becomes necessary. Surgical procedures include laparotomy or laparoscopy with drainage of the abscess, unilateral or bilateral salpingo-ophorectomy, and hysterectomy. However, surgery for tuboovarian abscess is often technically difficult and associated with complications (LE 4) ([167,168]). An alternative approach is the use of imaging guided drainage of the abscess in combination with antibiotics: RCT indicates that ultrasound guided transvaginal drainage with concomitant antibiotics is especially safe and efficacious (LE 1b)([169]). Depending on the severity of symptoms, laparoscopy is therefore considered to be advantageous in selected cases of acute salpingitis (LE 4) ([165, 170]) and tubo-ovarian abscess (LE 4) ([171]).

Initial management of a suspected follicular or haemorrhagic cyst is supportive management and continued observation with a repeat pelvic ultrasound in approximately 4 to 6 weeks to document resolution. Indications for immediate operative intervention include

a large amount of peritoneal fluid found on a transvaginal ultrasound, hemodynamic instability, and severe pain. Delayed operative management is indicated for patients in whom pain does not improe with conservative management or for persistent tumors to rule out a neoplastic process. A cystectomy is recommended as opposed to a unilateral salpingo-oophorectomy in reproductive-aged women. Laparoscopic evaluation is usually feasible; however, if cancer is suspected, laparotomy may be necessary to ensure complete removal and for staging purposes (LE 5) ([116]). Laparoscopic surgery advantages over laparotomy include shorter hospital stay without increased adverse events (LE 2b) ([172]).

Nonspecific abdominal pain

Diagnostic laparoscopy is technically feasible and can be applied safely for selected patients with acute nonspecific abdominal pain after a complete diagnostic work-up (GoR A).

Nonspecific acute abdominal pain (NSAP) is defined as acute abdominal pain lasting less than 7 days and for which diagnosis remains uncertain after baseline examination and diagnostic tests **(173)**.

Although attempts have been made towards developing consensus guidelines and diagnostic algorithms, no evidence-based clinical guidelines about NSAP have been developed or validated to date **(174,175)**.

Recently, enhanced or non-enhanced computed tomography of the abdomen and pelvis has been proposed as a particularly useful adjunct in the initial assessment of patients with NSAP **(176,177)** (LE 1a)

Several studies have documented the feasibility and safety of

diagnostic laparoscopy (DL) under general anaesthesia for patients with acute abdominal pain [178,179] (LE 1a)

The diagnostic accuracy of the procedure is high, ranging between 90 and 100% (LE 2a) and prevents unnecessary laparotomies in 36-95% of patients in the published series [180] (LE 3b)

Overall morbidity, also in ICU patients, has been reported between 0% and 8% in expert hands, and no mortality directly associated with the procedure has been described [181,182] (LE 2b).

Contraindications for DL do not differ from contraindications to exploratory laparotomy [180].

The role of early laparoscopy compared with the traditional "wait and see" in the management of NSAP in patients with unclear diagnosis after baseline examinations and tests, has been evaluated by randomized controlled trials [183,184,185] with controversial results due to small sample size, or absence of long term follow-up.

DL seems to improve the diagnosis rate (81-97% versus 28-36% in observational group) and subsequent treatment of patients with NSAP leads to reduced hospital stays (LE 2b) but it seems not to be useful in prevention of recurrence of symptoms (LE 1b) [185,186]

The available literature has a number of limitations including the lack of homogeneity in the reported patient populations and the frequent absence of high-quality preoperative imaging studies, which may have provided the diagnosis without the need for an invasive procedure. Furthermore, better-quality research is needed to evaluate the definitive role of DL in patients with acute NSAP.

Perforated peptic ulcer

Diagnostic laparoscopy is a useful tool when pre-operatory diagnostic findings are not conclusive especially if

performed with therapeutic intention (GoR A). Laparoscopy is a possible alternative to open surgery in the treatment of perforated peptic ulcer (GoR B).

The diagnosis of a perforated peptic ulcer (PPU) is based on clinical history, on clinical examination and on instrumental investigations. A CT scan of the abdomen represents the most reliable exam not only for the diagnosis of perforation (sensibility nearly 100% for the detection of pneumoperitoneum), but also to identify the perforation site (specificity approximately 86%) ([187,188,189]) (LE 2b). A diagnostic laparoscopy is possible when preoperative exams are not sufficiently clear for definite diagnosis (LE 1a) ([190, 191, 192]). However, a missed identification of PPU represents one of the most frequent causes conversion to laparotomy ([193]) (LE 1a).

Up to today, there is no unanimous agreement about which group of patients might benefit from a laparoscopic approach of PPU. Several studies suggest that Boey's shock-score on admission (blood pressure BP < 90mmHg), ASA III-V (severe co-morbidities), duration of symptomatology (>24 h) ([194, 195]) is the most reliable for selecting patients: (LE 3b). Laparoscopic approach is safe in patients with no risk factors (Boey score=0) ([190]) (LE 1a). Other principles of selection have been considered: MPI (Mannheim Peritonitis Index ([196]) (LE 2b), age > 70 years ([195]) (LE 3b), APACE II([197]) (LE3b) and "surgeon's skill in mini-invasive surgery"

The choice of perforation closure technique depends on lesion characteristics: if margins are edematous, friable and or less mobile, repair can might be performed using only an omental patch ([198]) (LE 5); when the margins can be easily brought together, without tension, direct suturing can be sufficient with or without omentoplasty ([199]) (LE 3a). To make the PPU repair simpler, and consequently reducing operating times, a "sutureless" technique has

been proposed ([198]). However debate exists whether the reduction of operating times by simplified techniques could be a risk to the patient's safety, with a higher incidence of post-operative complications (especially of leakage) (LE 5).

Decontamination of the peritoneal cavity by washing after treatment of PPU represents a fundamental step of the surgical procedure (LE 1a) ([199]).

Predictive factors of conversion are: shock on admittance and the free interval between the beginning of perforation and the diagnosis >24 h ([200, 201, 202]) (LE 2b).

In Lau's meta-analysis[193] the re-operation rate was higher after the laparoscopic approach (3.7%) than with conventional surgery (1.6%) (LE 1a). Suture site leakage represents the most important cause of re-operation (LE 1a). Lee APACHE II (5 points) and ulcer size (> 10 mm) are independent risk factors for postoperative leak for laparoscopic sutureless fibrin glue repair ([197]) (LE3b). A systematic review by Lunevicius ([190]) reported a re-operation rate nearly double that for open surgery (5.3% vs 2.1%). The results of these studies, due to many biases, are not enough to definitively clarify the role of the laparoscopic repair for PPU. Further trials are needed.

One of the advantages of laparoscopic surgery is less post-operative pain ([190, 198, 203]) (LE 1a), but others experiences ([198]) of earlier data about pain (within 24 h of p.o. time) did not show any difference, probably due to peritoneal phlogosis. Recent literature reports confirm a decrease in the incidence of complications in laparoscopic surgery compared to open surgery (abdominal wall complications, prolonged post-operative ileus, pulmonary infection and reduction of mortality rate) ([199]). On the other hand a higher incidence of intra-abdominal fluid collection (mostly due to leakage of the suture site) ha been reported ([199]). However none of these

differences are statistically significant ([199]). The operative times are longer for laparoscopy ([198, 204]) (LE1b) (except one study) ([191]), however, a progressive and constant reduction of operative times over the past ten years has been shown, probably due to an improvement in the surgeon's skill, better technology and better organization of the surgical teams. The hospital stay has shown to be more favorable for the laparoscopic approach compared to traditional surgery in Siu ([191]) but not in Lau ([198]) and Bertleff ([204]).

Acute diverticulitis

Laparoscopic approach with lavage and drainage is indicated in complicated diverticulitis Hinchey I and IIa (when percutaneous drainage failed and when indicated for clinical deterioration) and Hinchey IIb and III (GoR B). In Hinchey IV diverticulitis, as well as Hinchey III when lavage and drainage is not advised, a colonic resection may be indicated, with or without diverting protection stoma, which may be performed laparoscopically, depending on the general conditions of the patient and on the skill of the operator (GoR C).

Acute diverticulitis is defined from a clinical point of view by physical examination and blood count; when complicated diverticulitis is suspected, CT scan should be performed. Uncomplicated disease is defined as an inflammatory process limited to the colon, including signs such as wall thickening and inflammation of the pericolic fat. Patients with acute uncomplicated diverticulitis should be treated conservatively with antibiotics and not to undergo emergency surgery (LE 2a) ([205], [206]). Following

recovery, a study of the colon should be performed, to evaluate the extension of diverticular disease and to rule out alternative diagnoses such as ischemic colitis, inflammatory disease or colonic cancer. Optical colonoscopy, barium enema and CT colography (the so-called virtual colonoscopy) may all be employed, but the latter provides data about the bowel and the surrounding tissues and organs as well. When elective sigmoidectomy is indicated, laparoscopy treatment offers a reduction in postoperative pain, systemic analgesia requirements, hospital stay, overall postoperative morbidity and total hospital cost and finally improves quality of life (LE 2b) ([207], [208], [209], [210], [211], [212], [213], [214], [215]).

Complicated cases of diverticular disease are classified according to the modified Hinchey classification. Stage I indicates the presence of a pericolic abscess, stage IIa indicates distant abscess amenable to percutaneous drainage, stage IIb indicates complex abscess with or without fistula. Diffuse peritonitis is classified as stage III (purulent), or stage IV (fecal) ([216], [217], [218]).

In stages Hinchey I and IIa, percutaneous drainage usually is effective in controlling symptoms ([219]), although in most cases simple medical therapy could be equally effective ([220], [221]). Abscess size and location influence the likelihood of response to percutaneous therapy. In patients maintaining septic signs after drainage and in those with Hinchey IIb and Hinchey III, surgical treatment is indicated. In those cases, laparoscopic lavage is possible, with the aim to potentially spare the patient from both a major bowel resection and stoma creation (LE 2b); abundant lavage of the peritoneal cavity and positioning of multiple (at least 2) drainages is indicated. The search for the perforation should not be pursued at all costs; when a large leak is spontaneously evident, a fecal fistula is usually present or will appear after the operation, and the patient should be managed as an Hinchey IV case (LE 5). However, if a small colonic perforation is shown during lavage, a

suture can be performed, eventually with an omental patch. In case of a concomitant fistula with bladder and small bowel, and stenosis, lavage and drainage may allow elective management, by the open or the laparoscopic approach, according to the preference of the operator (LE 5).

This strategy, which aims to convert generalized purulent peritonitis to localized diverticulitis which can be safely treated by antibiotic therapy, is successful in most cases (>90%), with immediate improvement of the clinical conditions of the patient, and is associated with decreased mortality and morbidity (with particular reference to surgical site – SS - complications such as dehiscence, SS infection, and incisional hernia) (LE 3a) ([222], [223], [224], [225], [226], [227], [228], [229], [230]). After peritoneal lavage and drainage, elective colonic resection can be planned within 3-6 months, but some authors actually propose to limit treatment to simple peritoneal lavage and not to proceed to sigmoid resection. More than 50% of patients in the reported series did not need subsequent sigmoidectomy; up to 90 out of 92 cases in the Irish prospective multicentric study, which followed the patients for a mean of 36 months (range 12-84 months) (LE 2B) ([231]).

Hinchey III patients in whom exploration of the abdomen is not satisfactory because of adhesions or obstruction and patients with severe peritonitis with numerous false membranes should be considered for conversion to open surgery ([222], [226], [223]), or should undergo emergency colonic resection by laparoscopy but only if performed by experienced hands (LE 3b) ([232], [233], [234]).Of note, elective resection of the diseased segment decreases the risk of conversion and increases the rate of primary anastomosis, when compared to emergency surgery (LE 5). In stage Hinchey IV, colonic resection should be done, by laparoscopy or by open surgery, depending on the skill of the operator and the clinical stability of the patient, even if the evidence is too weak for a specific

recommendation (LE 3b) ([235], [236], [237]).

Small bowel obstruction due to adhesions

Laparoscopic treatment of small bowel obstruction can be successfully accomplished in selected patients (GoRC).

Adhesions represent the leading cause of small bowel obstruction (SBO), accounting for about 75% of all SBO. The first reports of laparoscopic treatment date from the early 90's ([238]). Surgery does not influence the risk of recurrence nor the need for a future operation ([239], [240])(LE 2b). Duron et al. ([241]) suggested that the rate of primary or secondary recurrence (12 and 18% respectively) were not different after open compared to laparoscopic surgery (LE 2b). Neither RCTs nor prospective controlled studies are available in the scientific literature. ([242])

An animal experimental study showed that laparoscopy decreased the incidence, extension and strength of intraperitoneal adhesions compared with laparotomy ([243]). A retrospective cohort of 716 consecutive patients undergoing either laparoscopic (211 pt) or open bowel resection (505 pt) suggested that postoperative SBO requiring hospitalization with conservative management was reduced in those patients who had laparoscopic surgery (n = 4) compared to the open surgery cases (n = 31) ($p < 0.016$)([244]) (LE). The main concern is the high conversion rate: complete laparoscopic treatment has been reported possible in only 50%–60% of patients. Papers published after 2005 have showed a trend toward a reduction in conversion rate, in the laparoscopically treated patients, constantly lower than 50% ([245], [246], [247], [248], [249], [250], [251], [252], [253], [254]) (LE 3b).

Guidelines concerning laparoscopy and SBO published after

the EAES consensus statements are controversial. The statement of the EAST guidelines for the management of bowel obstruction ([255]) suggests that in a highly selected group of patients the laparoscopic treatment of SBO should be considered and leads to a shorter hospital length of stay (LE 2). Notwithstanding, laparoscopy was not included in the suggested flow chart.

The SAGES guidelines on diagnostic laparoscopy consider laparoscopy contraindicated in patients with a clear indication for surgical intervention such as massive bowel obstruction, perforated viscus (free air), besides those with hemodynamic instability ([256]).

A systematic review including all papers published up to 2007 (1236 patients) found a successful therapeutic laparoscopy rate in the range of 40-88% and a conversion rate ranging from 0 to 52%. Positive predictive factors for success are less than 2 previous laparotomies and absence of peritonitis. ([257]) (LE 2b)

Laparoscopy should not be used for diagnosis of SBO, but it should be preceded by conventional imaging, in order to reduce the risk of iatrogenic injuries without therapeutic purposes. In some studies the following criteria were found to be statistically significant for failure of the laparoscopic approach: small bowel loop diameter > 4 cm, more than two previous abdominal operations (LE 2B), operation after 24 hrs from diagnosis, duration of surgery, and dense and extensive adhesions. Previous appendectomy was statistically associated with a higher rate of successful laparoscopic management, with the single band adhesion as the ideal condition for the laparoscopic approach (LE 3B) ([2], [258], [259], [260], [261], [262]).

The use of a tailored laparotomy (i.e incision according to exploratory laparoscopy findings) would be a potential benefit of the laparoscopic approach but it has not yet been demonstrated. Successful laparoscopic treatments of patients with negative predictive criteria are described without complication in some

papers. A low threshold for open conversion is recommended (LE 5).

Incarcerated/strangulated hernias

The laparoscopic technique for the treatment of non reducible or strangulated inguinal hernias, whether TEP or TAPP, may be performed (GoR B). The laparoscopic repair of non-inguinal incarcerated hernias (diaphragmatic, either congenital or acquired, supra-vescical and spigelian, obturatorian, and internal hernias) may be performed, but further studies are necessary to validate this approach (GoR D).

In the natural history of inguinal hernia, 0.29-2.9% of cases become incarcerated; 10-15% of these become strangulated with gangrene, a complication which has a mortality of up to 5% in the elderly ([263],[264],[265],[266],[267],[268]).

In 1993, Watson demonstrated the feasibility of laparoscopic hernia repair (LHR) for incarcerated hernias ([269]).

In 2003, a Cochrane library study showed that the outcome of LHR, in elective surgery, is at least equivalent to that of the open approach ([270]). This study was confirmed, in 2010 by an extensive meta-analysis ([271]). On the other hand, there are no comparative studies between the laparoscopic and the open approach in urgent adult cases.

A review of cohort studies on laparoscopic repair of incarcerated groin hernias was published in 2009 by Deeba updating the information given in the previous guidelines on laparoscopic emergency ([272],[2]). It reviews 7 articles on this topic, dating from 1989 to 2008, reporting on 328 cases treated with TEP or TAPP. Of these 7 articles, 2 are LE 2b prospective cohort studies and 5 are LE

4 small case series ([273],[274],[275],[276], [277],[278],[279]). The overall results of Deeba's study were: average operative time 61.3 min, average hospital stay 3.8 days, mortality 0.28%, complications rate 10.3%, conversions 1.8%, intestinal laparoscopic or mini-laparotomy resections 5.1%, reoperations 0.9%. The most serious complications consisted of two colonic lesions and one divided vas deferes. The others were infected mesh (0.6%), wound infections (0.3%), deep venous thrombosis (0.3%) and other minor complications. The highest recurrence rate at 7 years was 5.8%. The authors concluded that the laparoscopic approach, either TEP or TAPP, is possible to repair incarcerated hernia taking into account the knowledge of anatomy and expertise needed to dissect and reduce the sac. Laparoscopy can also be used to resect bowel, if needed or to repair an occult contralateral hernia, present in 11.2% to 50% of cases. The overall rate of complications, recurrences, and hospital stay seem to be very similar to the rates documented in open repair for strangulated/incarcerated hernias.

The "hernioscopy" is a new mixed laparoscopic-open technique for incarcerated hernias, which spontaneously reduce during the surgical manipulations. A randomized controlled study (LE 2b) suggested that this was effective technique, which involves the introduction of the laparoscope into the hernia sac, to evaluate the viability of the herniated loop, thus avoiding unnecessary laparotomy ([280]).

Only a few single or small case series studies (LE 4) are reported concerning the laparoscopic treatment of non-reducible retro-xiphoid diaphragmatic hernias (Bochdalek and Morgagni-Larrey). They all conclude the need for consensus on this subject ([281],[282]).

The acquired diaphragmatic para-esophageal incarcerated hernias are approached by laparoscopy by some authors in low-level studies (LE 4). The most important absolute contraindication

to this procedure seems to be the presence of a gastric necrosis ([283],[284],[285],[286]).

