



South-East European Endo-Surgery

/ IMPRESSUM

ABOUT THE JOURNAL

South-East European Endo-Surgery (SEES) is a surgical journal of Bosnia and Herzegovina, founded in 2022. The intention and goal of this journal is for new ideas, knowledge and techniques from the field of endoscopic surgery and related disciplines to be available to surgeons in Bosnia and Herzegovina, but also throughout South East Europe. The journal publishes reviewed articles in the following surgical fields: abdominal, thoracic and cardio- surgery, plastic and reconstructive surgery, pediatric surgery and neurosurgery, urology and anesthesiology. However, SEES will also publish articles on open surgery in order to promote medical research and writing in South East Europe, as well as more advanced surgical techniques and technologies.

In addition, SEES publishes letters to the editor, reviews of surgical books, comments on published articles, calendars of surgical congresses and meetings, and other information from the field of surgery and related disciplines.

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REVIEW

Acute Care Surgery in the US – A Review and Personal Experience

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ABSTRACT

Acute care surgery is a new specialty created in response to the erosion of traditional general surgery and trauma surgery models. Multiple surgical societies have successfully developed the definition, designation, and training of an Acute Care Surgeon over many years. These are applicable worldwide. In the US, most larger hospital systems have successfully implemented acute care surgery, but rural and economically challenged areas remain underserved. Acute care surgeons in the US are generally employed either by the Hospital or a medical group. The profession provides a perfect work-life balance and, therefore, has become very attractive for the younger generations and surgeons who want to step down from exhausting full-time practices at the end of their careers. In the US, it is an entirely accepted specialty with dedicated and verified fellowship training.

Keywords: acut care, trauma surgery, critical care, emergency surgery.

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Introduction

About 4 million patients undergo emergency general surgery procedures annually in the US, representing about 11% of all surgical procedures and accounting for almost a quarter of overall inpatient costs according to the American College of Surgeons¹. How these patients are cared for, how the surgeons train to do so, and how they organize patient care in the hospital setting have fundamentally changed over the last 20 years and have led to the creation of a new surgical specialty: the acute care surgeon. In the United States, Acute Care Surgery is a specialty that focuses on the immediate surgical treatment of patients with acute, life-threatening injuries and conditions. It encompasses three key areas: trauma surgery, critical care, and emergency surgery²⁻⁴.

- **Trauma Surgery:** This aspect of Acute Care Surgery is concerned with the surgical treatment of injuries caused by impact forces, such as those resulting from motor vehicle accidents, falls, or acts of violence. Often working in trauma centers specially equipped for the treatment of severe trauma, trauma surgeons train to treat complex and multi-system injuries.
- **Surgical Critical Care:** This involves the care of surgical patients who are critically ill. Surgeons in this specialty manage complex physiological problems and life-supporting systems in the intensive care unit. They work closely with other specialists to provide comprehensive care to patients who are critically ill because of surgery, trauma, or other medical conditions.
- **Emergency Surgery:** This field involves the surgical treatment of urgent and emergent, non-trauma-related conditions, such as acute appendicitis, perforated bowel, or blocked blood vessels. Emergency surgeons must quickly diagnose and treat a wide range of conditions requiring immediate surgical intervention.

The subject of this paper is the evolution that led to the creation of the Acute Care Surgery specialty and

what the practice of a single surgeon in that specialty might look like today.

Evolution of the Acute Care Surgery specialty

By the early 2000s, the American Association for the Surgery of Trauma and others recognized the convergence of trauma surgery, emergency general surgery, and surgical critical care. In response to challenges such as increasing nonoperative management of trauma and work-hour restrictions for trainees, they proposed the establishment of Acute Care Surgery as a unified specialty⁵⁻¹². It would take nearly 20 years to implement the new surgical specialty.

The initial impetus came from significant changes in trauma surgeon practice. These changes reflected advances in medical knowledge, technology, and healthcare systems. The following are some of the most important developments:

Integration of surgery for the acutely ill patient: Trauma surgery underwent integration with emergency general surgery and surgical critical care into a unified model known as Acute Care Surgery. This change has catalyzed a more comprehensive approach to patient care.

Minimally Invasive Techniques (MIS): There has been an increased use of minimally invasive surgical techniques, such as laparoscopy and thoracoscopy, in the evaluation and treatment of trauma patients. The advent of MIS has forced trauma surgeons to change their skill set to resemble that of a general surgeon and, ultimately, of a minimally invasive surgeon^{13,14}.

Damage Control Surgery: The concept of damage control surgery, which performs the minimum necessary procedures to stabilize a critically injured patient before definitive surgery, has been increasingly adopted.

Trauma Systems and Protocols: There has been a greater emphasis on developing regionalized trauma systems that ensure prompt patient transport to facilities that provide the required level of care. Specific

care protocols have facilitated patient care alignment between trauma-, emergency-, and general surgeons.

Education and Training: Reflecting the increasing complexity of the specialty, trauma surgeons now receive more formalized training in trauma and critical care during their residencies and fellowships, allowing them to broaden their practice to include emergency general surgery.

Research and Evidence-Based Practice: Trauma-related research leading to evidence-based practice guidelines that improve patient outcomes has increased significantly.

Resilience and Prevention: There is a growing focus on injury prevention strategies and public health approaches to reduce the incidence and severity of trauma.

Advances in Technology: The adoption of electronic medical records, telemedicine, and improved imaging technologies have changed the workflow and increased the efficiency of trauma care. It also has allowed general and emergency surgeons to quickly adopt and integrate trauma and acute care of patients into their practice.

Multidisciplinary Collaboration: Trauma care has become more collaborative, with teams often consisting of surgeons, emergency physicians, anesthesiologists, nurses, and other healthcare professionals working closely together.

These changes have collectively improved survival and outcomes for trauma patients and continue to shape the evolving field of acute care surgery.

Changes in Surgical Decision-Making:

The increased awareness that patient outcomes may improve by delaying or declining surgical intervention has transformed the landscape of trauma and emergency surgery. The decision between operative and nonoperative treatment in managing trauma and other surgical conditions relies on several factors, including the type and severity of the injury, the patient's overall health, and the potential risks and benefits of surgery. Here

is an overview of each driver of the operative versus nonoperative approach:

Operative Treatment:

Indications:

- Life-threatening conditions that require immediate surgical intervention (e.g., internal bleeding, perforation of an organ).
- Injuries with a high risk of complications if they are left untreated (e.g., complex fractures).
- Conditions where surgery significantly improves patient outcomes.

Advantages:

- It can be lifesaving and is often the quickest way to stabilize a critical condition,
- It allows direct and definitive repair of anatomical injuries.
- It may decrease the risk of future complications or secondary procedures.

Disadvantages:

- Risk of surgical and anesthetic complications.
- It involves recovery time and may result in a more extended hospital stay.
- It may cause postoperative pain and require rehabilitation.

Nonoperative treatment:

Indications:

- Injuries that can heal naturally with time (e.g., minor fractures, specific abdominal trauma).
- High-risk patients with comorbidities or poor overall health.
- The risks of surgery outweigh the potential benefits.

Benefits:

- Eliminates surgical risks and possible anesthetic complications.

- Likely shorter hospital stays and faster return to regular activity.
- More often associated with reduced pain and discomfort.

Disadvantages:

- Some injuries may take longer to heal or not heal properly.
- Failure to detect other surgically treatable injuries.
- Need for close monitoring and follow-up to ensure proper healing.

Whether or not to operate is complex and often involves a multidisciplinary team. Factors to consider include:

Clinical guidelines: Evidence-based protocols that suggest the best course of action for specific injuries or conditions.

Patient preferences: Some patients prefer to avoid surgery, if possible, while others want a rapid resolution even if surgery is required.

Surgeon's expertise: The surgeon's experience and judgment are critical to determining the most appropriate course of treatment.

Imaging and diagnostic tests: These tests provide critical information about the nature and extent of injury.