The mini-invasive repair of rare abdominal wall acute hernias, such as supra-vescical and Spigelian, is rarely described. Most case reports (LE 4) concern emergency obturator hernioplasties, with good results in terms of resolution of symptoms and hospital stay ([287],[288],[289],[290],[291],[292],[293],[294],[295],[296],[297],[298],[299]).

Finally, there are several articles concerning the laparoscopic repair of incarcerated internal hernias, such as the para-duodenal, para-cecal, broad uterus ligament, trans-mesosigma and post-surgery hernias. Even though all of them are low LE, the potential role of laparoscopy in the diagnosis seems to be demonstrated and would, at times, prevent unnecessary laparotomies ([300],[301],[302],[303],[304],[305],[306],[307],[308],[309],[310],[311],[312],[313],[314],[315],[316],[317],[318],[319]).

Ventral hernias

The laparoscopic approach to incarcerated ventral and incisional hernia may be performed in selected patients (GoR B).

In 2005, the previous International Consensus Conference of the European Association of Endoscopic Surgery (EAES) stated that the open approach remains the standard treatment for incarcerated hernia, although laparoscopic surgery may be considered in carefully selected patients and restricted to surgeons with maximum expertise in this field (GoR C) ([2]).

In 2010, an Italian Consensus Conference of the main National Scientific Societies (SIC-Società Italiana di Chirurgia; ACOI - Associazione Chirurghi Ospedalieri Italiani; SICE – Società Italiana di Chirurgia Endoscopica and Italian Chapter of Hernia Society) on laparoscopic treatment of ventral and incisional hernia, underlined that the incidence of intra- and postoperative complications and

recurrences in emergency cases, was the same as in elective cases. A good experience in emergency surgery and in laparoscopic repair of abdominal wall in elective patients is always strictly required. The grade of recommendation was increased to B ([320]).

Patients should be selected according to the following criteria:

· *Absence of marked abdominal distension* that precludes entry into the peritoneal cavity and limits adequate working space. Some studies suggested that a small bowel diameter exceeding 4 cm, at a preoperative abdominal x-ray, and a late operation (>24 hours post-onset, > 6 hours post hospital admission) were risk factors for conversion ([321], [322], [323], [324]);(LE 4)

· Some authors have introduced introduce the *number (>4) of previous laparotomies* as a predictive factor of conversion ([321]). However, not only the number but also the type of previous procedure and the location of the surgical scars are very important. As far as adhesiolysis is concerned, one surgical xipho-pubic scar following an abdominal trauma or massive peritonitis will often give rise to more difficulties than three scars (for example in the right subcostal area, in the hypogastrium and in the right iliac region) resulting from elective and uncomplicated surgery ([325]); (LE5)

· *Absence of peritonitis* with the need for bowel resection and bowel handling in a highly inflamed environment ([326]) and *absence of clinical signs of intestinal ischemia.* (LE4)

· *Absence of high septic risk situations, such as concomitant execution of contaminated abdominal procedures or the presence of contaminated skin lesions or entero-cutaneous fistulae* ([327])*;*(LE4)

· *Absence of major defects* with loss of domain or hernias that do not allow the laparoscopic approach with adequate over-lap for the mesh ([327])*;*(LE4)

· *Absence of hemodynamic instability and severe co-morbid conditions such as heart and lung diseases that preclude the use of pneumoperitoneum* ([326])*;*(LE4)

· *Morbid obesity* ([328])*, old age and debilitation* are not considered contraindications to laparoscopy ([325], [324], [329]). (LE4)

As for operative technique the use of atraumatic graspers is essential, adhesiolysis should be proper and cautious and the contents in the defect should be always accurately checked for blood supply, motility and integrity.

If a enterotomy occurs, it can be repaired laparoscopically (LE 5).

The mesh is positioned intraperitoneally with an adequate overlap (at least 3 cm); the immediate mesh repair is preferably ([330], [331], [332], [333]) deferred only in cases of abundant peritoneal contamination or bowel necrosis ([322]).(LE 3b)

The introduction of biological meshes in clinical practice provides a new prospective for abdominal wall defect repair in the contaminated surgical field ([334])**.** A few authors have suggested the use of biomaterial in the laparoscopic emergency hernia repair with good results in terms of recurrence and wound infection ([335], [336])(LE 4). There are no comparative trials evaluating the commercially available biological meshes products and their application in laparoscopic repair of potentially contaminated ventral hernias

Abdominal trauma

In stable penetrating trauma of the abdomen, laparoscopy may be useful in patients with documented or equivocal penetration of the anterior fascia. (GorB)

stable blunt trauma patients with suspected intra-abdominal injury and equivocal findings on imaging studies or even in patients with negative studies but with a high clinical likelihood for intra-abdominal injury ("unclear abdomen") to exclude relevant injury (GoRC)

To optimize results, the procedure should be incorporated in institutional diagnostic and treatment algorithms for trauma patients (GorD).

Ultrasound and contrast-enhanced Computed tomography (CT) can be applied quickly and efficiently in trauma patients, but hemodynamic stability is a prerequisite for a CT. ([337],[338]).

Angiography is indicated to delineate and treat active bleeding of abdomen and pelvis, when detected by CT and/or other means (US, X-ray of pelvis and cystography) ([338]).

Diagnostic accuracy of laparoscopy has been reported as high as 75% (LE 2b) ([339]) is indicated in hemodynamically stable patients with suspected intra-abdominal lesions and equivocal findings on imaging studies, and when non-operative management is not indicated (suspected hollow viscus injuries with peritonitis, potential diaphragmatic lesion). The procedure has been shown to effectively decrease the rate of negative laparotomies and minimize patients morbidity. ([340], [341]).

The procedure is usually performed under general anesthesia; however, local anesthesia with I.V. sedation has also been used successfully in the emergency department ("awake laparoscopy") (LE 4)([342])

The positioning and draping of the patient should be as for trauma laparotomy so that if needed, conversion to open technique can be accomplished without loss of time. For this reason, the patient should be supine and the entire abdomen washed and draped from the jugular to the groin. ([337])

Pneumoperitoneum should be induced slowly and carefully. If the blood pressure drops and respiratory pressure suddenly rises, insufflation is stopped, or the gas pressure reduced ([337]).

Special attention should be given to the possibility of a tension pneumothorax caused by the pneumoperitoneum due to an unsuspected diaphragmatic rupture.

The peritoneal cavity should be examined systematically, beginning with the right upper quadrant and proceeding clockwise, taking advantage of patient positioning manipulations

Suction/irrigation may be needed for optimal visualization, and methylene blue can be administered to help identify gastrointestinal injuries. In penetrating injuries, peritoneal violation can be determined ([343]).

The surgeon should not hesitate to convert to an exploratory laparotomy if he or she is not confident that there are no missed injuries (LE 4)([341]).

In a highly selected group of patients therapeutic laparoscopy should be performed only by surgeons skilled in advanced mini-invasive surgery (LE 3a) ([341],[344]).

Therapeutic laparoscopic options have increased in the last years to manage hemoperitoneum, diaphragmatic, mesentery and hollow viscus injuries ([337]) and to avoid non-therapeutic laparotomy diaphragmatic lacerations (LE 4) ([345], [346], [347]), and to treat perforating stab wounds of the gastrointestinal tract which can be sewn or stapled safely when laparoscopic expertise is available (LE 4) ([341],[348],[349]).

Procedure-related complications occur in up to 11% of patients: Tension pneumothorax in patients with diaphragmatic injury from positive-pressure pneumoperitoneum ([350], [351]), gas embolism in patients with intraabdominal venous injuries, especially in liver lacerations, causing the trans-peritoneal absorption of carbon dioxide which may cause metabolic and hemodynamic

changes such as acidosis, cardiac suppression, atelectasis, subcutaneous emphysema, and increased intracranial pressure, resulting in more profound consequences for the trauma patient.

A retrospective cost analysis comparing the total hospital costs of exploratory laparotomy versus diagnostic laparoscopy in 37 patients with penetrating abdominal trauma, showed that laparoscopy is 1136 Euro cheaper than exploratory laparotomy) ([352]) although in a prospective, randomized study of 43 patients with abdominal stab wounds, there was no difference between the two strategies in the total hospital costs (LE 4) ([339]).

Acute Mesenteric Ischemia

Laparoscopy does not offer significant advantages in acute mesenteric ischemia besides a potential role as bedside and second look procedure (GoR C)

Acute mesenteric ischemia (AMI) is an uncommon but serious disease, which is often associated with other systemic illnesses and has poor prognosis ([353]). It is caused in 50% of cases by arterial obstruction, in 20-30% by non-occlusive arterial ischemia and in 5-15% by venous occlusion. AMI presents a high mortality rate (59-93%) ([354]) and prognosis is frequently to the timeliness of diagnosis ([355]).

With a sensibility of 93,3% and a specificity of 95,9% ([356]) multidetector CT is the best diagnostic approach in a patient with clinical suspicion of AMI (LE 1a). Few reports have been found concerning the diagnostic role of laparoscopy and literature data confirm that the laparoscopic picture of AMI depends on its stage (ischemia, infarct, peritonitis) and etiology (arterial thrombosis and embolism, venous thrombosis, non-occlusive mesenteric ischemia)([357]). Since laparoscopy does not offer adequate

diagnostic accuracy in spite of the use of fluorescein and ultraviolet light ([358],[359]) it does not appear to offer advantages compared with classic imaging although it may have a role as bedside laparoscopy in ICU ([360]) (LE 4). There are no reports highlithing advantages of the use of laparoscopy in the treatment of patients with AMI.

The "laparoscopic second-look" might be an alternative option to the "surgical second-look" in patients already operated for acute mesenteric ischemia. ([361,362])(LE 4).

Discussion

Practice guidelines have to be regularly updated to be effective. A thorough literature review was necessary to assess whether the recommendations issued in 2006 are still current. In many cases new studies allowed us to better clarify some issues, but occasionally previous strong recommendations have to be challenged after review of recent research.

The accuracy of imaging techniques has enormously improved during the last few years, reducing the need to use laparoscopy as a sole diagnostic tool, thus avoiding the minimal insult of laparoscopic exploration in most cases without any indication for laparoscopic treatment. On the other hand, surgical techniques have also progressed and the use of laparoscopic surgery is now widespread, increasing therapeutic laparoscopic options and allowing an even more refined diagnosis in those cases that could benefit from a laparoscopic procedure.

In the 2006 EAES consensus ventral and inguinal hernias were “lumped together” . In our update we have chosen to separate the two entities as the diagnostic and the therapeutic choice for each of the two conditions are substantially different. In fact laparoscopic treatment of ventral hernias is more common than

inguinal repair, and in emergency setting their diagnosis relies on different examinations. A recent Italian consensus on ventral hernia repair, issued a GoRB recommendation about laparoscopic ventral hernia repair, and we raised the grade of recommendation for emergency repair. Hernia repair has gained a grade B in emergency situations (incarcerated or strangulated), thanks to recent reviews of cohort studies, reporting fair results. Interesting considerations have arisen, in this field, regarding "hernioscopy", particularly useful in association to emergent open repair to assess the viability of the herniated bowel once it has fallen back into the abdominal cavity. Surgeons have gained confidence with diagnostic laparoscopy over the last few years, and even if accuracy of the imaging techniques have improved at the same time, laparoscopy appears to be particularly useful when a laparoscopic treatment is also possible as in NSAP, gynaecological pathology and in small bowel obstruction. On the other hand the available imaging techniques reduce the indications of laparoscopy in mesenteric ischemia only to its bedside application and second-look operations. Some progress is also been seen in the treatment of acute cholecystitis, for which complicated disease (gangrenous or empyematous) or age are no longer considered contraindication for laparoscopic emergency treatment (GoR B). Moreover, the aggressive approach is feasible also in high-risk patients, as an alternative to percutaneous cholecystotomy or to conservative treatment, and has comparable results. Early cholecystectomy seems to have substantial advantages in acute conditions. Early laparoscopic cholecystectomy (in the same admission) is still advised after biliary pancreatitis, and interesting applications of retroperitoneoscopy start to gain evidence in the step-up approach to necrotic infections. Laparoscopic lavage and drainage in the treatment of Hinchey II-III diverticulitis has gained a moderate recommendation, and increasing evidence is seen favouring

minimally invasive sigmoid resection, although it does require high expertise. The role of laparoscopy in trauma is still limited to stable patients in order to ascertain depth of penetrating injuries or for definitive diagnosis in "unclear abdomen" as a consequence of an equivocal diagnostic workup.

Some of the RCTs and reviews published in the last 5 years have caused us to reluctantly reduce the recommendations for emergency laparoscopy, when compared to standard open treatments in a few cases. This is especially true for perforated peptic ulcer, in which morbidity due to suture leakage seems higher with laparoscopic repair: the panel agreed that the good outcomes experienced in everyday practice of laparoscopic perforated peptic ulcer, have not been reflected in the available literature studies. Some reappraisal has been made for laparoscopic appendectomy, that is strongly recommended in fertile women but has not gained level I evidence for men, obese, elderly or pregnant women due to conflicting RCTs' results. An effort to establish the right treatment recommendations for a normal appendix found at laparoscopy has been made. (Tab. 1)

The technique of pneumoperitoneum induction and surgical learning curve, both topics of general interest for the laparoscopic surgeon, have been widely discussed.

Concerning pneumoperitoneum establishment in the emergency setting the panel has not converged in opinion on the best single technique. This is due to the different preferences and practices of individual surgeons and the lack of evidence in the literature to favour a specific access (closed or open). Each access modality has its specific related complications and there is no clear evidence to suggest which is the best method for the individual patient's problem (bowel distension; previous laparotomies and so on). The surgeon's experience in using his chosen method is very important.

The panel agreed that the use of laparoscopy in an emergency setting requires surgical experience and skills, however in the literature there is no complete and objective definition of “experienced” and “skilled” and several factors limit our ability to reach such definitions. A specific “learning curve” for every single situation is impossible to define, in particular, in an emergency laparoscopic setting, where the operative condition may be worsened by reduction of the surgical field (intestinal distension, adhesions), unclear anatomy due to the inflammatory status, and a wide variety of possible therapeutic findings. On the other hand there was a general agreement that experience gained in one specific procedure reduces the learning curve for other procedures because the judgement, ability, and the skills developed can be used in a large number of situations.

Every surgeon has to decide the best approach according to a personal evaluation of his own experience, the particular clinical situation, his proficiency (and the experience of his team) with the various techniques and the specific organizational setting in which he is working. A low threshold for conversion carries only minor disadvantages for the patient, and such a good judgment can obviate the need for a questionable strict definition of “expert laparoscopic emergency surgeon”. These guidelines have been developed to help surgeons with their decisions in the very difficult situation of emergency surgery.

Effectivenes of laparoscopic surgery	2006 Consensus	2011 Consensus
Perforated gastroduodenal ulcer	+++	++
Acute cholecystitis	+++	+++
Acute pancreatitis	+	++
Acute appendicitis	+++	+++
Acute diverticulitis	-?	+
Small bowel obstruction	+?	+

Incarcerated Hernia	+?	+
Ventral hernias		+
Mesenteric Ischemia	-?	-
Gynecologic disorders	+++	+++
Non-specific abdominal pain	+++	+++
Abdominal trauma	+?/-?	+

Table 1: EAES 2006 Guidelines "evidence" of effectivenes of laparoscopy in acute abdomen and 2011 Consensus ones (+: effectiveness from strongest +++ to weakest +; -: no effectiveness; ?: doubtful effectiveness)

ANNEX

ANAESTHESIA IN LAPAROSCOPIC SURGERY FOR ABDOMINAL EMERGENCIES

ANESTHESIOLOGICA CONSIDERATIONS

Anna Levati MD, Domenico Pietrini MD for the Società Italiana di Anestesia Analgesia Rianimazione e Terapia Intensiva – SIAARTI (Italian Society of Anaesthesiology, Analgesia, and Intensive Care)

INTRODUCTION

The overall incidence of perioperative complications depends on several multidisciplinary factors. Patient physical status according to American Society of Anesthesiology (ASA) classification, emergency or routine interventions, intraoperative determinants (bleeding, long operating time), and the clinical experience of care-givers (mainly anaesthesiologists and surgeons).

All these factors can significantly affect the postoperative course (LE 2b)[363].

The literature data regarding laparoscopy related complications and death rate are few, and show conflicting results.

Bottger describes an overall postoperative hospital mortality rate of 2.6%, with cardiac or pulmonary complications predominating. A significant rate of deaths (10%) are associated with emergency surgery while elective surgery is burdened by a lower rate (2%).

General complications (up to 12% of the treated patients, according to Bottger data) are cardiac impairment, protracted ventilation, cerebral complications, reanimation, pneumonia, and urinary tract infection. Surgical-site infection, anastomotic leak, bleeding, and sepsis mainly represent surgical complications. A significant correlation has been reported between cardiac complication, the need for protracted ventilation and ASA patient physical status, surgery duration and requirement for blood transfusion. A close correlation between the anaesthesiologist's skill and perioperative complications has been also described (LE 2b)[363].

Total operative time has been reported to be significantly affected in patients with incarcerated hernia contents preoperatively, suprapubic hernia location, bowel adhesion to the abdominal wall or hernia sac, a greater number of previous ventral hernia repairs, and larger hernia defects. Total operative time may be also affected by a higher ASA classification and hernias requiring a larger mesh for repair (LE 2b) [364] . During laparoscopy, pneumoperitoneum (PP) may result in intraoperative atelectasis. Positive end expiratory pressure (PEEP) of 5 cmH2O in pressure-controlled ventilation (PCV) mode has been suggested by Ji et al to protect pulmonary gas exchange during surgery (LE 2b)[365].

Conversely Luz-Moreira found that Laparoscopic Colectomy (LC) could be a safe option for patients with a high ASA classification as the LC approach is associated with faster postoperative recovery, lower morbidity rates, and lower hospital costs than the Open Colectomy (OC) approach (LE 2b)[366]. This Author reported an overall morbidity rate of 24% with an overall postoperative morbidity and wound infection rate significantly lower

in the LC group than in the OC group and no difference in terms of 30-day re interventions or postoperative mortality between the two groups. Interestingly the LC group had also a significantly less estimated blood loss. Luz-Moreira concluded that LC should be considered safe for ASA 3 and 4 patients and is associated with faster postoperative recovery, lower morbidity, and similar hospital costs compared with OC.

The literature did not systematically report pulmonary complications, and most studies did not have sufficient statistical power to detect differences in postoperative pulmonary complication rates (LE 2a)[367] so that it is not clear whether laparoscopic procedures reduce the risk for clinically important pulmonary complications.

A detailed multidisciplinary strategy has been described by Patel et al to facilitate early recovery (LE 4)[368]. In patients undergoing a laparoscopic procedure antibiotics administration is planned prior to surgery, followed by 8–10 mg dexamethasone at induction of anaesthesia. The surgical approach is performed with no use of drains and tubes, urinary catheter (for right and transverse colon resections) and immediate removal of catheter after low anterior colon resections. Epidural anaesthesia is also avoided**.** However a careful choice of the anaesthetic technique should be tailored to the type of surgery. General anaesthesia (balanced anaesthesia technique with several intravenous and inhalational agents and the use of muscle relaxants); peripheral nerve blocks and neuraxial anaesthesia alternative to general anaesthesia for outpatient pelvic laparoscopy; local anaesthesia infiltration in micro laparoscopy for limited and precise gynaecologic procedures; intravenous sedation can be performed and have been described in literature with safe profile for patients (LE 5)[369], (LE 4)[370], (LE 2b)[371,372], (LE 1b)[373], (LE 1a)[374], (LE 4)[375], (LE 1b)[376,377], (LE 2b)[378,379], (LE 1b)[380]. Laparoscopy is most commonly

performed with the patient under general anaesthesia especially for prolonged and upper abdominal procedures. However regional techniques involving peripheral and neuraxial blocks and local anaesthetic infiltrations could be used for pelvic laparoscopy. Finally spinal and epidural anaesthesia and combination of the two have been described as suitable for pelvic laparoscopy.

Standardization of the surgical technique, resulting in a reduced surgical time, a "bloodless'' surgery, standardization of intraoperative monitoring, and employment of skilled anaesthesiologists for high-risk patients may partially modify the rate of perioperative complications but other factors such as obesity, ASA classification, and urgency of the intervention cannot be influenced by clinicians.

Suggestions

The patient should be evaluated by the whole team (surgeon, anaesthetist, radiologist) with the aim to define risk/benefit ratio.

PATIENT ELIGIBILITY FOR LAPAROSCOPIC PROCEDURES

Preoperatively, the patients should be submitted to a comprehensive physical examination, followed by further investigations (laboratory and instrumental diagnostic evaluations such as electrocardiogram, plain chest X-ray, internistic workup consultation), and the ASA score in order to properly plan the anaesthesia management. Prior to surgery, according to E.A.E.S. guidelines, (LE 1b)[381] patient scheduled for laparoscopic surgery should be evaluated regarding the presence of comorbidities, assessment of ASA III-IV, COPD, NYHA III-IV, CRF. The presence of heart disease should not constitute an absolute contraindication to laparoscopic surgery (LE 2b)[382] since perioperative risks can be reduced adopting the most appropriate anaesthesia and/or surgical treatment option. In trauma patients a minimally invasive approach

could be useful and safe as it can reduce the potential morbidity of negative laparotomy (LE 3a)[383].

Suggestions

Hemodynamic and respiratory stability parameters stability is necessary to perform laparoscopic procedures. Major trauma patients or patients with severe disease may be eligible if lasting hemodynamic and respiratory parameters stability is achieved after resuscitation and/or intensive medical treatment.

PATHOPHYSIOLOGICAL CHANGES DURING LAPAROSCOPY

In laparascopic surgery PP is the crucial element affecting respiratory mechanisms and cardiovascular responses, especially in patients with comorbidities. The knowledge of pathophysiologic changes is essential in order to plan an appropriate anaesthesia strategy aimed to early detect and prevent potential complications.

Respiratory effects

PP, shifting the diaphragm upwards, decreases the lung compliance, leading to a diminished functional residual capacity, closing volume related. Even if uncommon in healthy patients (LE 1b)[384] a ventilation-perfusion mismatch may also occur, sometimes resulting in perioperative hypoxemia (LE 1b)[385,386,387]; (LE 2a)[388]. Lung volume decrease, associated to airway (P_{aw}) and intra-abdominal pressure (IAP) increase may lead to lung atelectasis, mainly in patients with extensive pulmonary disease (LE 1b)[381,389].

IAP higher than 15 mm/Hg associated with the Trendelemburg position should be avoided because they may severely reduce pulmonary compliance causing a ventilation-perfusion mismatch (LE 1b)[390].

Transperitoneally CO_2 absorption determines higher end-tidal CO_2 ($EtCO_2$) 8-10 minutes after gas insufflations, irrespective of the site and duration of administration; increased minute ventilation

maintains $PaCO_2$ in normal limits in most cases, possibly leading to further increase in airway pressure (LE 1b)[391,392]. Increased arterial CO_2 content might not be accurately reflected by $EtCO_2$ perhaps as a consequence of increased dead-space PP induced.

Cardiovascular effects

Major hemodynamic alterations include hypotension, hypertension, arrhythmias and cardiac arrest; the cardiovascular effects of PP occur during gas insufflations and are associated to IAP levels, volume of CO_2 absorbed, patient's intravascular volume, co-morbidities and positioning, with IAP and patient positioning representing the most important determinants of cardiovascular function during laparoscopy (LE 1b)[389].

Abdominal venous compression causes a decline in venous return and preload, due to a reduced flow through the inferior vena cava (LE 1b)[390, 393]; IAP and the stimulated neurohormonal vasoactive system cause an increase in mean arterial pressure, systemic vascular resistance (SVR) and pulmonary vascular resistance (PVR), resulting in an increased afterload (LE 1b)[394].

Preload and afterload combined variations may cause a decrease in cardiac output (CO) with a further detrimental effect following head-up positioning and patient's inadequate intravascular volume content (LE 1b)[395].

Although venous return decreases during PP, central venous pressure (CVP) and pulmonary capillary wedge pressure (PCWP) rise during abdominal insufflations probably due to a cephalad shift of diaphragm with an increased intra-abdominal and intrathoracic pressure. In ASA I and II patients, hemodynamic changes at a IAP level lower than 15 mm/Hg are not clinically relevant and vanish after desufflation (LE 1b)[381].

Regional perfusion (brain, kidney, liver, bowel) may also be affected by the rise of IAP (LE 1b)[396]; these changes should be

considered especially in patients with impaired hepatic and/or renal function or modified cerebral hemodynamics (LE 5)[397]**.** Accordingly to previous data, IAP level should be as low as possible in critical ill patients undergoing laparoscopic surgery for abdominal urgencies.

Monitoring during anaesthesia

During anaesthesia, standard and comprehensive monitoring (HR, ECG, BP, SpO_2, $EtCO_2$, P_{aw}, body temperature) should be applied to enrolled patients. Airway pressures, both peek and plateau pressures, should be monitored during the whole procedure; it is necessary to closely monitor P_{aw} at the time of induction of PP with the aim to adjust given P_{aw} to new acceptable values. Monitoring the changes of airway pressures during PP enables the early detection of atelectasis (LE 5)[398].

Even if $EtCO_2$ doesn't accurately reflect $PaCO_2$ changes, it should be used to indirectly assess arterial CO_2 rise and to titrate minute ventilation with the aim to correct increased plasma CO_2 concentrations (LE 1b)[381]. In patients with compromised cardiopulmonary function a frequently control of arterial blood gas analysis may be necessary, as PaCO2 /$EtCO_2$ gradient (LE 1b)[389] may change**;** therefore an arterial line positioning is suggested in ASA III and IV patients.

CVP rise following PP institution may lead to possible misinterpretation of preload status; as for airway pressure, measurement before and after PP application makes possible to detect hemodynamic changes and properly assess the true patient volemia. In ASA III and IV patients invasive monitoring of arterial blood pressure and of circulating volume is strongly suggested (LE 1b)[384].

Suggestions

Standard monitoring (monitoring (HR, ECG, BP, SpO_2, $EtCO_2$,

P_{aw}, body temperature) for general anaesthesia should be performed. Invasive arterial blood pressure and circulating volume monitoring is strongly suggested in ASA III and IV patients.

Ventilatory strategies to protect the lung

A rational approach to overcome the rise of $PaCO_2$ and acidosis is controlled mechanical hyperventilation (LE 1b)[391]; as a detrimental ventilator-induced lung injury (VILI) is closely related to high-volume/high pressure mechanical ventilation mode, especially during long lasting procedures, therefore $PaCO_2$ decrease should be achieved through higher respiratory rate thus avoiding tidal volume increase.

PEEP is a rational strategy to maintain the lung open and prevent lung injury and atelectasis (LE 5)[398]. In fact PEEP application increases alveolar recruitment especially in patients at greater risk of atelectasis (obese, underlying lung disease patients (LE 1b)[399]. In case of atelectasis, hypoxemia can develop both during anaesthesia and in the postoperative period. The first line treatment is to increase inspiratory fraction of oxygen (FiO_2), keeping in mind that oxygen toxicity might injury the lung.

Actually there is no evidence to suggest that pressure-controlled ventilation is better than volume-controlled ventilation to prevent lung injury and improve oxygenation during laparoscopic surgery, even if “peak pressure “ is limited with pressure-controlled ventilation (LE 1b)[400,401].

Suggestions

In order to improve the patient oxygenation, respiratory rate increase is safer than higher tidal volume. Positive end-expiratory pressure (PEEP) is suitable to “open up the lung and keep it open”. Recruitment manoeuvres are useful in recruiting the collapsed

alveoli.

Non ventilatory strategies to protect the lung: positioning and anaesthesia

Reverse Trendelenburg position improves respiratory mechanisms and oxygenation, while the Trendelenburg position worsens lung compliance during PP (LE 3b)[402]. In a recent review Valenza et al (LE 5)[398] reported that head-up positioning alone or PEEP in supine position have the same effects on lung volume and oxygenation, while P_{aw} is lower in the beach-chair position. However the Authors prefer head–up positioning, if appropriate, to protect the lung. In case of Trendelenburg position, a close monitoring of P_{aw} is mandatory to titrate the mechanical ventilation parameters so as to prevent lung strain and atelectasis formation.

At the moment, there are no available data to make either inhalational or intravenous anaesthesia preferable for laparoscopy. However in 1998 Gehring and co-authors found $PaCO_2$ levels significantly higher and PaO_2 concentrations significantly lower in patients undergoing isoflurane anaesthesia rather than in patients undergoing propofol anaesthesia (LE 1b)[403].

Suggestions

The reverse Trendelenburg position is associated with an improvement of lung compliance and a decrease of P_{aw}. In the Trendelenburg position it is mandatory to strictly monitor the P_{aw} in order to titrate the mechanical ventilation parameters so as to prevent lung strain and atelectasis formation.

Anaesthesia and laparoscopic surgery in obese patients

The obese patient is generally evaluated as a complicated patient. Merkow found an adverse correlation between body mass index (BMI) and short-term outcomes in cancer patients undergoing open colectomy. The morbidly obese group was found to have a higher morbidity rate than normal weight patients, particularly in

relation to such complications as wound infection, dehiscence, pulmonary embolism, and renal failure (LE 1a)[404]. At the same time Scheidbach et al. evaluated laparoscopic colorectal resection in overweight, obese, and morbidly obese patients and reported equivalent outcomes for these groups; however no extensive investigation of the correlation between the degree of BMI, the feasibility of laparoscopic colon resection, the benefits, and the short-term outcomes was provided (LE 1a)[405]**.** Respiratory function is markedly impaired in morbidly obese patients (BMI =40 kg/m^3) undergoing laparoscopic surgery. Several factors contribute to affect pulmonary function: supine position, muscle paralysis, and PP (LE 2b)[406,407]. The related reduced functional residual capacity, increased closing volume, and consequent atelectasis (EL 3a)[408,409] increase the risk for postoperative respiratory complications (LE 1b)[410] and prolonged hospital length of stay (LE 1b)[411]. Almarakbi found that recruitment with the inspiratory manoeuvre repeated every 10 min followed by PEEP application of 10 cm H2O was associated with the best intraoperative respiratory compliance, that is a PaCO2 decrease and PaO2 increase in obese patients undergoing laparoscopic gastric banding without adverse events (LE 1b)[401]**.**

Intraoperative ventilatory strategies should be adopted to improve gas exchange and prevent Ventilation Induced Lung Injury (VILI). If these strategies are followed, laparoscopic procedures may be performed even in morbidly obese patients, with clinical outcomes (recovery of intestinal function and LOS) equivalent to those for non-obese patients. However, the complication rate (morbidity and conversion rates) is higher for morbidly obese patients undergoing LC than for non-obese patients.

Suggestions

The morbidly obese group has a higher morbidity rate than

normal weight patients. As the most frequent complications are respiratory, intraoperative ventilatory strategies should be adopted to improve gas exchange and prevent Ventilation Induced Lung Injury (VILI).

Anaesthesia and laparoscopic surgery in pregnant patients

According to some evidences in the literature, laparoscopic surgery in pregnancy seems to be a safe option. The most common indications are cholelithiasis, appendicitis, persistent ovarian cyst, adnexal torsion (LE 5)[412,413], splenectomy (LE 4)[414], heterotopic pregnancies and adrenal pheochromocytoma (LE 4)[415]. Interestingly Sagiv reported a significant number of successful cases of laparoscopic surgery for extrauterine pregnancy in hemodynamically unstable patients (LE 2b)[416]. However changes in respiratory and cardiovascular function may be present: adding PP to an abdomen during pregnancy is generally associated with significant increase in peak airway pressure, decrease in functional reserve capacity, increased pulmonary shunt, increased alveolar-arterial oxygen gradient, decreased respiratory compliance (LE 4)[417]. As a consequence anaesthesiologists should pay special attention to patient positioning during surgery and the physiologic and mechanical effects following CO_2 PP realization.

CO_2 and fetal heart monitoring and prophylaxis for deep vein thrombosis should be performed during laparoscopic procedures. End-tidal carbon dioxide and maternal blood pressure should be respectively maintained between 32– 34 mm/Hg and within 20% of baseline values. Finally abdominal insufflation pressure of carbon dioxide should not rise above 12–15 mm/Hg. (LE 5)[418]. The Society of American Gastrointestinal Endoscopic Surgeons (SAGES) published guidelines for laparoscopic surgery during pregnancy that include perioperative monitoring of arterial blood gases as well as perioperative fetal and uterine monitoring reinforced in a practice

guideline in 2000. However the anaesthesia management for pregnant women undergoing laparoscopic surgery does not differ from anaesthesia during pregnancy for any other procedure (LE 5)[419].

Suggestions

Changes in respiratory and cardiovascular function may be observed in pregnant women: adding PP to an abdomen may lead to a significant increase in peak airway pressure, decrease in functional reserve and capacity, increased pulmonary shunt, increased alveolar-arterial oxygen gradient and decreased respiratory compliance. As a consequence, special attention should be paid to patient positioning during surgery and to the physiologic and mechanical effects following CO_2 pneumoperitoneum realization.

---

[1] Grundmann RT, Petersen M, Lippert H, Meyer F Das acute (chirurghische) abdomen-epidemiologie, diagnostik und allgemeine prinzipien des managements. Z. Gastroenterol 2010, 48: 696-706

[2] Sauerland S, Agresta F, Bergamaschi R, Borzellino G, Budzynsky A, Champault G, Fingerhut A, Isla A, Johansson M, Lundorff P, Navez B, Saad S, Neugebauer EA (2006) Laparoscopy for abdominal emergencies: evidence based guidelines of the European Association for Endoscopic Surgery. Surg Endosc 20(1):14–29.

[3] Eccles M, Mason J How to develop cost-conscious guidelines. Health Technology Assessment 2001, Vol. 5, No 16

[4] Scottish Intercollegiate Guidelines Netwok. SIGN 50 a guideline developer's handbook. Revised Edition January 2008

[5] National Guidelines System (SNLG) - Italian National Institute of Health (ISS) - Novembre 2009, available at www.snlg-iss.it

[6] Hirota M, Takada T, Kawarada Y, Nimura Y, Miura F, Hirata K, Mayumi T, Yoshida M, Strasberg S, Pitt H, Gadacz TR, de Santibanes E, Gouma DJ, Solomkin JS, Belghiti J, Neuhaus H, Büchler MW, Fan ST, Ker CG, Padbury RT, Liau KH, Hilvano SC, Belli G, Windsor JA, Dervenis C (2007) Diagnostic criteria and severity assessment of acute cholecystitis: Tokyo Guidelines. J Hepatobiliary Pancreat Surg. 14(1):78-82

[7] Kiviluoto T, Siren J, Luukkonen P, Kivilaakso E (1998) Randomised trial of laparoscopic versus open cholecystectomy for acute and gangrenous cholecystitis. Lancet 351: 321– 325

[8] Johansson M, Thune A, Nelvin L, Stiernstam M, Westman B, Lundell L (2005) Randomized clinical trial of open versus laparoscopic cholecystectomy in the treatment of acute cholecystitis. Br J Surg 92: 44–49

[9] Csikesz N, Ricciardi R, Tseng JF, Shah SA (2008) Current status of surgical management of acute cholecystitis in the United States. World J Surg 32(10):2230-6.

[10] Boo YJ, Kim WB, Kim J, Song TJ, Choi SY, Kim YC, Suh SO (2007) Systemic immune response after open versus laparoscopic cholecystectomy in acute cholecystitis: a prospective randomized study. Scand J Clin Lab Invest. 67(2):207-14.

[11] Schietroma M, Carlei F, Cappelli S, Pescosolido A, Lygidakis NJ, Amicucci G. (2007) Effects of cholecystectomy (laparoscopic versus open) on PMN-elastase. Hepatogastroenterology. 54(74):342-5.