Risk assessment: Evaluating potential risk of operative and nonoperative approaches.

Ultimately, the choice between surgical and non-surgical treatment is individualized, considering the specifics of each case to optimize patient outcomes and align with the patient's values and goals for recovery.

When confronted with an urgent acute surgical need, medical decision-making has become significantly more complex due to the availability of specialized perioperative care tailored to an aging population and the recognition that the timing of surgery or its

postponement is an essential determinant of patient outcome. As the population ages, physicians will increasingly face patients with multiple comorbidities, increasing the complexity and risk of surgery. These patients require comprehensive perioperative care that addresses not only their surgical condition but also their broader health issues. With growing disparities in health care and the health care systems increasingly pushed to their limits, patients who present later in the course of their disease are not uncommon. Delayed presentation can complicate treatment options and outcomes and narrow the window for safe and effective surgical intervention. Recognizing when not to operate has become a critical surgical skill. Understanding nuances of surgical indications and patients' ability to withstand surgery has replaced traditional views where surgery appears as the only and primary solution to many medical problems. Modern medicine now emphasizes patient-centered care, shared decision-making, and carefully weighing the risks and benefits of surgical intervention, especially for high-risk procedures. This changing approach requires a better understanding of selecting patients for surgery, with a greater emphasis on nonsurgical management when appropriate. To ensure the best possible patient outcomes, a multidisciplinary approach to care is needed, involving surgeons, geriatricians, anesthesiologists, and other specialists. Nonsurgical decision-making is thus a reflection of the more conservative and judicious use of surgery, with a focus on quality of life and individual goals of care for each patient. The recognition that neither the trauma surgeon, emergency physician, or general surgeon could provide that level of care alone led to the development of the specialty of acute care surgery. This development is seen mainly in trauma surgery. The advent of non-operative therapy for trauma patients has enticed trauma surgeons to start treating patients with critical non-trauma surgical needs in the Hospital and emergency room, with mixed outcomes due to their unfamiliarity with general surgery procedures. The landscape of general surgery practice has changed.

The progressive devaluation of the traditional general surgery practice model and fundamental changes in the expectations towards the professional core of general surgery also drove the motivation to create the specialty of acute care surgery. Several factors contributed to its decline: Surgeons are increasingly subspecializing, allowing them to focus on specific areas of interest and become highly skilled in certain procedures. Because of their focused expertise, specialized surgeons may provide better outcomes for complex procedures. As more surgeons specialize, fewer surgeons may have the broad skills traditionally associated with general surgery or are willing to perform a wide range of general surgery and at the same time be available for emergencies. Particularly in rural or underserved areas, the reluctance to be on call 24 hours a day may create challenges in providing continuous emergency surgical care. The traditional general surgery model, where a surgeon performs a wide range of procedures and is on call 24/7, is replaced by increased specialization and changing work-life expectations.

Hospitals and health systems have adapted by hiring more surgeons to cover the same on-call schedule or using hospital-based general surgeons to handle emergencies. Some health systems responded by developing in-hospital surgical teams that work in shifts to cover emergencies 24/7. These hospital-based surgeons represented the blueprint for creating the acute care surgeon specialty. The advent of telemedicine and surgical collaboratives can support general surgeons by bringing in specialists as necessary, especially in remote areas; in rural areas with unique challenges to hiring surgeons, new models of care are being explored, including the use of advanced practice providers, such as surgical physician assistants and nurse practitioners, to extend the reach of surgeons. In conclusion, the landscape of general surgery has changed due to the trend toward specialization and a focus on work-life balance¹⁵. Innovative solutions are necessary to ensure that all patients receive high-quality surgical care, including those in emergencies. While this may appear to “devalue” the traditional model of general surgery, it could

also lead to an evolution of the field towards a more modern, sustainable, and patient-centered approach to surgical care.

Societal factors driving the new specialty of acute care surgery

Broader factors are also responsible for the challenges to the disappearance of the traditional general surgery model in the US. These factors are generally affecting all medical care delivery but need to be mentioned in the context of acute care surgery^{3,16,17}.

Economic pressures: Financial considerations, including reimbursement rates, malpractice insurance costs, and hospital and insurance business models excluding independent physicians, have much reduced the viability of a general surgery practice.

Regulatory and administrative burdens: Surgeons often face significant administrative obligations and compliance requirements that overwhelm the management abilities of single independent practices.

Technological advancements: Rapid technological changes, particularly the MIS and robotic revolution, require constant learning and adaptation, which is challenging for general surgeons who must maintain a broad knowledge base.

Patient expectations: Patients often expect specialized care, which can lead to a preference for specialists, even for procedures that fall within the scope of general surgery.

Education and training requirements: Changes in surgical training, including limits on resident work hours, have resulted in less experienced surgeons completing their training. These limits have contributed to the need for specialized training for surgeons providing trauma and emergency care.

Competition from nonsurgical modalities: Many conditions that once required surgery now respond favorably to medical treatment alone or are treatable with less invasive interventional procedures, thus reducing the demand for traditional surgery.

Consolidation of healthcare systems: Consolidation of hospitals and clinics has led to centralized specialty services, reducing the role of general surgeons in specific settings.

In 2016, the American College of Surgeons distributed a survey to its Governors exploring the impact of acute care surgery on the surgical landscape¹⁸. It found that acute care surgery services positively affected healthcare delivery, such as quicker ER and inpatient consults, and improved patient outcomes. However, there were concerns about continuity of care and the quality of care due to less experienced acute care surgeons; the survey revealed that income for most non-acute care surgeons remained relatively the same with the implementation of acute care surgical services. The survey also suggested that the presence of acute care services, with their more appealing and predictable lifestyle without frequent on-call duties, could entice medical students and residents to choose a career in general/acute care surgery. Half of the surgeons participating in the survey reported being a specialist, and 36% were both a specialist and a general surgeon. Only 14% viewed themselves as being only general surgeons. Of those responding to the survey, almost half (49%) were in full academic practice, 23% in private practice, and the Hospital or a medical group employed 15%. Over two-thirds of the responders (68%) worked in hospitals with an acute care surgery team on duty.

Lastly, undeniable demographic changes in the population and workforce have raised the need for acute care surgery as a specialty in the US. The US population growth of 30% from 1981 to 2006 has far outstripped that of trained general surgeons (only 4%). These demographic changes have led to many hospitals lacking surgical coverage for acute care, and in a 2005 survey by the American College of Emergency Physicians 75% of emergency medical directors in the US reported inadequate surgical coverage. Almost one-third (29%) of the approximately 3000 counties in the 48 states do not have a general surgeon, thus creating “surgical deserts”. In 2013, 44.5% of general surgeons were aged 55

or older. Decreased reimbursement, unpredictable administration, and hostile professional liability push surgeons into early retirement¹⁹.

Acute care surgery training and certification

Acute Care Surgeons require a robust knowledge base and technical skills that enable them to manage a wide range of urgent surgical conditions. These skills include assessing and managing critically ill patients, performing emergency surgery, and providing comprehensive postoperative care. This dual competency ensures that Acute Care Surgeons can provide timely and effective care to patients facing acute surgical emergencies. The following timeline describes the process and the involved medical societies that led to the creation of an Acute Care Surgery fellowship program^{20,21}:

- 2003** Joint meeting of the American College of Surgeons, American Association for the Surgery of Trauma (AAST), Western Trauma Association, and Eastern Association for the Surgery of Trauma.
- 2005** AAST to reorganize the specialty of Trauma, Surgical Critical Care, and Emergency Surgery
- 2006** AAST renames committee - Acute Care Surgery Committee
- 2007** Institute of Medicine confirms a shortage of on-call specialists.
- 2008** AAST develops curriculum, competency tools, case registry, certification criteria, and site visits.
- 2014** First AAST Acute Care Surgery Fellowship Program
- 2018** Establishment of a longitudinal/experiential model with case minimum requirements

The establishment of the Acute Care Surgery fellowship program in 2014 responded to the need for a specialized approach to emergency surgical

care, including trauma and critical care. Acute care surgery has become a defined specialty with dedicated training programs, fellowships, and a focus on improving patient outcomes for emergent surgical conditions. The model has been widely adopted and integrated into US healthcare systems to ensure that high-quality, timely care is available for patients with urgent surgical needs. The benefits of acute care surgeons are essential to the functioning of Hospital-based medicine and include immediate availability of surgeons in emergencies, expertise in managing complex trauma and critical care cases, optimal coordination for the care of acutely ill surgical patients, improved patient outcome through efficient care, and 24-hour surgical support for other departments in Hospitals.