[12] Borzellino G, Sauerland S, Minicozzi AM, Verlato G, Di Pietrantonj C, de Manzoni G, Cordiano C. (2008) Laparoscopic cholecystectomy for severe acute cholecystitis. A meta-analysis of results. Surg Endosc 22(1):8-15.

[13] Soleimani M, Mehrabi A, Mood ZA, Fonouni H, Kashfi A, Büchler MW, Schmidt J. (2007) Partial cholecystectomy as a safe and viable option in the emergency treatment of complex acute cholecystitis: a case series and review of the literature. Am Surg 73(5):498-507

[14] Fried, G.M., Barkun, J.S., Sigman, H.H., Joseph L, Clas D, Garzon J, Hinchey EJ, Meakins JL (1994) Factors determining conversion to laparotomy in patients undergoing laparoscopic cholecystectomy. Am. J. Surg. 167:35-41

[15] Brunt LM, Quasebarth MA, Dunnegan DL, Soper NJ. Outcomes analysis of laparoscopic cholecystectomy in the extremely elderly. Surg Endosc. 2001;15:700-705.

[16] Bingener J, Richards ML, Schwesinger WH, Strodel WE, Sirinele KR (2003) Laparoscopic cholecystectomy for elderly patients; gold standard for golden years? Arch Surg 138: 531–535

[17] Kirshtein B, Bayme M, Bolotin A, Mizrahi S, Lantsberg L (2008) Laparoscopic cholecystectomy for acute cholecystitis in the elderly: is it safe? Surg Laparosc Endosc Percutan Tech 18:334–339

[18] do Amaral PC, Azaro Filho Ede M, Galvao TD et al (2006) Laparoscopic cholecystectomy for acute cholecystitis in elderly patients. JSLS 10:479–483

[19] Pessaux P, Regenet N, Tuech JJ, Rouge C, Bergamaschi R, Arnaud JP (2001) Laparoscopic versus open cholecystectomy: A prospective comparative study in the elderly with acute cholecystitis. Surg Laparosc Endosc Percutan Tech 11/4):252-255

[20] Lujan JA,Sanchez-Bueno F.,Parrilla P.,Robles R., Torralba J A, Gonzalez-Costea R. Laparoscopic vs. open cholecystectomy in patients aged 65 and older(1998) Surg Laparosc Endosc Percutan Tech 8(3):208-210.

[21] Chau CH, Tang CN, Siu WT, Ha JP, Li MK (2002) Laparoscopic cholecystectomy versus open cholecystectomy in elderly patients with acute cholecystitis: retrospective study. Hong Kong Med J8: 394–399

[22] Massie MT, Massie LB, Marrangoni AG, D'Amico FJ, Sell HW Advantages of laparoscopic cholecystectomy in the elderly and in patients with high ASA classifications. (1993) J Laparoendosc Surg 3:467-76

[23] Van der Linden W, Edlund G (1970) Early versus delayed operation for acute cholecystitis. A controlled clinical trial. Am J Surg 120:7-13

[24] Lathinen J, Alhava EM, Aukee S (1978) Acute cholecystitis treated by early and delayed surgery. A controlled clinical trial. Scand J Gastroenterol 13:673-8

[25] Jarvinen HJ, Hastbacka J (1980) Early cholecystectomy for acute cholecystitis: a prospective randomized study. Ann Surg 191:501-5

[26] Norrby S, Herlin P, Holmin T, Sjodahl R, Tegesson C (1983) Early or delayed cholecystectomy in acute cholecystitis? A clinical trial Br J Surg 70:163-5

[27] Kum CK, Goh PM, Isaac JR, Tekant Y, Ngoi SS (1994) Laparoscopic cholecystectomy for acute cholecystitis. Br J Surg 81:1651-4

[28] Kum CK, Eypasch E, Lefering R, Math D, Paul A, Neugebauer E, Troidl H (1996)

Laparoscopic cholecystectomy for acute cholcystitis: is it really safe? World J Surg 20:43-9

[29] Lai PBS, Kwong KH, Leung KL, Kwok SPY, Chan ACW, Chung SCS,. Lau WY (1998) Randomized trial of early *versus* delayed laparoscopic cholecystectomy for acute cholecystitis. Br J Surg 85(6):764-7

[30] Lo C, Liu C, Fan S, Lai ECS, Wong J (1998) Prospective randomized study of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Ann Surg 227(4):461-7

[31] Dàvila D, Manzanares C, Pichò ML, Albors P, Càrdenas F, Fuster E (1999) Experience in the treatment (early vs delayed) of acute cholecystitis via laparoscopy. Cirugia Espanola 66(suppl 1):233

[32] Chandler CF, Lane JS, Ferguson P, Thompson JE, Ashley SW. (2000) Prospective evaluation of early versus delayed laparoscopic cholecystectomy for treatment of acute cholecystitis. Am Surg 66:896–900

[33] Johansson M, Thune A, Blomqvist A, Nelvin L, Lundell L (2003) Management of acute cholecystitis in the laparoscopic era: results of a prospective, randomized clinical trial. J Gastrointest Surg 7: 642–645

[34] Serralta AS, Bueno JL, Planells MR, Rodero DR (2003) Prospective evaluation of emergency versus delayed laparoscopic cholecystectomy for early cholecystitis. Surg Laparosc Endosc Percutan Tech 13: 71–75

[35] Kolla SB, Aggarwal S, Kumar A, Kumar R, Chumber S, Parshad , R, Seenu V (2004) Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a prospective randomized trial. Surg Endosc 18: 1323–1327

[36] Papi C, Catarci M, DÕAmbrosjo L, Gili L, Koch M, Grassi GB, Capurso L (2004) Timing of cholecystectomy for acute calculous cholecystitis: a meta-analysis. Am J Gastroenterol 99: 147– 155

[37] Shikata S, Noguchi Y, Fukui T (2005) Early ersus delayed cholecystectomy for acute cholecystitis: a meta-analysis of randomized controlled trials . Surg Today 35:553–560

[38] Lau H, Lo Y, Patil NG, Yuen WK (2006) Early versus delayed-interval laparoscopic cholecystectomy for acute cholecystitis . A metaanalysis . Surg Endosc 20: 82–87

[39] Gurusamy KS, Samraj K (2006) Early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Chochrane Database Syst Rev (4):CD005440

[40] Siddiqui T, MacDonald A, Chong PS, Jenkins JT. (2008) Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a meta-analysis of randomized clinical trials. Am. J. Surg 195(1):40-47

[41] Gurusamy K, Samraj K, Gluud C, Wilson E, Davidson BR. (2010) Meta-analysis of randomized controlled trials on the safety and effectiveness of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Br J Surg 97(2):141-150.

[42] Yadav RP, Adhikary S, Agrawal CS, Bhattarai B, Gupta RK, Ghimire A. (2009) Kathmandu Univ Med J (KUMJ) 7(25)16:20

[43] Sánchez Beorlegui J, Lagunas Lostao E, Lamata Hernández F, Monsalve Laguna EC. (2009) Treatment of acute cholecystitis in the elderly: urgent surgery versus medical therapy and surgery delay. Rev Gastroenterol Peru. 29(4):332-40

[44] Riall TS, Zhang D, Townsend CM Jr, Kuo YF, Goodwin JS. (2010) Failure to perform cholecystectomy for acute cholecystitis in elderly patients is associated with increased morbidity, mortality, and cost. J Am Coll Surg. 210(5):668-77, 677-9.

[45] Vetrhus M, Soreide O, Nesvik I, Sondenaa K (2003) Acute cholecystitis: delayed surgery or observation. A randomized clinical trial. Scand J Gastroenterol 38: 985–990

[46] Akyürek N, Salman B, Yüksel O, Tezcaner T, Irkörücü O, Yücel C, Oktar S, Tatlicioglu E. (2005) Management of acute calculous cholecystitis in high-risk patients: percutaneous

cholecystotomy followed by early laparoscopic cholecystectomy. Surg Laparosc Endosc Percutan Tech. 15(6):315-20.

[47] Macrì A, Scuderi G, Saladino E, Trimarchi G, Terranova M, Versaci A, Famulari C. (2006) Acute gallstone cholecystitis in the elderly: treatment with emergency ultrasonographic percutaneous cholecystostomy and interval laparoscopic cholecystectomy. Surg Endosc 20(1):88-91

[48] Borzellino G, de Manzoni G, Ricci F, Castaldini G, Guglielmi A, Cordiano C. (1999) Emergency cholecystostomy and subsequent cholecystectomy for acute gallstone cholecystitis in the elderly. Br J Surg 86(12):1521-5.

[49] Kim HJ, Lee SK, Kim MH, Yoo KS, Lim BC, Seo DW, Min YI. (2000) Safety and usefulness of percutaneous transhepatic cholecystoscopy examination in high-risk surgical patients with acute cholecystitis. Gastrointest Endosc 52(5):645-9.

[50] Winbladh A, Gullstrand P, Svanvik J, Sandström P (2009) Systematic review of cholecystostomy as a treatment option in acute cholecystitis. HPB (Oxford). 11(3):183-93.

[51] Macafee DA, Humes DJ, Bouliotis G, Beckingham IJ, Whynes DK, Lobo DN. (2009) Prospective randomized trial using cost-utility analysis of early versus delayed laparoscopic cholecystectomy for acute gallbladder disease. Br J Surg 96(9):1031-40

[52] Wilson E, Gurusamy K, Gluud C, Davidson BR. (2010) Cost-utility and value-of-information analysis of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Br J Surg. 97(2):210-9.

[53] Cengiz Y, Jänes A, Grehn A, Israelsson LA (2005) Randomized trial of traditional dissection with electrocautery versus ultrasonic fundus-first dissection in patients undergoing laparoscopic cholecystectomy. Br J Surg 92(7):810-3.

[54] Catena F, Ansaloni L, Di Saverio S, Gazzotti F, Coccolini F, Pinna AD (2009) Prospective analysis of 101 consecutive cases of laparoscopic cholecystectomy for acute cholecystitis operated with harmonic scalpel. Surg Laparosc Endosc Percutan Tech 19(4):312-6.

[55] Catena F, Ansaloni L, Di Saverio S, Gazzotti F, Coccolini F, Pinna AD (2009) The HAC Trial (Harmonic for Acute Cholecystitis) Study. Randomized, double-blind, controlled trial of Harmonic(H) versus Monopolar Diathermy (M) for laparoscopic cholecystectomy (LC) for acute cholecystitis (AC) in adults. Trials 26;10:34.

[56] Hsieh CH (2003) Early laparoscopic cholecystectomy in patients with acute cholecystitis. Am J Surg 185:344-348

[57] Pezzilli R, Zerbi A, Di Carlo V, Bassi C, Delle Fave GF (2010) Working Group of the Italian Association for the Study of the Pancreas on Acute Pancreatitis. Practical guidelines for acute pancreatitis. Pancreatology 10:523-35

[58] Lowenfels AB, Maisonneuve P, Sullivan T (2009) The changing character of acute pancreatitis: epidemiology, etiology, and prognosis. Curr Gastroenterol Rep 11:97-103

[59] Frey CF, Zhou H, Harvey DJ, White RH (2006) The incidence and case-fatality rates of acute biliary, alcoholic, and idiopathic pancreatitis in California, 1994–2001. Pancreas 33:336-344

[60] Hirota M, Takada T, Kawarada Y, Hirata K, Mayumi T, Yoshida M, Sekimoto M, Kimura Y, Takeda K, Isaji S, Koizumi M, Otsuki M, Matsuno S (2006) JPN Guidelines for the management of acute pancreatitis: severity assessment of acute pancreatitis. J Hepatobiliary Pancreat Surg 13:33-41

[61] Working Party of the British Society of Gastroenterology; Association of Surgeons of Great Britain and Ireland; Pancreatic Society of Great Britain and Ireland; Association of Upper GI Surgeons of Great Britain and Ireland (2005) UK guidelines for the management of acute pancreatitis. Gut 54(suppl 3):1-9

[62] Balthazar EJ, Freeny PC, van Sonnenberg E (1994) Imaging and intervention in acute

pancreatitis. Radiology 193:297-306

[63] Aboulian A, Chan T, Yaghoubian A, Kaji AH, Putnam B, Neville A, Stabile BE, de Virgilio C (2010) Early cholecystectomy safely decreases hospital stay in patients with mild gallstone pancreatitis: a randomized prospective study. Ann Surg 251:615-9

[64] Uhl W, Warshaw A, Imrie C, Bassi C, McKay CJ, Lankisch PG, Carter R, Di Magno E, Banks PA, Whitcomb DC, Dervenis C, Ulrich CD, Satake K, Ghaneh P, Hartwig W, Werner J, McEntee G, Neoptolemos JP, Büchler MW, International Association of Pancreatology (2002) IAP Guidelines for the Surgical Management of Acute Pancreatitis. Pancreatology 2:565-573

[65] Kimura Y, Takada T, Kawarada Y et al (2006) JPN Guidelines for the management of acute pancreatitis: treatment of gallstone induced acute pancreatitis. J Hepatobiliary Pancreat Surg 13:56-60

[66] Nebiker CA, Frey DM, Hamel CT, Oertli D, Kettelhack C (2009) Early versus delayed cholecystectomy in patients with biliary acute pancreatitis. Surgery 145:260-264

[67] Sinha R (2008) Early laparoscopic cholecystectomy in acute biliary pancreatitis: the optimal choice? HPB (Oxford) 10:332-335

[68] Taylor E, Wong C (2004) The optimal timing of laparoscopic cholecystectomy in mild gallstone pancreatitis. Am Surg 70:971-97

[69] Cameron DR, Goodman AJ (2004) Delayed cholecystectomy for gallstone pancreatitis: re-admissions and outcomes. Ann R Coll Surg Engl 86:358-362

[70] Williams EJ, Green J, Beckingham I, Parks R, Martin D, Lombard M; British Society of Gastroenterology (2008) Guidelines on the management of common bile duct stones (CBDS). Gut 57:1004-21

[71] Fernández-Esparrach G, Ginès A, Sánchez M, Pagés M, Pellisé M, Fernández-Cruz L, López-Boado MA, Quintó L, Navarro S, Sendino O, Cárdenas A, Ayuso C, BordasJM, Llach J, Castells A (2007) Comparison of endoscopic ultrasonography and magnetic resonance cholangiopancreatography in the diagnosis of pancreatobiliary diseases: a prospective study. Am J Gastroenterol 102:1632-9

[72] Petrov MS, Savides TJ (2009) Systematic review of endoscopic ultrasonography versus endoscopic retrograde cholangiopancreatography for suspected choledocholithiasis. Br J Surg 96:967-974

[73] Ayub K, Imada R, Slavin J (2004) Endoscopic retrograde cholangiopancreatography in gallstone-associated acute pancreatitis. Cochrane Database Syst Rev CD003630

[74] Rogers SJ, Cello JP, Horn JK, Siperstein AE, Schecter WP, Campbell AR, Mackersie RC, Rodas A, Kreuwel HT, Harris HW (2010) Prospective randomized trial of LC+LCBDE vs ERCP/S+LC for common bile duct stone disease. Arch Surg 145:28-33

[75] Morino M, Baracchi F, Miglietta C, Furlan N, Ragona R, Garbarini A (2006) Preoperative endoscopic sphincterotomy versus laparoendoscopic rendezvous in patients with gallbladder and bile duct stones. Ann Surg 244:889-893

[76] Clayton ES, Connor S, Alexakis N, Leandros E (2006) Metaanalysis of endoscopy and surgery versus surgery alone for common bile duct stones with the gallbladder in situ. Br J Surg 93:1185-1191

[77] Martin DJ, Vernon DR, Toouli J (2006) Surgical versus endoscopic treatment of bile duct stones. Cochrane Database Syst Rev 19;(2): CD003327

[78] Mier J, Leon EL, Castillo A, Robledo F, Blanco R. Early versus late necrosectomy in severe necrotizing pancreatitis (1997) Am J Surg 173:71-75. doi: 10.1016/S0002-9610(96)00425-4

[79] Adamson GD, Cuschieri A (2003) Multimedia article. Laparoscopic infracolic necrosectomy for infected pancreatic necrosis. Surg Endosc 17:1675. doi: 10.1007/s00464-003-0041-6

[80] Horvath KD, Kao LS, Wherry KL, Pellegrini CA, Sinanan MN (2001) A technique for laparoscopic-assisted percutaneous drainage of infected pancreatic necrosis and pancreatic abscess. Surg Endosc 15:1221-5

[81] Besselink MG, van Santvoort HC, Schaapherder AF, van Ramshorst B, van Goor H, Gooszen HG; Dutch Acute Pancreatitis Study Group (2007) Feasibility of minimally invasive approaches in patients with infected necrotizing pancreatitis. Br J Surg 94:604-8

[82] Gardner TB, Coelho-Prabhu N, Gordon SR, Gelrud A, Maple JT, Papachristou GI, Freeman ML, Topazian MD, Attam R, Mackenzie TA, Baron TH (2011) Direct endoscopic necrosectomy for the treatment of walled-off pancreatic necrosis: results from a multicenter U.S. series. Gastrointest Endosc 2011 Jan 13 (Epub ahead of print) PMID: 21237454

[83] Horvath K, Freeny P, Escallon J, Heagerty P, Comstock B, Glickerman DJ, Bulger E, Sinanan M, Langdale L, Kolokythas O, Andrews RT (2010) Safety and efficacy of video-assisted retroperitoneal debridement for infected pancreatic collections: a multicenter, prospective, single-arm phase 2 study. Arch Surg 145:817-25

[84] Van Santvoort HC, Besselink MG, Bakker OJ, Hofker HS, Boermeester MA, Dejong CH, van Goor H, Schaapherder AF, van Eijck CH, Bollen TL, van Ramshorst B, Nieuwenhuijs VB, Timmer R, Laméris JS, Kruyt PM, Manusama ER, van der Harst E, van der Schelling GP, Karsten T, Hesselink EJ, van Laarhoven CJ, Rosman C, Bosscha K, de Wit RJ, Houdijk AP, van Leeuwen MS, Buskens E, Gooszen HG; Dutch Pancreatitis Study Group (2010) A step-up approach or open necrosectomy for necrotizing pancreatitis. N Engl J Med 362:1491-1502

[85] Mentula P, Hienonen P, Kemppainen E, Puolakkainen P, Leppäniemi A (2010) Surgical decompression for abdominal compartment syndrome in severe acute pancreatitis. Arch Surg 145:764-9

[86] De Waele JJ, Leppäniemi AK (2009) Intra-abdominal hypertension in acute pancreatitis. World J Surg 33:1128-33

[87] Chen H, Li F, Sun JB, Jia JG (2008) Abdominal compartment syndrome in patients with severe acute pancreatitis in early stage. World J Gastroenterol 14:3541-8

[88] Semm K. Die endoskopische appendektomie. Gynakol Prax. 1983;7:131

[89] Korndorffer JR Jr, Fellinger E, Reed W. SAGES guideline for laparoscopic appendectomy. Surg Endosc. 2010;24(4):757-61.