With the formalization of the specialty, training programs were developed. Initially, surgeons interested in ACS would typically complete a general surgery residency followed by trauma surgery and surgical critical care fellowships. However, newly developed integrated ACS fellowships offer comprehensive training in all aspects of the discipline.

Figure 1 describes the five pillars of Acute Care Surgery conceived by the American College of Surgery. Of note is the fifth pillar: surgical rescue. Taking care of hospitalized surgical patients with acute post-operative complications is an undervalued benefit of having a hospital-based team available². The Acute Care Surgeon is vital in supporting other providers and directing patient care in the ‘surgical rescue’ of complications.

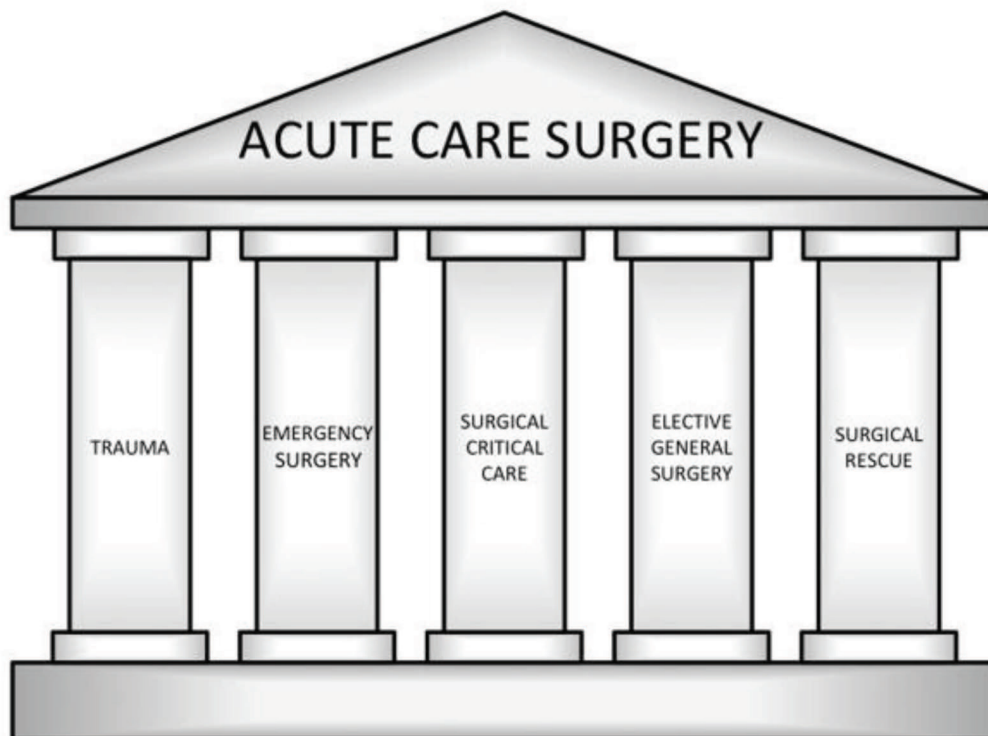


Figure 1. This figure shows the five pillars of Acute Care Surgery. Note the fifth pillar, named “surgical rescue”. Surgical rescue is an essential and often underrecognized aspect of Acute Care Surgery.

Acute Care Surgery Fellowship

The Acute Care Surgery Fellowship is an advanced training program after completing a general surgery residency. The fellowship usually includes traumatology, surgical critical care, and public emergency surgery. Fellows receive extensive clinical experience, often in high-volume centers, to hone their skills in managing critically ill and injured patients. In addition to research and teaching opportunities, the curriculum typically includes rotations in critical care, trauma, and emergency surgery. The fellowship aims to prepare surgeons for leadership roles in acute surgical care.

As a specific example, here is a description from the University of Texas Houston Acute Care Surgery fellowship program²²:

Year One: Trauma and Acute Care Surgery. Rotations in Trauma, Emergency General Surgery, HPB/transplant, Interventional Radiology and Cardiovascular. Complex abdominal wall reconstruction, EMS/pre-hospital trauma systems, and research months. Additional vascular and thoracic experience is available.

Year Two: Traditional Critical Care. 4 to 6 months in Shock-Trauma ICU and one month in the Burn ICU, MICU, Advanced Airway with Anesthesia, Advanced Trauma/Critical Care Ultrasound, and Research. IVC filters, bronchoscopy, endoscopy, percutaneous tracheostomy, transesophageal echocardiography for resuscitation, and other ICU procedures.

The study by Van der Wee et al. describes worldwide Acute Care Surgery models²³. Specific to North America 18 studies describing Acute Care Surgery models are listed, most of which identify a dedicated service with daytime on-site attending coverage supported by trainees. Most models provide trauma and critical care. Eight studies describe protected operating room time. Less than half also provided emergency department coverage.

In 2023, the American College of Surgeons launched a program to verify Acute Care Surgery training programs based on Optimal Resources for Emergency

General Surgery standards and the ACS National Surgical Quality Improvement Program registry (NSQIP)^{1,16,11}. This Emergency General Surgery Verification Program (EGS-VP) establishes emergency general surgery standards and ensures necessary resources and protocols to provide quality hospital care. The program includes a rigorous evaluation process verifying hospitals using specific criteria related to patient care, surgical resources, and quality improvement measures in emergency general surgery. The proposed review process to audit verification criteria would be like that currently in place for the certification of trauma centers. The requirements discussed include triaging patients across the spectrum of needs, standards for both timeliness and team availability, and the record of clinically relevant Emergency General Surgery (EGS) data to drive quality improvement. In addition, a new EGS-focused NSQIP-targeted registry module and a multidisciplinary approach to care and quality are being developed.

The Hospital of the University of Pennsylvania, the University of Kansas Health System, the University of Wisconsin UW Health, Riverside University Health System Medical Center, California, and the JPS Health Network, Texas, are the first five certified EGS-VP programs in the US.

Despite the clear advantages of Acute Care Surgery teams in the care of hospitalized patients and the perceived inadequacy in providing emergency care in the US, penetration of the acute care surgery model is not perfect. Figure 2 shows that many Hospitals, especially in rural regions of the US, lack 24-hour access to critical surgical care²⁰. A survey of 1690 acute care hospitals on implementing acute care surgery published in 2018 showed that only 272 hospitals had implemented acute care surgery by 2-15. Rural and less educated areas were especially underserved¹³.

In summary, Acute care Surgery has become a recognized and respected specialty. It fulfills an essential role in patient care of trauma centers, emergency departments, and intensive care units across the



Figure 2. US acute care general hospitals that do (red circles; 1355) and do not (green squares; 279) provide 24-hour critical care surgery.

spectrum of academic centers and rural hospitals. Further refinement of Acute Care Surgery training, research, and best practices is needed to improve outcomes for acutely ill surgical patients. These refinements are particularly pertinent for surgical access in rural areas.

Personal Experience as an Acute Care Surgeon

I have worked as an acute care surgeon in 5 different small-town critical care hospitals across California and Texas.