[90] Vettoretto N, Gobbi S, Corradi A, Ricciardelli L, Belli F, Piccolo D, Mannino L. Consensus conference on laparoscopic appendectomy: development of guidelines. Colorectal Dis. 2011. DOI:10.1111/j.1463-1318.2011.02557.x [e-pub ahead of print]

[91] Toorenvliet BR, Wiersma F, Bakker RFR, Merkus JWS, Breslau PJ, Hamming JF. Routine ultrasound and limited computed tomography for the diagniosis of acute appendicitis. World J Surg 2010;34:2278-85

[92] Al-Khayal KA, Al-Omran MA. Computed tomography and ultrasonography in the diagnosis of equivocal acute appendicitis. A meta-analysis. Saudi Med J. 2007;28(2):173-80.

[93] Sauerland S, Lefering R, Neugebauer EA. Laparoscopic versus open surgery for suspected appendicitis. Cochrane Database Syst Rev. 2004;(4):CD001546

[94] Kirshtein B, Perry ZH, Mizrahi S, Lantsberg L. Value of laparoscopic appendectomy in the elderly patient. World J Surg. 2009;33:918-22

[95] Corneille MG, Steigelman MB, Myers JG, Jundt J, Dent DL, Lopez PP, Cohn SM, Stewart RM. Laparoscopic appendectomy is superior to open appendectomy in obese patients. Am J Surg. 2007;194(6):877-80

[96] Tzovaras G, Baloyiannis I, Kouritas V, Symeonidis D, Spyridakis M, Poultsidi A, Tepetes K, Zacharoulis D. Laparoscopic versus open appendectomy in men: a prospective randomized trial. Surg Endosc. 2010;24(12):2987-92

[97] Markides G, Subar D, Riyad K. Laparoscopic versus open appendectomy in adults with complicated appendicitis: a systematic review and meta-analysis. World J Surg. 2010;34:2026-40

[98] Dindo D, Demartines N, Clavien PA. Classification of surgical complications. A new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240(2):205-13

[99] Ohno Y, Furui J, Kanematsu T. Treatment strategy when using intraoperative peritoneal lavage for perforated appendicitis in children: a preliminary report. Pediatr Surg Int. 2004;20:534-7

[100] Kapischke M, Caliebe A, Tepel J, Schulz T, Hedderich J. Open versus laparoscopic appendectomy: a critical review. Surg Endosc. 2006;20:1060-8

[101] Jackson H, Granger S, Price R, Rollins M, Earle D, Richardson W, Fanelli R. Diagnosis and laparoscopic treatment of surgical diseases during pregnancy: an evidence-based review. Surg Endosc. 2008;22(9):1917-27

[102] Walsh CA, Tang T, Walsh SR. Laparoscopic vs open appendectomy in pregnancy: a systematic review. Int J Surg. 2008;6:339-44

[103] Grimes C, Chin D, Bailey C, Gergely S, Harris A. Appendiceal faecaliths are associated with right iliac fossa pain. Ann R Coll Surg Engl. 2010;92(1):61-4

[104] Navez B, Therasse A. Should every patient undergoing laparoscopy for clinical diagnosis of appendicitis have an appendicectomy? Acta Chir Belg. 2003;103(1):87-9

[105] Kazemeier G, in't Hof KH, Saad S, Bonjer HJ, Sauerland S. Securing the appendiceal stump in laparoscopic appendectomy: evidence for routine stapling? Surg Endosc. 2006;20:1473-6

[106] Sauerland S, Kazemier G. Appendix stump closure during laparoscopic appendectomy (Protocol). Cochrane Database of Systematic Reviews. 2007, Issue 2. Art. No.: CD006437

[107] Kollmar O, Z'graggen K, Schilling MK, Buchholz BM, Buchler MW. The suprapubic approach for laparoscopic appendectomy. Surg Endosc. 2002;16:504-8

[108] Sajid MS, Khan MA, Cheek E, Baig MK. Needlescopic versus laparoscopic appendectomy: a systematic review. Can J Surg. 2009;52:129-134

[109] Karl Langer. "Zur Anatomie und Physiologie der Haut. Über die Spaltbarkeit der Cutis". Sitzungsbericht der Mathematisch-naturwissenschaftlichen Classe der Wiener Kaiserlichen Academie der Wissenschaften Abt. 44 (1861)

[110] Teoh AY, Chiu PW, Wong TC, Wong SK, Lai PB, Ng EK. A case-controlled comparison of single-access versus conventional three-port laparoscopic appendectomy. Surg Endosc. 2010 Oct 23. [epub ahead of print]

[111] Park PO, Bergstrom M. Transgastric peritoneoscopy and appendectomy: thoughts on our first experience in humans. Endoscopy. 2010;42:81–4

[112] Kuzma J. Randomized clinical trial to compare the lenght of hospital stay and morbidity for early feeding with opioid-sparing analgesia versus traditional care after open appendectomy. Clin Nutr. 2008;27(5):694-9

[113] Gorenoi V, Dintsios CM, Schonermark M, Hagen A. Laparoskopische vs. offene Appendektomie. Systematische Ubersicht zur medizinischen Wirksamkeit und gesundheitsokonomische Analyse. HTA-Bericht 148. In: Deutsche Agentur fur Health Technology Assessment des Deutschen Instituts fur Medizinische Dokumentation und Information (DAHTA@DIMDI) (Hrsg.). Schriftenreihe Health Technology Assessment (HTA) in der Bundesrepublik Deutschland. DAHTA-Datenbank des DIMDI, Koln

[114] Chu T, Chandhoke RA, Smith PC, Schwaitzberg SD. The impact of surgeon choice on the cost of performing laparoscopic appendectomy. Surg Endosc. 2010 Sep 11. [epub ahead of

print]

[115] Wong K, Duncan T, Pearson A. Unsupervised laparoscopic appendectomy by surgical trainees is safe and time-effective. Asian J Surg. 2007;30(3):161-6

[116] McWilliams GD, Hill MJ, Dietrich CS 3rd. Gynecologic emergencies. Surg Clin North Am. 2008; 88:265-83.

[117] Chung RS, Diaz JJ, Chari V. Efficacy of routine laparoscopy for the acute abdomen. Surg Endosc. 1998; 12:219-22.

[118] Agresta F, Mazzarolo G, Ciardo LF, Bedin N. The laparoscopic approach in abdominal emergencies: has the attitude changed? A single-center review of a 15-year experience. Surg Endosc. 2008; 22:1255-62.

[119] Porpora MG, Gomel V. The role of laparoscopy in the management of pelvic pain in women of reproductive age. Fertil Steril. 1997; 68:765-79.

[120] Golash V, Willson PD. Early laparoscopy as a routine procedure in the management of acute abdominal pain: a review of 1,320 patients. Surg Endosc. 2005; 19:882-5.

[121] Al-Mulhim AS, Nasser MA, Abdullah MM, Ali AM, Kaman L. Emergency laparoscopy for acute abdominal conditions: a prospective study. J Laparoendosc Adv Surg Tech A. 2008; 18:599-602.

[122] Karamanakos SN, Sdralis E, Panagiotopoulos S, Kehagias I. Laparoscopy in the emergency setting: a retrospective review of 540 patients with acute abdominal pain. Surg Laparosc Endosc Percutan Tech. 2010; 20:119-24.

[123] Kontoravdis A, Chryssikopoulos A, Hassiakos D, Liapis A, Zourlas PA. The diagnostic value of laparoscopy in 2365 patients with acute and chronic pelvic pain. Int J Gynaecol Obstet 1996; 52: 243–248.

[124] Magos AL, Baumannn R, Turnbull AC. Managing gynaecolo gical emergencies with laparoscopy. Br Med J 1989; 299: 371–374.

[125] Navarrete Aulestia S, Cantele H, Leyba JL, Navarrete M, Navarrete Llopla S. Laparoscopic diagnosis and treatment in gynecologic emergencies. J Soc Laparoendosc Surg 2003; 7:239–242.

[126] Easter DW, Cuschieri A, Nathanson LK, Lavelle-Jones M. The utility of diagnostic laparoscopy for abdominal disorders. Audit of 120 patients. Arch Surg 1992; 127: 379–383.

[127] Ou CS, Rowbotham R. Laparoscopic diagnosis and treatment of nontraumatic acute abdominal pain in women. J Laparoendosc Adv Surg Tech A 2000; 10: 41–45.

[128] Promecene PA. Laparoscopy in gynecologic emergencies. Semin Laparosc Surg 2002; 9:64–75.

[129] Valentin L. Characterising acute gynaecological pathology with ultrasound: an overview and case examples. Best Pract Res Clin Obstet Gynaecol. 2009; 23:577-93.

[130] Vandermeer FQ, Wong-You-Cheong JJ. Imaging of acute pelvic pain. Clin Obstet Gynecol. 2009; 52:2-20.

[131] Andreotti RF, Lee SI, Choy G, DeJesus Allison SO, Bennett GL, Brown DL, Glanc P, Horrow MM, Javitt MC, Lev-Toaff AS, Podrasky AE, Scoutt LM, Zelop C. ACR Appropriateness Criteria on acute pelvic pain in the reproductive age group. J Am Coll Radiol. 2009; 6:235-41.

[132] Potter AW, Chandrasekhar CA. US and CT evaluation of acute pelvic pain of gynecologic origin in nonpregnant premenopausal patients. Radiographics. 2008; 28:1645-59.

[133] Heverhagen JT, Klose KJ. MR imaging for acute lower abdominal and pelvic pain. Radiographics. 2009; 29:1781-96.

[134] Mikkelsen AL, Felding C. Laparoscopy and ultrasound examination in women with acute

pelvic pain. Gynecol Obstet Invest 1990; 30:162–164.

[135] Allen LA, Schoon MG Laparoscopic diagnosis of acute pelvic inflammatory disease. Br J Obstet Gynaecol 1983; 90:966–968.

[136] Taylor EW, Kennedy CA, Dunham RH, Bloch JH Diagnostic laparoscopy in women with acute abdominal pain. Surg Laparosc Endosc 1995; 5: 125–128.

[137] Sauerland S, Jaschinski T,Neugebauer EAM. Laparoscopic versus open surgery for suspected appendicitis. CochraneDatabase of Systematic Reviews 2010, Issue 10. Art. No.: CD001546.

[138] Ates M, Sevil S, Bulbul M. Routine use of laparoscopy in patients with clinically doubtful diagnosis of appendicitis. J Laparoendosc Adv Surg Tech A. 2008; 18:189-93.

[139] Varma R, Gupta J. Tubal ectopic pregnancy. Clinical Evidence 2009; 04:1406.

[140] Horne AW, Duncan WC, Critchley HO. The need for serum biomarker development for diagnosing and excluding tubal ectopic pregnancy. Acta Obstet Gynecol Scand. 2010; 89:299-301

[141] Hajenius PJ, Mol F, Mol BWJ, Bossuyt PMM, Ankum WM, Van der Veen F. Interventions for tubal ectopic pregnancy. Cochrane Database of Systematic Reviews 2007, Issue 1. Art. No.: CD000324.

[142] Mol F, Mol BW, Ankum WM, van der Veen F, Hajenius PJ. Current evidence on surgery, systemic methotrexate and expectant management in the treatment of tubal ectopic pregnancy: a systematic review and meta-analysis. Hum Reprod Update. 2008; 14:309-19.

[143] Bignardi T, Condous G. Current evidence about treatments for ectopic pregnancy: need for a rethink on RCTs. Hum Reprod Update. 2009; 15:261-2.

[144] Gray DT, Thorburn J, Lundorff P, Strandell A, Lindblom B A cost-effectiveness study of a randomised trial of laparoscopy versus laparotomy for ectopic pregnancy. Lancet 1995; 345:1139–1143

[145] Lundorff P, Thorburn J, Hahlin M, Kallfelt B, Lindblom B Laparoscopic surgery in ectopic pregnancy. A randomized trial versus laparotomy. Acta Obstet Gynecol Scand 1991; 70:343–348.

[146] Lundorff P, Thorburn J, Lindblom B Fertility outcome after conservative surgical treatment of ectopic pregnancy evaluated in a randomized trial. Fertil Steril 1992; 57:998–1002

[147] Vermesh M, Silva PD, Rosen GF, Stein AL, Fossum GT, Sauer MV. Management of unruptured ectopic gestation by linear salpingostomy: a prospective, randomized clinical trial of laparoscopy versus laparotomy. Obstet Gynecol 1989; 73:400–404

[148] Fernandez H, Marchal L, Vincent Y. Fertility after radical surgery for tubal pregnancy. Fertil Steril 1998; 70:680–686

[149] Murphy AA, Nager CW, Wujek JJ, Kettel LM, Torp VA, Chin HG. Operative laparoscopy versus laparotomy for the management of ectopic pregnancy: a prospective trial. Fertil Steril 1992; 57:1180–1185

[150] Oelsner G, Shashar D. Adnexal torsion. Clin Obstet Gynecol. 2006; 49:459-63.

[151] Lo LM, Chang SD, Horng SG, Yang TY, Lee CL, Liang CC. Laparoscopy versus laparotomy for surgical intervention of ovarian torsion. J Obstet Gynaecol Res. 2008; 34:1020-5.

[152] Balci O, Icen MS, Mahmoud AS, Capar M, Colakoglu MC. Management and outcomes of adnexal torsion: a 5-year experience. Arch Gynecol Obstet. 2010 Oct 6. [Epub ahead of print] PubMed PMID: 20922399

[153] Cohen SB, Wattiez A, Seidman DS, Goldenberg M, Admon D, Mashiach S, Oelsner G. Laparoscopy versus laparotomy for detorsion and sparing of twisted ischemic adnexa. JSLS. 2003; 7:295-9

[154] Medeiros LR, Rosa DD, Bozzetti MC, Fachel JM, Furness S, Garry R, Rosa MI, Stein AT. Laparoscopy versus laparotomy for benign ovarian tumour. Cochrane Database Syst Rev. 2009 Apr 15;(2):CD004751

[155] Mais V, Ajossa S, Piras B, Marongiu D, Guerriero S, Melis GB. Treatment of nonendometriotic benign adnexal cysts; a randomized comparison of laparoscopy and laparotomy. Obstet Gynecol 1995; 86:770–774

[156] Yuen PM, Yu KM, Yip SK, Lau WC, Rogers MS, Chang A. A randomized prospective study of laparoscopy and laparotomy in the management of benign ovarian masses. Am J Obstet Gynecol 1997; 177:109–114.

[157] Nitke S, Goldman GA, Fisch B, Kaplan B, Ovadia J. The management of dermoid cysts—a comparative study of laparoscopy and laparotomy. Isr J Med Sci 1996; 32:1177–1179

[158] Ferrero S., Remorgida V and Venturini P. Endometriosis. Clinical Evidence 2010;08:802

[159] Almeida Filho DP, Oliveira LJ, Amaral VF. Accuracy of laparoscopy for assessing patients with endometriosis. Sao Paulo Med J. 2008; 126:305-8

[160] Giudice LC. Clinical practice. Endometriosis. N Engl J Med. 2010; 362:2389-98.

[161] Jacobson TZ, Barlow DH, Garry R, Koninckx P. Laparoscopic surgery for pelvic pain associated with endometriosis. Cochrane Database Syst Rev 2001; CD001300

[162] Abbott J, Hawe J, Hunter D, Holmes M, Finn P, Garry R. Laparoscopic excision of endometriosis; a randomized, placebo controlled trial. Fertil Steril 2004; 82:878–884

[163] Sutton CJG, Pooley AS, Ewen SP, Haines P. Follow-up report on a randomized controlled trial of laser laparoscopy in the treatment of pelvic pain associated with minimal to moderate endometriosis. Fertil Steril 1997; 68:1070–1074

[164] Morino M, Pellegrino L, Castagna E, Farinella E, Mao P. Acute nonspecific abdominal pain: A randomized, controlled trial comparing early laparoscopy versus clinical observation. Ann Surg. 2006; 244:881-6.

[165] Bevan CD, Johal BJ, Mumtaz G, Ridgway GL, Siddle NC. Clinical, laparoscopic and microbiological findings in acute salpingitis; report on a United Kingdom cohort. Br J Obstet Gynaecol 1995; 102:407–414

[166] Morcos R, Frost N, Hnat M, Petrunak A, Caldito G. Laparoscopic versus clinical diagnosis of acute pelvic inflammatory disease. J Reprod Med. 1993; 38:53-6.

[167] Soper DE. Pelvic inflammatory disease. Obstet Gynecol. 2010; 116:419-28

[168] Granberg S, Gjelland K, Ekerhovd E. The management of pelvic abscess. Best Pract Res Clin Obstet Gynaecol. 2009; 23:667-78.

[169] Perez-Medina T, Huertas MA, Bajo JM. Early ultrasound-guided transvaginal drainage of tubo-ovarian abscesses: a randomized study. Ultrasound Obstet Gynecol. 1996; 7:435-8

[170] Soper DE Diagnosis and laparoscopic grading of acute salpingitis. Am J Obstet Gynecol 1991; 164:1370–1376

[171] Teisala K, Heinonen PK, Punnonen R () Laparoscopic diagnosis and treatment of acute pyosalpinx. J Reprod Med 1990; 35:19–2162gd.