Most emergencies that require an acute care surgeon are abdominal conditions including, but not limited to, acute appendicitis, cholecystitis, diverticulitis, pancreatitis, intestinal obstruction, intestinal ischemia, intra-abdominal sepsis, incarcerated hernias, and perforated internal organs.

Our acute care team of 3 full-time and one part-time acute care surgeon comes from very different training backgrounds: trauma, general surgery, colorectal,

and oncologic surgery. We average 500-600 cases per year, of which approximately 30% are appendectomies, 30% cholecystectomies, and 10% hernias of all kinds; in addition, 10% deal with complex wounds/abscesses, and 5% each with colectomies, intestinal perforations, and trauma. Other procedures, such as thoracic drainage and lysis of adhesions, comprise the remaining 10%. The case types range from simple abscess drainage to emergent en bloc resections for perforated cancer in general surgery and from chest tube drainage to gunshots to the heart, liver, or pancreas in trauma. Each acute care surgeon covers approximately ten 24-hour monthly shifts to cover the hospitalized patients and the emergency department for consultations and surgical emergencies. The on-call surgeon might call in a colleague for help at any time. Excellent collegiality and flawless patient sign-outs are essential for this model to function. Any communication breakdown is potentially disastrous for the patient.

A successful acute care surgeon must make good decisions based on poor information, whether from a doctor or a nurse. He also needs to be able to

make life and death decisions without help and with limited information and be ok with the outcomes, adapt his skills to the ability of the Hospital to care for patients, always consider transfer to a higher level of care, and recognize the urgent need for timely surgical intervention at any time of day or night. Furthermore, the surgeon must excel at problem-solving, think quickly, be confident in his skills and knowledge, and be humble enough to know when to call for help. Trusting another colleague who takes over the care of a personal patient is essential. So is skillful professional communication and managing expectations by colleagues and patients. An acute care surgeon should learn to work closely, be helpful to Medical Hospitalists and other consultants, and feel comfortable with rescue surgery and management of surgical complications.

Conflict of interests

The author has no relevant financial or non-financial interests to disclose.

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References

1. <https://www.facs.org/for-medical-professionals/news-publications/news-and-articles/press-releases/2023/emergency-general-surgery-verification-program-verifies-first-five-hospitals/>
2. Kutcher ME, Sperry JL, Rosengart MR, Mohan D, Hoffman MK, Neal MD, Alarcon LH, Watson GA, Puyana JC, Bauzá GM, Schuchert VD, Fombona A, Zhou T, Zolin SJ, Becher RD, Biliar TR, Forsythe RM, Zuckerbraun BS, Peitzman AB. Surgical rescue: The next pillar of acute care surgery. *J Trauma Acute Care Surg.* 2017;82:280-286. doi: 10.1097/TA.0000000000001312.
3. Kashuk JL, Klein Y, Bacchus H, Kluger YS. Acute care surgery: what's in a name? A new specialty comes of age. *Isr Med Assoc J.* 2013;15:147-51.
4. Richardson JD, Spain DA, Livingston DH. Trauma and acute care surgery: The evolution of a specialty. *J Trauma Acute Care Surg.* 2022 Feb 1;92(2):242-249. doi: 10.1097/TA.0000000000003456.
5. Institute of Medicine of the National Academies. Hospital-based emergency care at the breaking point. Washington (DC): The National Academy Press; 2007.
6. Green SM. Trauma surgery: discipline in crisis. *Ann Emerg Med.* 2009;53:198-207. doi: 10.1016/j.annemergmed.2008.03.023.
7. Richardson JD, Miller FB. Is there an ideal model for training the trauma surgeons of the future? *J Trauma.* 2003;54:795-7. doi: 10.1097/01.TA.0000056156.20400.E5.
8. Esposito TJ, Rotondo M, Barie PS, Reilly P, Pasquale MD. Making the case for a paradigm shift in trauma surgery. *J Am Coll Surg.* 2006;202:655-67. doi: 10.1016/j.jamcollsurg.2005.12.008.
9. Moore EE. Acute care surgery: the safety net hospital model. *Surgery.* 2007;141:297-8.
10. Committee to Develop the Reorganized Specialty of Trauma Surgical Critical Care and Emergency Surgery. Acute care surgery: trauma, critical care, and emergency surgery. *J Trauma.* 2005;58:614-6.
11. Jurkovich GJ. Training in trauma and emergency surgery. *Am Surg.* 2007;73:157-60.
12. Jurkovich GJ, Davis KA, Burlew CC, Dente CJ, Galante JM, Goodwin JS 2nd, Joseph B, de Moya M, Becher RD, Pandit V. Acute care surgery: An evolving paradigm. *Curr Probl Surg.* 2017;54:364-395. doi: 10.1067/j.cpsurg.2017.05.001.
13. Mandrioli M, Inaba K, Piccinini A, Biscardi A, Sartelli M, Agresta F, Catena F, Cirocchi R, Jovine E, Tugnoli G, Di Saverio S. Advances in laparoscopy for acute care surgery and trauma. *World J Gastroenterol.* 2016;22:668-80. doi: 10.3748/wjg.v22.i2.668.

14. Ietto G, Amico F, Pettinato G, Iori V, Carcano G. Laparoscopy in Emergency: Why Not? Advantages of Laparoscopy in Major Emergency: A Review. *Life (Basel)*. 2021;11:917. doi: 10.3390/life11090917.
15. Søreide K. Trauma and the acute care surgery model--should it embrace or replace general surgery? *Scand J Trauma Resusc Emerg Med*. 2009 Feb 4;17:4. doi: 10.1186/1757-7241-17-4
16. Ross SW, Reinke CE, Ingraham AM, Holena DN, Havens JM, Hemmila MR, Sakran JV, Staudenmayer KL, Napolitano LM, Coimbra R. Emergency General Surgery Quality Improvement: A Review of Recommended Structure and Key Issues. *J Am Coll Surg*. 2022;234:214-225. doi: 10.1097/XCS.0000000000000044.
17. Knowlton LM, Minei J, Tennakoon L, Davis KA, Doucet J, Bernard A, Haider A, Scherer LRT 3rd, Spain DA, Staudenmayer KL. The economic footprint of acute care surgery in the United States: Implications for systems development. *J Trauma Acute Care Surg*. 2019;86:609-616. doi: 10.1097/TA.0000000000002181.
18. <https://bulletin.facs.org/2017/05/2016-acs-governors-survey-will-acute-care-surgery-change-the-surgical-landscape/> 2016 Juan C. Paramo, MD, FACS, et al.ACS Governors Survey: Will acute care surgery change the surgical landscape?
19. Bernard A, Staudenmayer K, Minei JP, Doucet J, Haider A, Scherer T, Davis KA. Macroeconomic trends and practice models impacting acute care surgery. *Trauma Surg Acute Care Open*. 2019;4:e000295. doi: 10.1136/tsaco-2018-000295. PMID
20. Geographic Diffusion and Implementation of Acute Care Surgery An Uneven Solution to the National Emergency General Surgery Crisis Jasmine A. Khubchandani, MD, et al. *JAMA Surg*. 2018;153:150-159.
21. <https://www.aast.org/acute-care-surgery-overview>
22. (<https://med.uth.edu/surgery/education/fellowship/acute-care-surgery-surgical-critical-care-trauma-fellowship-programs/>)
23. van der Wee MJL, van der Wilden G, Hoencamp R. Acute Care Surgery Models Worldwide: A Systematic Review. *World J Surg*. 2020;44:2622-2637.

REVIEW

TEP, STEP BY STEP

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ABSTRACT

TEP is endoscopic surgery, recommended by many associations as the method of choice in the treatment of primary unilateral inguinal hernias. However, due to the limitations of space, and the complexity of the anatomy of the posterior wall of the inguinal region, it involves a somewhat steeper learning curve. Some steps in the surgical procedure are not simple, therefore we would like to point out and explain the more difficult aspects of dissection during a TEP, and facilitate the acceptance of this excellent technique in the repair of inguinal hernias.

Keywords: inguinal hernia, laparoscopic total extraperitoneal, mesh repair

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Introduction

TEP, or the total extraperitoneal laparoscopic technique for repair of hernias, is an endoscopic technique that follows the principles of the Stoppa technique, which consists of strengthening the abdominal wall using a mesh within the preperitoneal space, in order to completely cover the entire myopectineal orifice¹.

In order to perform TEP we have to understand the anatomy of the myopectineal orifice.

The Anatomy of the Myopectineal Orifice

The concept of a critical view of the myopectineal orifice has been introduced to help us better understand the anatomy of the posterior inguinal wall². We can define it as the appropriate exposure of the anatomical area which must be undertaken before placing the mesh itself.

The Y concept and the 5-triangle concept (Figure 1) serve as guides for safe laparoscopic and robotic repair of inguinal hernias³.

Therefore, it is very important to visualize the lower epigastric vessels, which are located vertically in the field of vision (they help a beginner in orientation using the top to bottom line), and the Y concept indicates the position of the vas deferens and the spermatic vessels. The epigastric blood vessels divide the parts of the lateral and medial inguinal fossa, the place where direct and indirect hernias occur. Beneath the iliopubic tract is the site where femoral hernias occur, and the doom triangle, which we must always be wary of.

It is very helpful to divide the operating field into 3 zones (Figure 2). Zone 1 corresponds to the area from the lateral to the deep inguinal ring and the spermatic vessels, Zone 2 is from the medial line to the lower epigastric vessels, and Zone 3 is the operating field that requires particular care, because it includes the lower epigastric vessels, the deep inguinal ring and the spermatic elements, and the external iliac blood vessels⁴.

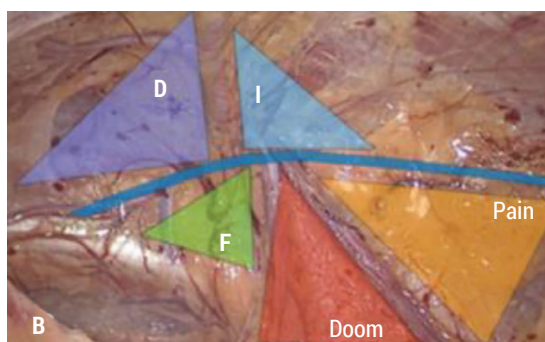


Figure 1: A. Inverted Y: inferior epigastric vessels (red— superiorly), vas deferens (white—medially), and spermatic vessels laterally (blue—laterally); B. Iliopubic tract (represented in dark blue) that passes horizontally through the deep inguinal ring at the center of the inverted Y and enables visualization of five areas in the MPO known as the “Five Triangles” (Right groin).

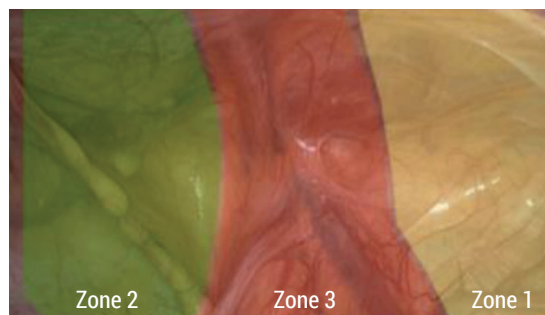


Figure 2: Three zones of dissection of the pre-peritoneal space following the tactical proposal for standardization of MIS techniques (Right groin).

In TEP dissection, Zone 2 is created either by the trocar balloon or by blunt dissection using a telescope, and this is followed by dissection Zone 1. Dissection Zone 3 or the central zone is created

last because it is the most important and the most difficult part of the surgical procedure.

After dissection of these three zones we are able to visualize the elements of the myopectineal orifice.

We define the 9 vital steps to establish a CV of the MPO as follows⁵:

1. Across the midline and Cooper ligament (CL), visualize and dissect the pubic tubercle. If the hernia is large and direct, the dissection should be right up to the contralateral CL.
2. Ensure it is not a case of a direct hernia. In order to notice a direct hernia before dissection, consider the anatomy. If there is any excess fat in the Hasselbach triangle, remove it.
3. In order to avoid mesh displacement when the bladder distends, dissect no less than 2 cm between the CL and the bladder to ease insertion of the medial and inferior edges of the mesh towards the space of Retzius
4. In order to identify the femoral orifice and ensure there is no femoral hernia, dissect between the CL and the iliac vein.
5. To parietalize the elements of the cord, dissect the indirect sac and the peritoneum. To avoid missing any tail on the sac, note the psoas muscle and iliac vessels, lift the sac and peritoneum, but avoid moving the elements of the cord and dissect between them.
6. Visualize and reduce cord lipomas. In most cases it is not necessary to remove lipomas, but they should be moved above the mesh to stop them moving upward.
7. The peritoneum should then be dissected laterally, along the elements of the cord, beyond the ASIS (the anterosuperior iliac spine), moving it back inferiorly, a good distance from the inferior edge of the mesh.
8. The dissection should now be performed, the mesh placed as cover, and then it is necessary to make sure the mesh and its fixation are well above

the imaginary inter-ASIS line and any defects that may be present, to prevent recurrence and injury to the nerves, especially the iliolumbar nerve.

9. The mesh should not be placed until all these procedures are complete and hemostasis is confirmed. The mesh should be no less than 15 x 10 cm, but occasionally it is necessary to use a larger mesh in order to cover the MPO. Ensure there are no folds or creases. Make sure the lateroinferior corner is inserted deep on the wall, and that it will not roll up when the space is deflated.

Implementing the CV of the MPO concept through education and training will standardize MIS inguinal hernia repair and facilitate teaching of this excellent technique.

Indications

The open Lichtenstein and endoscopic technique are recommended in the European Hernia Society (EHS) guidelines as the option with the best evidence for repair of a primary unilateral inguinal hernias, providing the surgeon is sufficiently experienced in the specific procedure, but also by American Hernia Society, and the Society of American Gastro-intestinal and Endoscopic Surgeons SAGES⁶⁻⁸.

TEP is the method of choice in women, since they have a greater risk of recurrence than men after open surgery for inguinal hernias, due to the greater incidence of femoral hernias.

For experienced surgeons, the endoscopic technique can also be used for incarcerated hernias in the absence of contamination of the surgical field. Diagnostic laparoscopy at the beginning of the procedure enables examination and an attempt to reduce the hernia content under visual control¹. In fact, after a period of reperfusion, it is possible to repeat exploration of the compromised intestine, which may reduce the need to resect the bowel.

TEP is probably the most cost-effective method for employed patients, especially for bilateral hernia⁹. Moreover, for recurrent hernias after conventional

open procedures, the endoscopic technique results in less post-operative pain and faster recovery than the Lichtenstein technique¹⁰.

TEP completely avoids entry into the abdomen, which can be an advantage in patients who have undergone previous surgery. TEP also avoids the problem of peritoneal closure and problems related to closure. TEP can also be performed without using electrocauterization, which leads to less post-operative pain. Using TEP it is possible to explore the possible existence of femoral, obturator and direct hernias, which are difficult to recognize by viewing from the peritoneal side¹¹.

However, the TEP technique is more difficult to learn because of the limited working space, differences in anatomical characteristics (we can say that it is difficult because of the failure to emphasize when teaching anatomy, the anatomical landmarks which are important for performing this procedure).

The learning curve related to this surgery is 50-65 operations¹²⁻¹⁴, but we are sure that a young surgeon who performs standard laparoscopic appendectomy and cholecystectomy will have a shorter learning curve than that given in the literature.

Contraindications

The contraindications are: previous surgery in the lower right or left quadrant, prostatectomy, classical appendectomy, surgical procedures that prevent the creation of a preperitoneal space due to the rupture of the peritoneum itself, and large irreducible scrotal hernias^{1,11}.