[172] Teng SW, Tseng JY, Chang CK, Li CT, Chen YJ, Wang PH. Comparison of laparoscopy and laparotomy in managing hemodynamically stable patients with ruptured corpus luteum with hemoperitoneum. J Am Assoc Gynecol Laparosc. 2003; 10:474-7.

[173] Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) 2007. Guidelines for diagnostic laparoscopy practice/clinical guidelines

[174] American College of Emergency Physicians. Clinical policy: critical issues for the initial evaluation and management of patients presenting with a chief complaint of nontraumatic acute abdominal pain (Am Emerg Med) 2000;36:406-15

[175] Robert T. Gerhardt MD, MPH, FACEP et al. Derivation of clinical guidelines for the assessment of nonspecific abdominal pain in the ED Setting (GAPEDS) Phase 1 Study. American Journal of Emergency Medicine (2005) 23,709-717

[176] Ng CS, Watson CJE, Palmer CR, et al. Evaluation of early abdomino-pelvic computed tomography in patients with acute abdominal pain of unknown cause: a prospective randomized study. BMJ 2002; 325:1-4

[177] Evis Sala, Clare Beadsmoore, et al. Unexpected changes in clinical diagnosis: early abdomino-pelvic CT compared with clinical evaluation. Abdom Imaging (2009) 34:783-787

[178] Sozuer EM, Bedirli A, Ulusal M et al. (2000) Laparoscopy for diagnosis and treatment of acute abdominal pain. J Laparoendosc Adv Surg Tech A 10:203-207

[179] Poulin EC, Schlachta CM, Mamazza J (2000) Early laparoscopy to help diagnose acute nonspecific abdominal pain. Lancet 355: 861-863

[180] Stefanidis D, Richardson WS et al. The role of diagnostic laparoscopy for acute abdominal conditions: an evidence based review. Surg Endosc. (2009) 23: 16-23

[181] Gagne, D.J., Malay, M.B. et al. Bedside diagnostic minilaparoscopy in the intensive care patients. Surgery 2002; 131(5): 491-6

[182] Pecoraro, A.P. Cacchione, R. et al. The routine use of diagnostic laparoscopy in the intensive care unit. Surg. Endosc 2001; 15(7):638-41

[183] Champault G, Rizk N, Lauroy J et al. Right iliac fosse in women: conventional diagnostic approach versus primary laparoscopy. A controlled study (65 cases) Ann Chir 1993; 47:316-319

[184] Decadt B, Sussman L, Lewis MO, et al. Randomized clinical trial of early laparoscopy in the management of acute non-specific abdominal pain Br J Surg. 1999; 86:1383-1386

[185] Morino M, Pellegrino L, et al. Acute Nonspecific abdominal pain: a randomized, controlled trial comparing early laparoscopy versus clinical observation. Ann Surg 2006; 244: 881-888

[186] Maggio A.Q., Reece-Smith A.M. et al. Early laparoscopy versus active observation in acute abdominal pain: Systematic review and meta-analysis. Int. Journ. of Surg. 6 (2008) 400-403

[187] Hainaux B, Agneessen E, Bertinotti R, De Maertelaer V, Rubesova E, Capelluto E, Moschopoulos C. (2006) Accuracy of MDCT in predicting site of gastrointestinal tract perforation. AJR 187:1179-1183.

[188] Earls JP, Dachaman AH, Colon E, Garrett MG, Molloy M.(1993) Prevalence and duration of postoperative pneumoperitoneum: sensitivity of CT vs left lateral decubits radiograph AJR 161:781-785.

[189] Chen CH, Huang HS, Yang CC, Yeh YH. (2001) Features of perforated peptic ulcers in conventional computed tomography. Hepatogastroenterology 48:1393-1396.

[190] Lunevicius R, Morkevicius M (2005) Systemic review comparing laparoscopic and open repair for perforated peptic ulcer. Br J Surg 92:1195-1207.

[191] Siu WT, Leong HT, Law BKB,.Chau CH, Li AC.N., Fung KH,. Tai YP,. Li MKW (2002) Laparoscopic repair for perforated peptic ulcer: a randomized controlled trial. Ann Surg 235: 3, 313–319

[192] Agresta F, Mazzarolo G, Ciardo LF, Bedin N (2005) The laparoscopic approach in abdominal emergiencies: has the attitude changed? A single-center review of a 15 year experience. Surg Endosc 22:1255-1262.

[193] Lau H (2004) Laparoscopic repair of perforated peptic ulcer. A meta-analysis. Surg Endosc 18:1013-1021

[194] Boey J, Wong J, Ong GB (1982) A prospective study of operative risk factors in perforated

duodenal ulcers Ann.Surg 195:, (3) 265-269.

[195] Agresta F, Michelet I, Coluci G, Bedin N. (2000) Emergency Laparoscopy: a community hospital experience. Surg.Endosc 14: 484-487

[196] Notash AY, Salimi J, Rahimian H, Fersharaki MH, Abbassi A. (2005) Evaluation of Mannheim Peritonitis Index and multiple failure score in patients with peritonitis. Ind J Gastroenterol 24:197-200.

[197] Lee FY, Leung KL, Lai BS, Ng SS, Dexter S, Lau WY (2001) Predicting mortality and morbidity of patients operated on for perforated peptic ulcers. Arch Surg 136:90-94.

[198] Lau WY, Leung KL, Kwong KH, Davey C, Robertson C, Dawson JJ, Chung SC, Li AK. (1996) A randomized study comparing laparoscopic versus open repair of perforated peptic ulcer using suture or sutureless technique. Ann Surg 224: (2) 131-138

[199] Sanabria AE, Morales CH, Villegas MI. Laparoscopic repair for perforated peptic ulcer disease . The Cochrane Library 2005, Issue 4-Updated: March 2010;

[200] Lagoo S., Mc Mahon RL, Kalkharu M, Pappas TN, Eubanks S. (2002) The sixth decision regarding perforated duodenal ulcer. JSLS 6:359-368.

[201] Katkhouda N, Mavor E, Mason RJ, Campos GMR Soroushyari A,. Berne TV, (1999) Laparoscopic repair of perforated duodenal ulcers: outcome and efficacy in 30 consecutive patients. Arch Surg 134:845-850.

[202] Robertson GS, Wemyss-Holden SA, Maddern GJ.(2000) Laparoscopic repair of perforated duodenal ulcers. The role of laparoscopy in generalized peritonitis. Ann R Coll Surg Engl 82:6-10

[203] Miserez M, Eypasch E, Spangenberger W, Lefering R, Troidl H.(1996) Laparoscopic and conventional closure of perforated peptic ulcer: a comparison. Surg Endosc 10:831-836.

[204] Bertleff M.. Halm JA. Bemelman WA, van der Ham AC. van der Harst E, HISmulders J. F.. Steyerberg E. W., Lange JF (2009)Randomized Clinical trial of laparoscopic versus open repair of the perforated peptic ulcer: the LAMA trial. World J Surg 33:1368-1373.

[205] Alvarez JA, Baldonedo RF, Bear IG, Otero J, Pire G, Alvarez P, Jorge JI (2007) Presentation, management and outcome of acute sigmoid diverticulitis requiring hospitalization. Dig Surg 24:471-476

[206] Shaikh S, Krukowski ZH (2007) Outcome of a conservative policy for managing acute sigmoid diverticulitis. Br J Surg 94:876-879

[207] Guller U, Jain N, Hervey S, Purves H, Pietrobon R (2003) Laparoscopic vs open colectomy: outcomes comparison based on large nationwide databases. Arch Surg 138:1179-1186

[208] Hinojosa MW, Murrell ZA, Konyalian VR, Mills S, Nguyen NT, Stamos MJ (2007) Comparison of laparoscopic vs open sigmoid colectomy for benign and malignant disease at academic medical centers. J Gastrointest Surg 11:1423-1429

[209] Klarenbeek BR, Veenhof AA, Bergamaschi R, van der Peet DL, van den Broek WT, de Lange ES, Bemelman WA, Heres P, Lacy AM, Engel AF, Cuesta MA (2009) Laparoscopic sigmoid resection for diverticulitis decreases major morbidity rates: a randomized control trial: short-term results of the Sigma Trial. Ann Surg 249:39-44

[210] Faynsod M, Stamos MJ, Arnell T, Borden C, Udani S, Vargas H (2000) A case-control study of laparoscopic versus open sigmoid colectomy for diverticulitis. Am Surg 66:841-843

[211] Dwivedi A, Chahin F, Agrawal S, Chau WY, Tootla A, Tootla F, Silva YJ (2002) Laparoscopic colectomy vs. open colectomy for sigmoid diverticular disease. Dis Colon Rectum 45:1309-1314

[212] Lawrence DM, Pasquale MD, Wasser TE (2003) Laparoscopic versus open sigmoid colectomy for diverticulitis. Am Surg 69:499-503

[213] Gonzalez R, Smith CD, Mattar SG, Venkatesh KR, Mason E, Duncan T, Wilson R, Miller J, Ramshaw BJ (2004) Laparoscopic vs open resection for the treatment of diverticular disease. Surg.Endosc 18:276-280

[214] Alves A, Panis Y, Slim K, Heyd B, Kwiatkowski F, MantionG (2005) French multicentre prospective observational study of laparoscopic versus open colectomy for sigmoid diverticular disease. Br J Surg 92:1520-1525

[215] Senagore AJ, Duepree HJ, Delaney CP, Dissanaike S, Brady KM, Fazio VW (2002) Cost structure of laparoscopic and open sigmoid colectomy for diverticular disease: similarities and differences. Dis Colon Rectum 45:485-490

[216] Hinchey EJ, Schaal PG, Richards GK (1978) Treatment of perforated diverticular disease of the colon. Adv Surg 12:85-109

[217] Sher ME, Agachan F, Bortul M, Nogueras JJ, Weiss EG, Wexner SD (1997) Laparoscopic surgery for diverticulitis. Surg Endosc 11:264-267

[218] Kohler L, Sauerland S, Neugebauer E (1999) Diagnosis and treatment of diverticular disease: results of a consensus development conference. The Scientific Committee of the European Association for Endoscopic Surgery. Surg Endosc 13:430-436

[219] Durmishi Y, Gervaz P, Brandt D, Bucher P, Platon A, Morel P, Poletti PA (2006) Results from percutaneous drainage of Hinchey stage II diverticulitis guided by computed tomography scan. Surg Endosc 20:1129-1133

[220] Brandt D, Gervaz P, Durmishi Y, Platon A, Morel P, Poletti PA (2006) Percutaneous CT scan-guided drainage vs. antibiotherapy alone for Hinchey II diverticulitis: a case-control study. Dis Colon Rectum 49:1533-1538

[221] Kumar RR, Kim JT, Haukoos JS, Macias LH, Dixon MR, Stamos MJ, Konyalian VR (2006) Factors affecting the successful management of intra-abdominal abscesses with antibiotics and the need for percutaneous drainage. Dis Colon Rectum 49:183-189

[222] O'Sullivan GC, Murphy D, O'Brien MG, Ireland A (1996) Laparoscopic management of generalized peritonitis due to perforated colonic diverticula. Am J Surg 171:432-434

[223] Faranda C, Barrat C, Catheline JM, Champault GG (2000) Two stage laparoscopic management of generalized peritonitis due to perforated sigmoid diverticula: eighteen cases. Surg Laparosc Endosc Percutan Tech 10:135-138

[224] Taylor CJ, Layani L, Ghusn MA, White SI (2006) Perforated diverticulitis managed by laparoscopic lavage. ANZ J Surg 76:962-965

[225] Bretagnol F, Pautrat K, Mor C, Benchellal Z, Huten N, de Calan L (2008) Emergency laparoscopic management of perforated sigmoid diverticulitis: a promising alternative to more radical procedures. J Am Coll Surg 206:654-657

[226] Franklin ME Jr, Portillo G, Trevino JM, Gonzalez JJ, Glass JL (2008) Long-term experience with the laparoscopic approach to perforated diverticulitis plus generalized peritonitis. World J Surg 32:1507-1511

[227] Karoui M, Champault A, Pautrat K, Valleur P, Cherqui D, Champault G (2009) Laparoscopic peritoneal lavage or primary anastomosis with defunctioning stoma for Hinchey 3 complicated diverticulitis: results of a comparative study. Dis Colon Rectum 52:609-615

[228] Alamili M, Mcgenur, Rosenberg J (2009) Acute complicated diverticulitis managed by laparoscopic lavage. Dis Colon Rectum 52:1345-9

[229] Favuzza J, Friel JC, Kelly JJ, Perugini R, Counihan TC (2009) Benefits of laparoscopic peritoneal lavage for complicated sigmoid diverticulitis. Int J Colorectal Dis 24:797-801

[230] Stocchi L (2010) Current indications and role of surgery in the management of sigmoid diverticulitis. World J Gastroenterol 16:804-17

[231] Myers E, Hurley M, O'Sullivan GC, Kavanagh D, Wilson I, Winter DC (2008)

Laparoscopic peritoneal lavage for generalized peritonitis due to perforated diverticulitis. Br J Surg 95:97-101

[232] Agaba EA, Zaidi RM, Ramzy P, Aftab M, Rubach E, Gecelter G, Ravikumar TS, Denoto G (2009) Laparoscopic Hartmann's procedure: a viable option for treatment of acutely perforated diverticulitis. Surg Endosc 23:1483–1486

[233] Titu L, Zafar N, Phillips S, Greenslade G, Dixon A (2009) Emergency laparoscopic surgery for complicated diverticular disease Colorectal Dis 11:401-404

[234] Chouillard E, Maggiori L, Ata T, Jarbaoui S, Rivkine E, Benhaim, L, Ghiles E, Etienne JC, Fingerhut A (2007) Laparoscopic two stage left colonic resection for patients with peritonitis caused by acute diverticulitis. Dis Colon Rectum 50:1157-1163

[235] Zdichavsky M., Granderath FA., Blumenstock G., Kramer M., Kuper MA., Konigsrainer A.: Acute laparoscopic intervention for diverticular disease: a feasible approach. Langenbecks Arch.Surg. 2010; 395:41-48

[236] Navez B, Tassetti V, Scohy JJ, Mutter D, Guiot P, Evrard S, Marescaux J. Laparoscopic management of acute peritonitis. Br J Surg 1998; 85: 32–6

[237] Gonzalez R, Smith CD, Mattar SG, Venkatesh KR, Mason E, Duncan T, Wilson R, Miller J, Ramshaw BJ. Laparoscopic vs open resection for the treatment of diverticular disease. Surg Endosc 2004; 18: 276–80

[238] Bastug DF (1991) Laparoscopic adhesiolysis for small bowel obstruction. Surg Laparosc Endosc 1:259-262

[239] ACS principle and practice (2005)

[240] Miller G, Boman J, Shrier J, Gordon PH (2000) Etiology of small bowel obstruction. Am J Surg 180:33–36

[241] Duron JJ, Jourdan-Da Silva N, Tezenas du Montcel S, Berger A, Muscari F, Hennet H, Veyrieres M, Hay JM (2006) Adhesive Postoperative Small Bowel Obstruction: Incidence and Risk Factors of Recurrence After Surgical Treatment. A Multicenter Prospective Study. Ann Surg 244:750–757

[242] Cirocchi R, Abraha I, Farinella E, Montedori A, Sciannameo F (2010) Laparoscopic versus open surgery in small bowel obstruction (Review). The Cochrane Collaboration. Cochrane Database Syst Rev 2010 Feb 17;(2): CD007511

[243] Tittel A (2001) Comparison of adhesion reformation after laparoscopic and conventional adhesiolysis in an animal model. Langenbeck's Arch Surg 386:141-145

[244] Duepree HJ, Senagore AJ, Delaney CP, Fazio VW (2003) Does Means of Access Affect the Incidence of Small Bowel Obstruction and Ventral Hernia After Bowel Resection? Laparoscopy Versus Laparotomy. J Am Coll Surg 197:177–181

[245] Majewski W (2006) How should a patient with acute abdomen be managed? Adhesion 9:14-16

[246] Iorgulescu R, Iordache M, Ilie R, Dragomirescu C (2005) Laparoscopic Surgery for small bowel obstruction. Chirurgia 101:313-18

[247] Khaikin M, Schneidereit N, Cera S, Sands D, Efron J, Weiss G, Nogueras JJ, Vernava AM, Wexner SD (2007) Laparoscopic vs. open surgery for acute adhesive small-bowel obstruction:patient' outcome and cost-effextiveness. Surg Endosc 21:742-746

[248] Cavaliere D, Schirru A, Caristo I, Bianchi M, Cosce U, Cavaliere P (2005) La laparoscopia nell'occlusione intestinale del tenue. Chir It 57:215-20

[249] Johanet H, Marmuse JP (2005) Occlusion aigue du grele sur bride. Prevention et traitement des occlusions du grele su bride. Referentiel Association Française de Chirurgie (A.F.C.) n°4513 créé(e) le 28/04/05 par Pr Denis Collet

[250] Zerey M, Sechrist CW, Kercher KW, Sing RF, Matthews BD, Heniford BT (2007) Laparoscopic management of adhesive small bowel obstruction. Am Surg 73:773-8

[251] Cirocchi R, Giustozzi G, De Sol A, et al (2007) Laparoscopic adhesiolysis in acute small bowel obstruction. Minerva Chir 62(6):477-88

[252] Binenbaum SJ, Goldfarb A (2006) Inadvert enterotomy in minimally invasive abdominal surgery. JSLS 10:336-40

[253] Qureschl I, Awad ZT (2010) Predictors of failure of the laparoscopic approach for the management of small bowel obstruction. Am Surg Sep;76(9):947-50

[254] Grafen FC, Neuhaus V, Schob O, Turina M (2010) Management of acute small bowel obstruction from intestinal adhesions: indications for laparoscopic surgery in a community teaching hospital. Langenbecks Arch Surg 395(1):57-63

[255] Diaz JJ, Jr, Bokhari F, Mowery NT, Acosta JA, Block EFJ, Bromberg WJ, Collier BR, Cullinane DC, Dwyer KM, Griffen MM, Mayberry JC, Jerome R (2008) Guidelines for Management of Small Bowel Obstruction J Trauma. 64:1651–1664