The technique

Patient Position and Room Set Up

The patient is on their back in the Trendelburg position, which enables the bowels to move away from the pelvis, and the surgeon stands on the opposite side to the hernia. It is necessary to insert a Foley catheter in order to liberate the preperitoneal space (alternatively the patient can empty their bladder

immediately before the procedure). The monitor stands at the foot of the operating table.

Surgical Steps

1. Create an incision in the skin immediately below the umbilicus. After cutting the skin and the subcutaneous tissue by electrocautery, we reach the anterior sheath of the rectus muscle. After opening the sheath on the same side as the hernia, by pulling the rectus laterally we reach the posterior sheath of the rectus muscle (Figure 3).

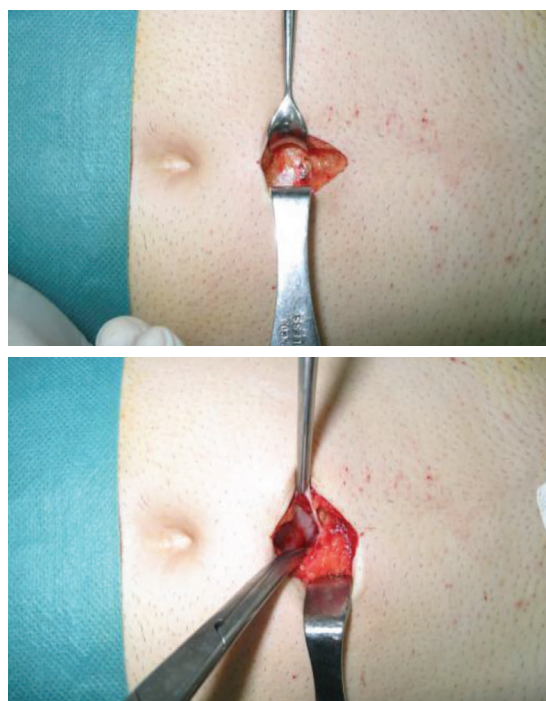


Figure 3: A. Incision in the skin immediately below the umbilicus. B. After opening the sheath of the rectus muscle on the same side as the hernia, by pulling the rectus laterally we reach the posterior sheath of the rectus muscle.

In the posterior of the sheath we can place a swab, a finger or a pean clamp, and gently move towards the symphysis.

2. We then insert the dilation balloon in the space towards the symphysis, and inflate the dilator moderately, monitoring the inflation or widening of the inguinal space (Figure 4). We must not inflate the space excessively because this may cause the rupture of the peritoneum, which would prevent us from creating a working space and performing the TEP procedure.



Figure 4: The dilation balloon.

Creation of this space may also be achieved using the camera alone, without the balloon dilation, that is, under direct control. We make a blunt dissection of the retromuscular space up to the pubic symphysis.

Mistakes in preparation and presentation of the posterior rectus sheath lead to the opening of the peritoneum and entry into the peritoneal cavity (Figure 5).



Figure 5: Opening the peritoneum.

3. After preparation of the working area with balloon dilation, we place a 12 mm trocar with a cuff. It is better to use a trocar with a cuff, but in countries with limited resources, we can use a standard 12 mm trocar, and close the incision using sutures.
4. We begin insufflation with CO₂ up to 12 mmHg pressure. As we have said, the patient is in the Trendelburg position. It is better to use a 10 mm camera at an angle of 30°. We enter the space we have created with the camera. We must not be afraid of unfamiliar images, but gently, using the camera, break up any growths we may see (Figure 6).

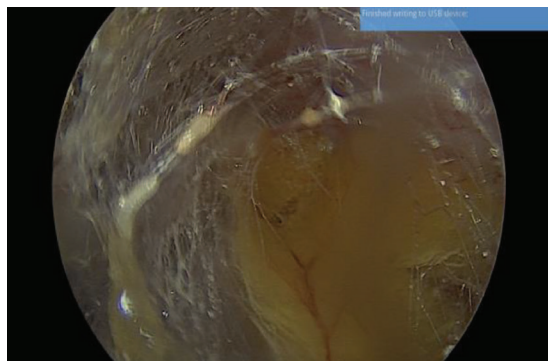


Figure 6: Entering the space we have created using a dilation balloon.

5. We then place two additional trocars in the central line under direct vision: one 5 mm trocar above the symphysis, and the other in the middle between that one and the camera (Figure 7). During this step and the further dissection, care should be taken not to damage the epigastric vessels.



Figure 7: Positions of the trocars.

Alternative Trocar Positions

The first trocar is made just below the navel on the contralateral side of the hernia (then a 10 mm trocar is inserted bluntly), a second reusable 5 mm trocar is inserted under direct vision about three finger widths directly below the first trocar. The 3rd trocar, also 5 mm and reusable, should ideally be inserted at the level of the navel, cranially and medially to the anterior superior iliac spine).

Instrumentation

All dissections are performed through the 5 mm trocar, 30% camera.

6. Dissection to Bogros' Space. In order to find the right plane, it may be necessary to cut through some of the fibers of the arcuate line of Douglas. The correct plane for preperitoneal dissection is easy to find thanks to the appearance of the so-called "angel hair". Dissection is performed immediately laterally and as close as possible to the anterior abdominal wall, between the hernia sac below and the epigastric vessels above. Also laterally, it is very important to remain in this plane. Dissection continues bluntly towards the lateral abdominal wall and the anterior superior iliac spine. This may be confirmed by lateral transillumination. Remain in this plane and do not dissect the lateral abdominal wall itself. Dissect all growths as close as possible to the navel and move them laterally. The purpose here is to remove the peritoneum from the posterior rectal sheath sufficiently to leave enough space for the upper edge of the mesh. Finally we have a view of the anatomy of the extraperitoneal space (Figure 8).

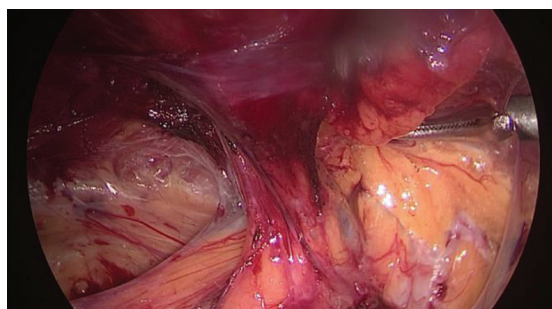


Figure 8: View of the posterior abdominal wall after creation of the space.

7. We perform an inspection of the inguinal space, identify the medial umbilical ligament (the remnant of the urachus), the medial umbilical ligament (the remainder of the umbilical artery) and the epigastric inferior artery, which is the most important marker. We use it for orientation up and down, where it must be vertical on the monitor image.

The epigastric artery divides the medial inguinal fossa, the site where direct hernias occur, and the lateral inguinalis lateralis, the site where indirect hernias occur (Figure 9).

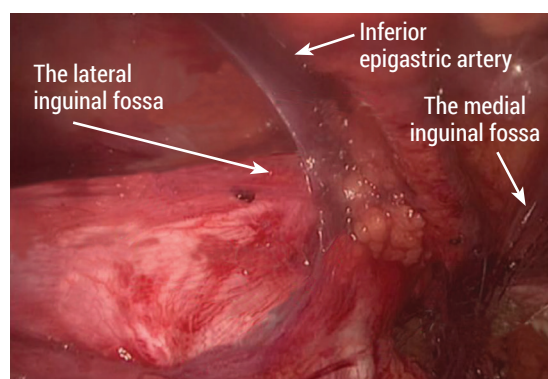


Figure 9: The epigastric artery with the sites of formation direct and indirect hernias.

After this, we prepare the structures of the funiculus and separate the indirect hernia sac (Figure 10).



Figure 10: An indirect hernia sac separated from the structures of the funiculus.