[256] SAGES (2008) Diagnostic laparoscopy guidelines Surg Endosc 22:1353–1383

[257] Farinella E, Roberto Cirocchi R, La Mura F, Morelli U, Cattorini L, Delmonaco P, Migliaccio C, De Sol AA, Cozzaglio L, Sciannameo F (2009) Feasibility of laparoscopy for small bowel obstruction. World Journal of Emergency Surgery 4:3

[258] Levard H (2001) Laparoscopic treatment of acute small bowel obstruction: a multicentre retrospective study. ANZ J Surg 71:641-646

[259] Suter M, Zermatten P, Halkic N, Martinet O, Bettschart V (2000) Laparoscopic management of mechanical small bowel obstruction Are there predictors of success or failure? Surg Endosc 14: 478–483

[260] Zago M, Mariani D, Kurihara H, Turconi MG, Poldi D, Rosati R (2010) Selection Criteria Analysis for Laparoscopic Treatment of Small Bowel Obstruction on a 100 Patients Series Eur J Trauma Emerg Surg 36:120

[261] Navez B, Arimont JM Guit P (1998) Laparoscopic approach in acute small bowel obtructio. A review of 68 patients. Hepatogastroenterology 45: 2146-50

[262] Léon EL, Metzger A, Tsiotos GG et al (1998) Laparoscopic management of small bowel obstruction: indication and outcomes. J Gastrointest Surg 2:132-140

[263] Kulah B, Kulacoglu IH, Oruc MT, Duzgun AP, Moran M, Ozmen MM, Coskun F (2001) Presentation and outcome of incarcerated external hernias in adults. Am J Surg Feb;181(2):101-4

[264] Gallegos NC, Dawson J, Jarvis M, Hobsley M (1991) Risk of strangulation in groin hernias. Br J Surg Oct;78(10):1171-3

[265] Bekoe S (1973) Prospective analysis of the management of incarcerated and strangulated inguinal hernias. Am J Surg Nov;126(5):665-8

[266] Brasso K, Løndal Nielsen K, Christiansen J (1989) Long-term results of surgery for incarcerated groin hernia. Acta Chir Scand Nov-Dec;155(11-12):583-5

[267] MacFadyen BV Jr, Mathis CR (1994) Inguinal Herniorrhaphy: Complications and Recurrences. Semin Laparosc Surg Jun;1(2):128-140

[268] Nilsson H, Stylianidis G, Haapamäki M, Nilsson E, Nordin P (2007) Mortality after groin hernia surgery. Ann Surg Apr;245(4):656-60

[269] Watson SD, Saye W, Hollier PA (1993) Combined laparoscopic incarcerated herniorrhaphy and small bowel resection. Surg Laparosc Endosc Apr;3(2):106-8

[270] McCormack K, Scott NW, Go PM, Ross S, Grant AM; EU Hernia Trialists Collaboration (2003) Laparoscopic techniques versus open techniques for inguinal hernia repair. Cochrane Database Syst Rev. 2003;(1):CD001785

[271] Dedemadi G, Sgourakis G, Radtke A, Dounavis A, Gockel I, Fouzas I, Karaliotas C,

Anagnostou E (2010) Laparoscopic versus open mesh repair for recurrent inguinal hernia: a meta-analysis of outcomes. Am J Surg Aug;200(2):291-7

[272] Deeba S, Purkayastha S, Paraskevas P, Athanasiou T, Darzi A, Zacharakis E (2009) Laparoscopic approach to incarcerated and strangulated inguinal hernias. JSLS Jul-Sep;13(3):327-31

[273] Leibl BJ, Schmedt CG, Kraft K, Kraft B, Bittner R (2001) Laparoscopic transperitoneal hernia repair of incarcerated hernias: Is it feasible? Results of a prospective study. Surg Endosc Oct;15(10):1179-83

[274] Mainik F, Flade-Kuthe R, Kuthe A (2005) Total extraperitoneal endoscopic hernioplasty (TEP) in the treatment of incarcerated and irreponible inguinal and femoral hernias. Zentralbl Chir Dec;130(6):550-3

[275] Rebuffat C, Galli A, Scalambra MS, Balsamo F (2006) Laparoscopic repair of strangulated hernias. Surg Endosc Jan;20(1):131-4

[276] Saggar VR, Sarangi R (2005) Endoscopic totally extraperitoneal repair of incarcerated inguinal hernia. Hernia May;9(2):120-4

[277] Ferzli G, Shapiro K, Chaudry G, Patel S (2005) Laparoscopic extraperitoneal approach to acutely incarcerated inguinal hernia. Surg Endosc Feb;18(2):228-31

[278] Ishihara T, Kubota K, Eda N, Ishibashi S, Haraguchi Y (1996) Laparoscopic approach to incarcerated inguinal hernia. Surg Endosc Nov;10(11):1111-3

[279] Legnani GL, Rasini M, Pastori S, Sarli D (2008) Laparoscopic trans-peritoneal hernioplasty (TAPP) for the acute management of strangulated inguino-crural hernias: a report of nine cases. Hernia Apr;12(2):185-8

[280] Sgourakis G, Radtke A, Sotiropoulos GC, Dedemadi G, Karaliotas C, Fouzas I, Karaliotas C (2009) Assessment of strangulated content of the spontaneously reduced inguinal hernia via hernia sac laparoscopy: preliminary results of a prospective randomized study. Surg Laparosc Endosc Percutan Tech Apr;19(2):133-7

[281] Taskin M, Zengin K, Unal E, Eren D, Korman U (2002) Laparoscopic repair of congenital diaphragmatic hernias. Surg Endosc May;16(5):869

[282] Dapri G, Himpens J, Hainaux B, Roman A, Stevens E, Capelluto E, Germay O, Cadière GB (2007) Surgical technique and complications during laparoscopic repair of diaphragmatic hernias. Hernia Apr;11(2):179-83

[283] Tagaya N, Tachibana M, Kijima H, Kakihara Y, Hamada K, Sawada T, Kubota K (2007) Laparoscopic treatment of paraesophageal hiatal hernia with incarceration of the pancreas and jejunum. Surg Laparosc Endosc Percutan Tech Aug;17(4):313-6

[284] Nattakom T, Schuerer D, Batra S, Velonovich V, Karmy-Jones R (1999) Emergency laparoscopic repair of a paraesophageal hernia. Surg Endosc Jan;13(1):75-6

[285] Chang CC, Tseng CL, Chang YC (2009) A surgical emergency due to an incarcerated paraesophageal hernia. Am J Emerg Med Jan;27(1):134.e1-3

[286] Cloyd DW (1994) Laparoscopic repair of incarcerated paraesophageal hernias. Surg Endosc Aug;8(8):893-7

[287] Sun HP, Chao YP (2010) Preoperative diagnosis and successful laparoscopic treatment of incarcerated obturator hernia. Hernia Apr;14(2):203-6

[288] Hunt L, Morrison C, Lengyel J, Sagar P (2009) Laparoscopic management of an obstructed obturator hernia: should laparoscopic assessment be the default option? Hernia Jun;13(3):313-5

[289] Velásquez-López JG, Gil FG, Jaramillo FE (2008) Laparoscopic repair of obturator bladder hernia: a case report and review of the literature. J Endourol Feb;22(2):361-4

[290] Wu JM, Lin HF, Chen KH, Tseng LM, Huang SH (2006) Laparoscopic preperitoneal mesh

repair of incarcerated obturator hernia and contralateral direct inguinal hernia. J Laparoendosc Adv Surg Tech A Dec;16(6):616-9

[291] Yau KK, Siu WT, Chau CH, Yang PC, Li MK (2005) Laparoscopic management of incarcerated obturator hernia. Can J Surg Feb;48(1):76-7

[292] Cueto-García J, Rodríguez-Diaz M, Elizalde-Di Martino A, Weber-Sanchez A (1998) Incarcerated obturator hernia successfully treated by laparoscopy. Surg Laparosc Endosc Feb;8(1):71-3

[293] Sarit C, Eliezer A, Mizrahi S (2003) Minimally invasive repair of recurrent strangulated umbilical hernia in cirrhotic patient with refractory ascites. Liver Transpl Jun;9(6):621-2

[294] Subramanya MS, Chakraborty J, Memon B, Memon MA (2010) Emergency intraperitoneal onlay mesh repair of incarcerated spigelian hernia. JSLS Apr-Jun;14(2):275-8

[295] López-Tomassetti Fernández EM, Martín Malagón A, Delgado Plasencia L, Arteaga González I (2006) Laparoscopic repair of incarcerated low spigelian hernia with transperitoneal PTFE DualMesh. Surg Laparosc Endosc Percutan Tech Dec;16(6):427-31

[296] Yau KK, Siu WT, Chau CH, Yang GP, Li MK (2005) A laparoscopic approach for incarcerated Spigelian hernia. J Laparoendosc Adv Surg Tech A Feb;15(1):57-9

[297] Cissé M, Konaté I, Ka O, Dieng M, Dia A, Touré CT (2009) Internal supravesical hernia as a rare cauase of intestinal obstruction: a case report. J Med Case Reports Dec 16;3:9333

[298] Mehran A, Szomstein S, Soto F, Rosenthal R (2004) Laparoscopic repair of an internal strangulated supravesical hernia. Surg Endosc Mar;18(3):554-6

[299] Gorgun E, Onur E, Baca B, Apaydin B, Yavuz N, Sirin F (2003) Laparoscopic repair of an internal supravesical hernia: a rare hernia causing small bowel obstruction. Surg Endosc Apr;17(4):659

[300] Khalaileh A, Schlager A, Bala M, Abugazala S, Elazary R, Rivkind AI, Mintz Y (2010) Left laparoscopic paraduodenal hernia repair. Surg Endosc Jun;24(6):1486-9

[301] Bittner JG 4th, Edwards MA, Harrison SJ, Li K, Karmin PN, Mellinger JD (2009) Laparoscopic repair of a right paraduodenal hernia. JSLS Apr-Jun;13(2):242-9

[302] Uchiyama S, Imamura N, Hidaka H, Maehara N, Nagaike K, Ikenaga N, Hotokezaka M, Chijiiwa K (2009) An unusual variant of a left paraduodenal hernia diagnosed and treated by laparoscopic surgery: report of a case. Surg Today 39(6):533-5

[303] Jeong GA, Cho GS, Kim HC, Shin EJ, Song OP (2008) Laparoscopic repair of paraduodenal hernia: comparison with conventional open repair. Surg Laparosc Endosc Percutan Tech Dec;18(6):611-5

[304] Palanivelu C, Rangarajan M, Jategaonkar PA, Anand NV, Senthilkumar K (2008) Laparoscopic management of paraduodenal hernias: mesh and mesh-less repairs. A report of four cases. Hernia Dec;12(6):649-53

[305] Moon CH, Chung MH, Lin KM (2006) Diagnostic laparoscopy and laparoscopic repair of a left paraduodenal hernia can shorten hospital stay. JSLS Jan-Mar;10(1):90-3

[306] Antedomenico E, Singh NN, Zagorski SM, Dwyer K, Chung MH (2004) Laparoscopic repair of a right paraduodenal hernia. Surg Endosc Jan;18(1):165-6

[307] Uematsu T, Kitamura H, Iwase M, Yamashita K, Ogura H, Nakamuka T, Oguri H (1998) Laparoscopic repair of a paraduodenal hernia. Surg Endosc Jan;12(1):50-2

[308] Guillem P, Cordonnier C, Bounoua F, Adams P, Duval G (2003) Small bowel incarceration in a broad ligament defect. Surg Endosc Jan;17(1):161-2

[309] Kanbur AS, Ahmed K, Bux B, Hande T (2000) Jejunal obstruction and perforation resulting from herniation through broad ligament. J Postgrad Med Jul-Sep;46(3):189-90

[310] Nozoe T, Anai H (2002) Incarceration of small bowel herniation through a defect of the

broad ligament of the uterus: report of a case. Surg Today 32(9):834-5

[311] Agresta F, Michelet I, Candiotto E, Bedin N (2007) Incarcerated internal hernia of the small intestine through a breach of the broad ligament: two cases and a literature review. JSLS Apr-Jun;11(2):255-7

[312] Garcia-Oria M, Inglada J, Domingo J, Biescas J, Ching C (2007) Small bowel obstruction due to broad ligament hernia successfully treated by laparoscopy. J Laparoendosc Adv Surg Tech A Oct;17(5):666-8

[313] Hirokawa T, Hayakawa T, Tanaka M, Okada Y, Sawai H, Takeyama H, Manabe T (2007) Laparoscopic surgery for diagnosis and treatment of bowel obstruction: case report of paracecal hernia. Med Sci Monit Jul;13(7):CS79-82

[314] Omori H, Asahi H, Inoue Y, Irinoda T, Saito K (2003) Laparoscopic paracecal hernia repair. J Laparoendosc Adv Surg Tech A Feb;13(1):55-7

[315] Osadchy A, Keidar A, Zissin R (2005) Small bowel obstruction due to a paracecal hernia: computerized tomography diagnosis. Emerg Radiol Jun;11(4):239-41

[316] Rivkind AI, Shiloni E, Muggia-Sullam M, Weiss Y, Lax E, Freund HR (1986) Paracecal hernia: a cause of intestinal obstruction. Dis Colon Rectum Nov;29(11):752-4

[317] Kabashima A, Ueda N, Yonemura Y, Mashino K, Fujii K, Ikeda T, Tashiro H, Sakata H (2010) Laparoscopic surgery for the diagnosis and treatment of a paracecal hernia repair: Report of a case. Surg Today Apr;40(4):373-5

[318] Van der Mieren G, de Gheldere C, Vanclooster P (2005) Transmesosigmoid hernia: report of a case and review of the literature. Acta Chir Belg Nov-Dec;105(6):653-5

[319] Gandhi AD, Patel RA, Brolin RE (2009) Elective laparoscopy for herald symptoms of mesenteric/internal hernia after laparoscopic Roux-en-Y gastric bypass. Surg Obes Relat Dis Mar-Apr;5(2):144-9

[320] Proceeding of the " Il trattamento laparoscopico del laparocele. Prima Consensus Conference Italiana. Napoli 14-15 Gennaio 2010

[321] Landau O, Kyzer S (2004) Emergent laparoscopic repair of incarcerated incisional and ventral hernia. Surg Endosc 18: 1374-1376

[322] Franklin ME, Gonzalez JJ, Miter DB, Glass JL, Paulson D (2004) Laparoscopic diagnosis and treatment of intestinal obstruction. Surg Endosc 18:26-30

[323] Suter M, Zermatten P, Halkie N, Martinet O, Bettschart V (2000) Laparoscopic management of mechanical small bowel obstruction. Surg Endosc 14:478-483

[324] Grafen FC, Neuhaus V, Schob O, Turina M. Management of acute small bowel obstruction from intestinal adhesions: indications for laparoscopic surgery in a community teaching hospital. Langenbecks Arch Surg (2010) 395(1):57-63

[325] Shah RH, Sharma A, Khullar R, Soni V, Baijal M, Chowbey PK (2008) Laparoscopic repair incarcerated ventral abdominal wall hernia. Hernia 12: 457-463

[326] Szomstein S, Lo Menzo E, Simpfendorfer C, Zundel N, Rosenthal R (2006) Laparoscopic Lysis of adhesions. World J Surg 30:535-540

[327] Olmi S, Cesana G, Eba L, Croce E (2009) Emergency laparoscopic treatment of acute incarcerated incisional hernia. Hernia 3:605-608

[328] Raftopoulos I, Courcoulas AP. Outcome of laparoscopic ventral hernia repair in morbidly obese patients with a body mass index exceeding 35 kg/m2 .

[329] Kirshtein B, Roy-Shapira A, Lantsberg L, Avinoach E, Mizrahi S (2005) Laparoscopic management of acute small bowel obstruction. Surg Endosc 19:464-467

[330] Sharma A, Mehrotra M, Khullar R, Soni V, Baijal M, Chowbey PK (2008) Limited-conversion techinique: a safe and viable alteranative to conversion in laparoscopic

ventral/incisional hernia repair. Hernia 12: 367-371

[331] Lujan HJ, Oren A, Plasencia G, Canelon G, Gomez E, Hernandez-Cano A, Jacobs M (2006) Laparoscopic management as the initial treatment of acute small bowel obstruction. JSLS 10:466-472

[332] Strickland P, Lourie J, Suddleson A, Blitz JB, Stain SC (1999) Is laparoscopic safe and effective for treatment of acute small-bowel obstruction? Surg Endosc 13: 695-698

[333] Carlson MA, Frantzides CT, Shostrom VK, Laguna LE (2008) Minimally invasive ventral herniorrhaphy : an analysis of 6,266 published cases. Hernia 12:9-22

[334] Campanelli G, Catena F, Ansaloni L (2008) Prosthetic abdominal wall hernia repair in emergency surgery: from polypropylene to biological meshes. WJ Emergency Surg 3:33

[335] Parra MW, Rodas EB, Niravel AA (2010) Laparoscopic repair of potentially contaminated abdominal ventral hernias using a xenograft: a case series. Hernia DOI: 10.1007/s10029-010-0687-7, June 11, 2010

[336] Franklin ME Jr, Trevino JM, Portollo G, Vela I, Glass JL, Gonzalez JJ (2008) The use of porcine small intetsinal sub mucosa as a prosthetic material for laparoscopic hernia repair in infected and potentially contaminated fields: long-term follow up. Surg Endosc 22: 1941-1946

[337] Uranüs S, Dorr K. (2010) Laparoscopy in Abdominal Trauma Eur J Trauma Emerg Surg 36:19–24

[338] American College of Radiology: Shuman W.P., Holtzman S.R., Bree R. L., Bettmann M A, Casciani T, Foley W. D., Gay S B, , Gomes A S, Rosen M P, Sacks D, Greene F L (2005) Blunt Abdominal Trauma - ACR Appropriateness Criteria®

[339] Leppäniemi A, Haapiainen R. (2003) Diagnostic laparoscopy in abdominal stab wounds: a prospective, randomized study. J Trauma Oct;55(4):636-45.