We can dissect the herniated sac in congenital or large inguinal-scrotal hernias. The proximal end is ligated, separated from the funiculus and dissected, and then pulled back (Figure 11).

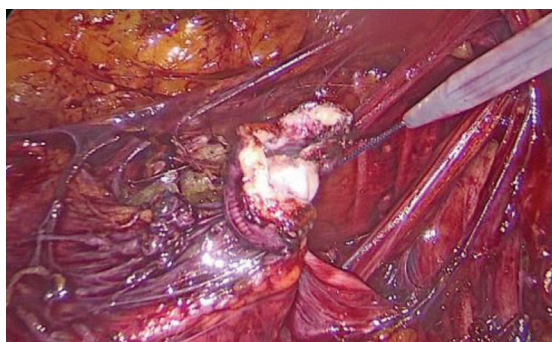


Figure 11: Proximal end of a hernia sac.

We find direct hernias medially to the epigastric blood vessels. In the case of direct hernias, very often the mere creation of extraperitoneal space leads to resolution of a direct hernia. If a direct hernia is present, we withdraw the preperitoneal fatty tissue and separate it from the accentuated fascia of the direct space.

8. A large mesh is placed 10 cm craniocaudally and 15 cm mediolaterally, in order to conceal the myopectineal orifice (Figure 12). Direct, indirect and femoral triangle should cover with an overlap of at least 3 to 4 cm.

The mesh should reach the pubic symphysis medially and the anterior-superior iliac spine (ASIS) and m. iliopsoas laterally. In a direct hernia, it is desirable for 1 to 2 cm of mesh to pass over to the contralateral side to achieve a minimum of 3 cm of medial overhang from the direct defect. Inferiorly, it must reach 1 to 2 cm below the pubis and superiorly cover 3 to 4 cm of the anterior abdominal wall in relation to the deep inguinal ring.

The surgeon must ensure that the peritoneum has not been left behind the mesh, in order to avoid it folding and/rolling up during evacuation of the gas. A medial mesh should be placed between the pubic bone and the urinary bladder in the Retzius space, laterally to the iliopsoas. The mesh must be placed without puckering or overlap.

It is possible to fix the mesh in several ways, but in most hernias, fixation is not needed.

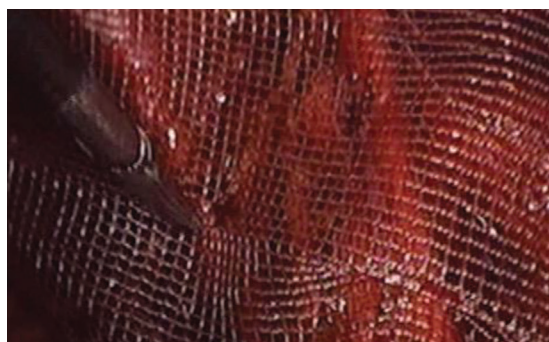


Figure 12: The mesh placed in the extraperitoneal space.

Fixation of the mesh is only recommended in large, and especially direct hernias. If we decide on fixation using a stapler, tacks or sutures, the recommendations are:

- Avoid the bone structures, placement of tacks must be above the pubic bone, in the Cooper's ligament, avoiding the risk of chronic osteitis.
- Take care of the inferior epigastric vessels.
- Fixation should avoid the space below the ilio-pubic tract and potential injuries to the triangle of doom.
- Five or six points are sufficient for efficient fixation of the mesh.
- Bimanual palpation of the abdominal wall is useful while we fix the mesh.

It is important to underline that fixation of the mesh with tacks, sutures, glue, or if we use self-fixing mesh, does not protect us from the problems of unsuitable dissection or incorrect placement of the mesh.

Conversion

The reasons for conversion may be laceration of the peritoneum, or vascular incidents. In smaller lacerations of the peritoneum, it is possible to place a Veress needle in Palmer's point, which maintains the creation of the preperitoneal space. Individually, small lacerations can be closed using a stapler or sutures.

Conversion of TEP may be into a TAPP, Stoppa or Lichtenstein procedure, depending on the surgeon's preference.

Learning Curve

Since the working space in the TEP procedure is limited, it requires a higher level of skill in manipulating the instruments for tissue dissection. Although the data on the TEP learning curve are limited, the guidelines suggest that the range is between 50-65 operations²⁻¹⁴.

The careful choice of patients is the first key step in mastering the learning curve¹⁵. The rate of complications and speed of learning the TEP technique can be improved by setting good patient selection criteria¹⁴.

Use of the TEP in all patients is not a good strategy for surgeons who are still in the process of learning. We need to follow the relative contraindications for TEP, which are as follows: previous TEP herniorrhaphy, a massive scrotal hernia, previous pelvic surgery, and incarcerated inguinal hernia.

Moreover, it has been shown that a patient with a BMI above 25kg/m² is a factor which may lead to technical difficulties during the learning period¹⁶. Therefore, we recommend the careful choice of patients in order to facilitate the introduction of beginners to the TEP procedure. Beginner surgeons build their experience by observing and imitating operations performed by an experienced surgeon.

Complications

As in any laparoscopic procedure, any of the complications of laparoscopy may occur, such as injury to the major blood vessels or hollow organs, or complications related to anesthesia.

Vascular Injuries

Cause and Prevention

Injuries to the inferior epigastric arteries are mentioned in the literature, but they are very rare¹⁷. Anatomical variations or confusion when creating the preperitoneal

space, in combination with a lack of experience, especially if the patient has had previous surgery in the lower quadrant, can lead to these lesions. Ligation with a 5 mm stapler will stop the bleeding.

Injury to the iliac blood vessels are possible for the same reasons. They must be repaired, which is best done in an open procedure due to the limited working space.

Recognition and Management

Bleeding is easily recognized during the surgical procedure. Delayed bleeding is manifested in the signs of haemorrhagic shock.

Urinary Complications

Cause and Prevention

Urinal retention, infection and hematuria are mentioned most often, along with injuries to the urinal bladder. They are usually the result of extensive preperitoneal dissection. Bladder injuries are most likely to occur during port placement, or when dissecting a large direct hernial sac¹⁸.

This is why previous surgeries in this area, especially prostate surgery, are considered to be relative contraindications.

Recognition and Management

Urinary catheterization and antibiotic therapy resolve the problems related to retention or infection. If any injury to the urinary bladder has occurred during the surgery, repair of the bladder is vital, whether by laparoscopy or an open method.

Pain in the lower quadrant of the abdomen, a distended bladder visible on ultrasound, dysuria, and hematuria need investigating. Placing a catheter alone may be sufficient in cases of retroperitoneal injuries to the bladder, but intraperitoneal injuries are best sutured by laparoscopy or laparotomy.

Nerve Injuries

Cause and Prevention

The femoral branches of the genitofemoral nerve and the lateral cutaneous nerve are at risk of injury, most often due to poor assessment of the anatomy of the

posterior aspect. The causes for this are difficulties in visualization of the nerves preperitoneally, variations in the course of the nerves in this region, and extensive preperitoneal dissection.

Recognition and Management

Symptoms of pain and numbness usually develop over a certain period after the surgery. In most cases, non-steroid anti-inflammatory drugs are sufficient. The need for re-exploration and removal of staplers is rare.

Testicular Complications and Damage to the Vas Deferens

Cause and prevention

Most of these complications are transitory and include pain in the testes, swelling, orchitis and epididymitis. Pain in the testes may be caused by trauma to the gentiofemoral nerve, or sympathetic innervation during dissection around the funiculus or during the separation of the hernial sac from the structure of the funiculus. A swollen testis may be due to ischemia, or interruption of the lymphatic blood vessels or veins during removal of a large indirect hernia sac.

Very rarely, in the case of large inguinal-scrotal hernias, a transient pneumoscrotum may occur.

Recognition and Management

Most of these cases can be treated with analgetics, and by limiting activity. If the vas preferens has been dissected, repair using individual 4/0 sutures is recommended.