[340] National Guideline Clearinghouse. Diagnostic Laparoscopy for trauma. Guideline Summary NGC – 6829(NCG Status: Update information was verified by the guideline developer on March 9, 2009)

[341] Choi YB., Lim KS. (2003) Therapeutic laparoscopy for abdominal trauma. Surg Endosc 17: 421–427

[342] Weinberg JA, Magnotti LJ, Edwards NM, Claridge JA, Minard G, Fabian TC, Croce MA. (2007) "Awake" laparoscopy for the evaluation of equivocal penetrating abdominal wounds". Injury Jan 38(1):60-4

[343] Stefanidis D , Richardson W S , Lily C, Earle D B. , Fanelli R D (2009) The role of diagnostic laparoscopy for acute abdominal conditions: an evidence-based review. Surg Endosc 23:16–23

[344] Warren O, Kinross J, Paraskeva P ,Darzi A (2006) Emergency laparoscopy – current best practice. World Journal of Emergency Surgery, 1:24

[345] Smith RS, Fry WR, Morabito DJ, Koehler RH, Organ CH Jr (1995) Therapeutic laparoscopy in trauma. Am J Surg 170:632–637

[346] Matthews BD, Bui H, Harold KL, Kercher KW, Adrales G, ParkA, Sing RF, Heniford BT (2003) Laparoscopic repair of traumatic diaphragmatic injuries. Surg Endosc. 17: 254–258

[347] Smith CH, Novick TL, Jacobs DG, Thomason MH (2000) Laparoscopic repair of a ruptured diaphragm secondary to blunt trauma. Surg Endosc 14: 501–502

[348] Zantut LF, Ivatury RR, Smith RS, Kawahara NT, Porter JM, Fry WR, Poggetti R, Birolini D, Organ CH Jr(1997) Diagnostic and therapeutic laparoscopy for penetrating abdominal trauma: a multicenter experience. J Trauma 42: 825–831.

[349] Mathonnet M, Peyrou P, Gainant A, Bouvier S, Cubertafond P (2003) Role of laparoscopy in blunt perforations of the small bowel. Surg Endosc 17: 641–645

[350] Fabian TC, Croce MA, Stewart RM, Pritchard F.E., Minard G, Kudsk KA (1993) A prospective analysis of diagnostic laparoscopy in trauma. Ann Surg 217: 557–565

[351] Chen RJ, Fang JF, Lin BC, Hsu YB, Kao JL, Kao YC, Chen MF (1998) Selective application of laparoscopy and fibrin glue in the failure of nonoperative management of blunt hepatic trauma. J Trauma 44: 691–695

[352] Marks JM, Youngelman DF, Berk T (1997) Cost analysis of diagnostic laparoscopy vs laparotomy in the evaluation of penetrating abdominal trauma. Surg Endosc 11: 272–2

[353] Meng X, Liu L, Jlang H (2010) Indications and procedures for second-look surgery in acute mesenteric ischemia. Surg Today Aug;40(8):700-5

[354] Brandt LJ, Boley SJ (2000) AGA technical review on intestinal ischemia. American Gastrointestinal Association. Gastroenterology May;118(5):954-68

[355] Zamir G, Reissman P (1998) Diagnostic laparoscopy in mesenteric ischemia. Surg Endosc May;12(5):390-3

[356] Menke J (2010) Diagnostic accuracy of multidetector CT in acute mesenteric ischemia: systematic review and meta-analysis. Radiology Jul;256(1):93-101

[357] Baeshko AA, Bondarchuk AG, Podymako NS, Sologub IM, Krukovich EA (2000) Laparoscopy in diagnosis of intestinal mesentery acute circulatory disturbance. Khirurgiia (Mosk), 5:18-20

[358] Paral J, Ferko A, Plodr M, Raupach J, Hadzi-Nikolov D, Dolezal D, Chovanec V (2007) Laparoscopic diagnostics of acute bowel ischemia using ultraviolet light and fluorescein dye: an experimental study.Surg. Laprosc. Endosc Percutan Tech Aug;17(4):291-5

[359] Paral J, Subrt Z, Lochman P, Ferko A, Dusek T, Slaninka I, Cecka F, Louda M, Romzova M, Jon B, Kaska M (2009) Peroperative diagnostics of acute bowel ischemia using ultraviolet light and fluorescein dye. Rozhl Chir Oct;88(10):590-5

[360] Jaramillo EJ, Trevino JM, Berghoff KR, Franklin ME Jr (2006) Bedside diagnostic laparoscopy in the intensive care unit: a 13-year experience. JSLS Apr-Jun;10(2):155-9

[361] Yanar H, Tavlloglu K, Ertekin C, Ozcinar B, Yanar F, Guloglu R, Kirtoglu M (2007) Planned second-look laparoscopy in the management of acute mesenteric ischemia. World J Gastroenterol Jun 28;13(24):3350-3

[362] Palanivelu C, Rangarajan M, Maheshkumaar GS, Rajan PS (2008) Relaparoscopy in the management of acute abdomen due to localized ischemic bowel: a novel technique--case report. Int J Surg Dec;6(6):89-91

[363] Bottger TC, Hermeneit S, Muller M Terzic A, Rodehorst A, Elad L, Schamberger M (2009) Modifiable surgical and anesthesiologic risk factors for the development of cardiac and pulmonary complications after laparoscopic colorectal surgery. Surg Endosc 23:2016–2025

[364] Jenkins ED, Yom VH, Melman L, Pierce RA, Schuessler RB, Frisella MM, Eagon JC, L. Michael Brunt, Matthews BD (2010) Clinical predictors of operative complexity in laparoscopic ventral hernia repair: a prospective study. Surg Endosc 24:1872–1877

[365] Ji YK, Cheung SS, Hong SK, Wol SJ, Hyun JK (2010) Positive end-expiratory pressure in pressure-controlled ventilation improves ventilatory and oxygenation parameters during laparoscopic cholecystectomy. Surg Endosc 24:1099–1103

[366] da Luz Moreira A, Kiran RP, Kirat HT, Remzi FH, Geisler DP, Church JM, Garofalo T, Fazio VW (2010) Laparoscopic versus open colectomy for patients with American Society of Anesthesiology (ASA) classifications 3 and 4: the minimally invasive approach is associated with significantly quicker recovery and reduced costs. Surg Endosc 24:1280–1286

[367] Valerie AL, John EC, GW Smetana (2006) Strategies To Reduce Postoperative Pulmonary Complications after Noncardiothoracic Surgery: Systematic Review for the American College

of Physicians Ann Intern Med 144:596-608

[368] Patel GN, Rammos CK, Patel JV, Estes NC (2010) Further reduction of hospital stay for laparoscopic colon resection by modifications of the fast-track care plan. Amer J Surg 199: 391–395

[369] Gerges FJ, Kanazi GE, Jabbour-Khoury SI (2006) Anesthesia for laparoscopy: a review. Journal of Clinical Anesthesia 18:67–78

[370] Gramatica JrL, Brasesco OE, Mercado Luna A (2002) Laparoscopic cholecystectomy performed under regional anesthesia in patients with chronic obstructive pulmonary disease. Surg Endosc 16(3):472-475

[371] Pursnani KG, Bazza Y, Calleja M, Mughal MM (1998) Laparoscopic cholecystectomy under epidural anesthesia in patients with chronic respiratory disease. Surg Endosc 12(8):1082-1084

[372] Azurin DJ, Go LS, Cwik JC , Schuricht AL (1996)The efficacy of epidural anesthesia for endoscopic preperitoneal herniorrhaphy: a prospective study. J Laparoendosc Surg 6(6):369–373

[373] Vaghadia H, McLeod DH, Mitchell GW, Merrick PM, Chilvers CR (1997) Small-dose hypobaric lidocaine-fentanyl spinal anesthesia for short duration outpatient laparoscopy. I. A randomized comparison with conventional dose hyperbaric lidocaine. Anesth Analg 84(1):59-64

[374] Chilvers CR, Vaghadia H, Erle Mitchell GW, Merrick PM (1997) Small-dose hypobaric lidocaine-fentanyl spinal anesthesia for short duration outpatient laparoscopy. II. Optimal dose. Anesth Analg 84(1):65-70

[375] Vaghadia H, Viskari D, Mitchell GW, Berrill A (2001) Selective spinal anesthesia for outpatient laparoscopy. I: characteristics of three hypobaric solutions. Can J Anaesth 48(3):256-260

[376] Lennox PH, Vaghadia H, Henderson C, Martin L, Mitchell GW (2002) Small-dose selective spinal anesthesia for short-duration outpatient laparoscopy: recovery characteristics compared with desflurane anesthesia. Anesth Analg 94(2):346-350

[377] Stewart AV, Vaghadi H, Collins L, Mitchell GW (2001) Small-dose selective spinal anaesthesia for short-duration outpatient gynaecological laparoscopy: recovery characteristics compared with propofol anaesthesia. Br J Anaesth 86(4):570–572

[378] Spivak H, Nudelman I, Fuco V, et al. Laparoscopic extraperitoneal inguinal hernia repair with spinal anesthesia and nitrous oxide insufflation. Surg Endosc 1999;13(10):1026-1029

[379] Hamad MA, El-Khattary OA (2003) Laparoscopic cholecystectomy under spinal anesthesia with nitrous oxide pneumoperitoneum: a feasibility study. Surg Endosc 17(9):1426-1428

[380] Naja MZ, Ziade MF, Lonnqvist PA (2004) General anaesthesia combined with bilateral paravertebral blockade (T5-6) vs. general anaesthesia for laparoscopic cholecystectomy: a prospective, randomized clinical trial. Eur J Anaesthesiol 21(6):489-495

[381] Neudecker C, Sauerlnad S, Neugebauer E, Bergamaschi R, Bonjer HJ, Cuschieri A, Fuchs KH, Jacobi Ch, Jansen FW, Koivusalo AM, Lacy A, MacMahon MJ, Millat B, Schwenk W (2002) The European Association for Endoscopic Surgery clinical practice guideline on the pneumoperitoneum for laparoscopic surgery. Surg Endosc 16:1121-1143

[382] Popken CA, Compton RP, Walter DN, Browder IW (1995) Benefits of pulmonary artery catheter and transesophageal echocardiographic monitoring in laparoscopic cholecistectomypatients with cardiac disease. Am J Surg 169:202-207

[383] Mallat AF, Mancini ML, Daley BJ, Enderson BL (2008) The Role of Laparoscopy in Trauma: A Ten-Year Review of Diagnosis and Therapeutics. The American Surgeon 74(12):1166-1170

[384] Mimica Z, Biocic M, Babic A, Banovic I, Tocilj J, Radonic V, Ilic N, Petricevic A (2001) Laparoscopic and laparotomic cholecystectomy : a randomized clinical trial comparing postoperative respiratory function. Respiration 67:153-158

[385] Koivusalo AM, Lindgren L (2000) Effects of carbon dioxide pneumoperitoneum for laparoscopic cholecystectomy. Acta Anaesthesiol Scand 44:834-841

[386] Ordemann J, Jacobi C, Schwenk W, Stösslein R, Müller JM (2001) Cellular and humoral inflammatory response after laparoscopic and conventional colorectal resections-results of prospective randomized trial. Surg Endosc 15:600-608

[387] Rauh R, Hemmerling TM, Rist M, Jacobi KE (2001) Influence of pneumoperitoneum and patient positioning on respiratory system compliance J Clin Anesth 13:361-365

[388] O' Malley C, Cunningham AJ (2001) Physiologic changes during laparoscopy. Anesth Clinics North America 19:1-19

[389] Gerges FJ, Kanazi GE, Jabbour-Khoury SI (2006) Anaesthesia for laparoscopy: a review. J Clin Anesth 18:67-78

[390] Koivusalo AM, Lindgren L (1999) Respiratory mechanics during laparoscopic cholecystectomy. Anesth Analg 89:800-806

[391] Yacoub OF, Cardona IJr, Coveler LA, Dodson MG (1982) Carbon dioxide embolism during laparoscopy. Anesthesiology 57:533-535

[392] Tan Pl, Lee TL, Tweed WA (1992) Carbon dioxide absorption and gas exchange during pelvic laparoscopy. Cand J Anaesth 39; 677-681

[393] Stuttmann R, Vogt C, Eypasch E, Doehn M (1995) Haemodynamic changes during laparoscopic cholecystectomy in the high risk patient. Endosc Surg Allied Technol 3:174-179

[394] Koivusalo AM, Kellokumpu I, Scheinin M, Tikkanen I, Mäkisalo H, Lindgren L (1998) A comparison of gasless mechanical and conventional carbon dioxide pneumoperitoneum methods for laparoscopic cholecystectomy. Anesth Analg 86:153-158

[395] Dexter SP, Vucevic M, Gibson J, McMahon MJ (1999) Hemodynamic consequences of high- and low-pressure capnoperitoneum during laparoscopic cholecystectomy. Surg Endosc 13 :376-381

[396] Nordentoft T, Bringstrup FA, Bremmelgaard A, Stage JG (2000) Effect of laparoscopy on bacteremia in acute appendicitis : a randomized controlled study. Surg Larparosc Endosc Percutan Tech 10:302-304

[397] Bloomfield GL, Ridings PC, Blocher CR, Marmarou A, Sugerman HJ (1996) Effects of increased intra-abdominal pressure upon intracranial and cerebral perfusion-pressure before and after volume expansion. J Trauma 40:936-941

[398] Valenza F, Chevallard G, Fossali T, Salice V, Pizzocri M, Gattinoni L (2010) management of mechanical ventilation during laparoscopic surgery. Best Practice & Research Clin. Anaesth. 24:227-241

[399] Almarakbi WA, Fawzi HM, Alhashemi JA (2009) Effects of four intraoperative ventilatory strategies on respiratory compliance and gas exchange during laparoscopic gastric banding in obese patients British Journal of Anaesthesia 102 (6):862–868

[400] Balick-Weber CC, Nicolas P, Hedreville-Montout M, Blanchet P, Stéphan F (2007) Respiratory and haemodynamic effects of volume-controlled vs pressure-controlled ventilation during laparoscopy: a cross over study with echocardiographic assessment. Br. J. Anaesth 99:429-435

[401] De Baerdemaeker LE, Van der Herten C, Gillardin JM, Pattyn P, Mortier EP, Szegedi LL (2008) Comparison of volume -controlled and pressure-controlled ventilation during laparoscopy gastric banding in morbidly obese patients. Obesity Surg 18:680-685

[402] Fahy BG, Barnas GM, Nagle SE, Flowers JL, Njoku MJ, Agarwal M (1996) Effects of

Trendelenburg and reverse Trendelenburg postures on lung and chest wall mechanics. J Clin Anesth 8; 236-244

[403] Gehring H, Kuhmann K, Klotz KF, Ocklitz E, Roth-Isigkeit A, Sedemund-Adib B, Schmucker P (1998) Effects of propofol vs isoflurane on respiratory gas exchange during laparoscopic cholecystectomy. Acta Anaesth Scand 42; 189-94.

[404] Merkow RP, Bilimoria KY, McCarter MD, Bentrem DJ (2009) Effect of body mass index on short-term outcomes after colectomy for cancer. J Am Coll Surg 208:53–61

[405] Scheidbach H, Benedix F, Hu¨gel O, Kose D, Ko¨Ckerling F, Lippert H (2008) Laparoscopic approach to colorectal procedures in the obese patient: risk factor or benefit? Obes Surg 18:66–70

[406] Dumont L, Mattys M, Mardirosoff C, Vervloesem N, Alle JL, Massaut J (1997) Changes in pulmonary mechanics during laparoscopic gastroplasty in morbidly obese patients. Acta Anaesthesiol Scand 41:408–413

[407] Casati A, Comotti L, Tommasino C, Leggieri C, Bignami E, Tarantino F, Torri G (2000) Effects of pneumoperitoneum and reverse Trendelenburg position on cardiopulmonary function in morbidly obese patients receiving laparoscopic gastric banding. Eur J Anaesthesiol 17:300–305

[408] Hedenstierna G, Edmark L (2005) The effects of anesthesia and muscle paralysis on the respiratory system. Intensive Care Med 31:1327–1335

[409] Hedenstierna G, Rothen HU (2000) Atelectasis formation during anesthesia: causes and measures to prevent it. J Clin Monit Comput 16:329–335

[410] Pelosi P, Croci M, Ravagnan I, Vicardi P, Gattinoni L (1996) Total respiratory system, lung, and chest wall mechanics in sedated-paralyzed postoperative morbidly obese patients. Chest 109:144–1451

[411] Putensen-Himmer G, Putensen C, Lammer H, Lingnau W, Aigner F, Benzer H (1992) Comparison of postoperative respiratory function after laparoscopy or open laparotomy for cholecystectomy. Anesthesiology 77:675–680

[412] Cunningham A, Brull S (1993) Laparoscopic cholecystectomy: anesthetic implications. Anesth Analg 76:1120-1125

[413] AL-Fozan H, Tulandi T (2002) Safety and risks of laparoscopy in pregnancy. Curr Opin Obstet Gynecol 14:375–379

[414] Hardwick RH, Slade RR, Smith PA, Thompson MH (1999) Laparoscopic splenectomy in pregnancy. J Laparoendosc Adv Surg Tech 9:439-440

[415] Demeure MJ, Carlen B, Traul D, Budney C, Lalande B, Lipinski A, Cruikshank D, Kotchen T, Wilson S (1998) Laparoscopic removal of a right adrenal pheochromocytoma in a pregnant woman. J Laparoendosc Adv Surg Tech 8(5):315-319

[416] Sagiv R, Debby A, Sadan O, Malinger G, Glezerman M, Golan A (2001) Laparoscopic surgery for extrauterine pregnancy in hemodynamically unstable patients. J Am Assoc Gynecol Laparosc 8:529–532

[417] Steinbrook RA, Brooks DC, Datta S (1996) Laparoscopic cholecystectomy during pregnancy. Surg Endosc 10(5):511-515

[418] Bhavani-Shankar K, Steinbrook RA (1998) Anesthetic considerations for minimally invasive surgery. In: Brooks DC, editor. Current Review of Minimally Invasive Surgery, ed 2. Philadelphia: Current Medicine p. 29

[419] Guidelines for laparoscopic surgery during pregnancy (1998) Surg Endosc 12(2):189-190