Mesh-Related Complications

Cause and Prevention

Migration and infection of the mesh
 Fixation of the mesh prevents its migration.

Recognition and Management

Complications occur weeks or years after the surgery in the form of abscesses or fistulas. They rarely

respond to conservative treatment and require an open approach.

Mesh infections are a very rare but serious complication of TEP. The source of infection is direct or indirect contamination of the wound. Most of the causes of mesh infection after laparoscopic surgery are inadequate sterilization techniques.

In rare cases, the patient has a fever, temperature, local sensitivity, redness and a swelling. Later symptoms may be chronic, recurrent or completely absent, and signs of sepsis.

Treatment of the infection include administration of antibiotics, local dressing of the wound and drainage. In deep infections, antibiotic therapy is indicated, in combination with percutaneous or open drainage. However, in a severe infection with limited penetration of medication into the infected regions, removal of flesh and extensive toilet of the infected region is the only option. This should be undertaken as soon as possible.

Hernia Recurrence

Cause and Prevention

Careful complete dissection of the preperitoneal space, including placement of a large mesh that covers the entire myopectineal space completely, without cutting or puckering of the mesh, is the best way to prevent recurrence. The causes are many and various: incomplete dissection, too small mesh, incomplete coverage of all defects, migration of the mesh, puckering or invagination of the mesh into the defect, and a hematoma causing the mesh to shift (Table 1).

Table 1. The causes of hernia recurrence

1	Incomplete dissection Inadequate identification of anatomical elements. The mesh curves instead of lying flat.
2	The mesh is too small Incomplete coverage of all defects
3	Bending or invagination of the mesh into the defect
4	Displacement of the mesh by a hematoma

Recognition and Management

Recurrence is noticed by the patient and doctors as a swelling in the groin. Repeat laparoscopic repair is indicated if the surgeon has sufficient experience to perform it, or otherwise conventional surgery should be performed.

Rare Complications

Pelvic osteitis pubis

Pelvic osteitis pubis is caused by placing tucks on a bone. Placing a tuck on the anterior and superior part of Cooper's ligament, or not fixing the mesh, prevents these complications. It presents as persistent pain above the pubic bone, and is treated with anti-inflammatory medication.

Seromas and hematomas occur in the groin due to extensive dissection or inadequate hemostasis. Wound infections are very rare complications.

Recognition and Management

Osteitis is difficult to diagnose and is usually concluded on the basis of exclusion. Anti-inflammatory medication and analgesics may be useful. Seromas and hematomas can imitate hernia recurrence because they palpitate as hard, non-reducible protrusions. Upon examination, they are found to be fluid and not a recurrence. Evacuation or aspiration is required. Wound infection needs a great deal of drainage, but it may be necessary to remove the mesh if the infection spreads to the groin.

In the case of an irreducible swelling in the groin in the early post-operative period, a recurrent incarcerated hernia will probably be excluded by taking a history and a physical examination; ultrasound may be useful to differentiate this from a post-operative seroma or hematoma. In the case of a swelling in the groin which is reducible, the difference is less clear, since a seroma can also "shrink". In these cases we prefer a conservative attitude in the first weeks.

Subcutaneous Emphysema

Subcutaneous emphysema, pneumomediastinum and pneumothorax are extremely rare complications

of TEP repairs and are most often related to an unintentional pneumo-peritoneum. There are some reports of this complication after TEP without rupture of the peritoneum. The cause in these cases may be excess pressure.

An increased risk of this complication is related to an extended period of extraperitoneal insufflation, which is often defined as longer than 2 hours. Moreover, it is supposed that increased insufflation pressure leads to more extensive fascial CO² dissection. Some surgeons advocate pressure <15 mmHg in order to reduce this complication to the minimum¹⁹, whilst other suggest using <10 mmHg²⁰. However, the limited data available leave these recommended parameters completely unclear.

Most cases of pneumomediastinum and pneumothorax after TEP repair of an inguinal hernia are treated conservatively with additional oxygen and observation. However, in view of the potential of significant morbidity, this is an important complication which surgeons and anesthesiologists should recognize. Minimizing the time of insufflation and pressure should reduce the risk of these complications, however specific limits remain unclear.

A high level of clinical suspicion is necessary and should be immediately followed by monitoring by chest auscultation, palpation for subcutaneous emphysema, and observation for signs of respiratory distress. The increasingly frequent use of laparoscopic procedures for inguinal hernias will probably lead to the increased frequency of these complications. As it is, further research is needed in order to describe the risk factors for these complications.

Postoperative Care

In order to reduce the risk of the occurrence of post-operative seromas and hematomas in the scrotum, we ask patients to wear slim fit underwear for a week.

The patient is free to continue their activities, doing whatever they feel they are able to do. It is probably

sufficient to limit lifting heavy weights for 2-3 weeks. It is necessary to encourage them to return to work quickly (2-4 weeks after the operation, depending on their physical activity). This will require a change in attitude by surgeons, general practitioners and patients, but may result in significant savings in health care expenditure.

Conclusion

In order to provide surgery adjusted to each patient, we believe that all surgeons who are qualified for general surgery not only should have a deeper knowledge of the anterior and posterior (preperitoneal) anatomy, but they must also be acquainted with the technical aspects of the anterior approach (Lichtenstein method) and the posterior approach.

TEP surgical correction of inguinal hernias is the method of choice for unilateral or bilateral inguinal hernia surgery. The use of endoscopic hernia techniques for primary hernias makes it possible for surgical trainees to have greater access to patients, in addition to the advantages given above, under the condition that the training conditions are optimal. Only then will surgeons be sufficiently well trained to perform laparoscopy in cases of recurrent and bilateral hernias.

Conflict of interests

The author has no relevant financial or non-financial interests to disclose.

References

- Miserez MJ. Totally extraperitoneal endoscopic inguinal hernia repair. In: H. Jaap Bonjer (ed.) *Surgical Principles of Minimally Invasive Procedures*. Springer International Publishing Switzerland. 2017. P. 91-117.
- Daes J, Felix E. Critical view of the myopectineal orifice. *Ann Surg*. 2017;266:e1-e2. <https://doi.org/10.1097/SLA.00000000000002104>
- Furtado M, Claus CMP, Cavazzola LT, Malcher F, Bakonyi-Neto A, Saad-Hossne R. Systemization of laparoscopic inguinal hernia repair (TAPP) based on a new anatomical concept: inverted y and five triangles. *Arq Bras Cir Dig*. 2019;32:e1426. <https://doi.org/10.1590/0102-672020180001e1426>
- Claus C, Furtado M, Malcher F, Cavazzola LE, Felix E. Ten golden rules for a safe MIS inguinal hernia repair using a new anatomical concept as a guide. *Surgical Endoscopy*. 2020;34:1458-1464. <https://doi.org/10.1007/s00464-020-07449-z>
- Daes J, Felix E. Critical view of myopectineal orifice. *Ann Surg*. 2017;266:e1-e2.
- Miserez M, Peeters E, Aufenacker T, Bouillot JL, Campanelli G, Conze J, et al. Update with level 1 studies of the European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia*. 2014;18:151-163.
- Hernia Surge Group. International guidelines for groin hernia management. *Hernia*. 2018;22:1-165.
- Bittner R, Arregui ME, Bisgaard T, Dudai M, Ferzli GS, Fitzgibbons RJ, et al. Guidelines for laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia [International Endohernia Society (IEHS)]. *Surg Endosc*. 2011;25:2773-2843.
- Gholghesaei M, Langeveld HR, Veldkamp R, Bonjer HJ. Costs and quality of life after endoscopic repair of inguinal hernia vs open tension-free repair: a review. *Surg Endosc*. 2005;19:816-21.
- Bittner R, Montgomery MA, Arregui E, Bansal V, Bingener J, Bisgaard T, et al. Update of guidelines on laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia (International Endohernia Society). *Surg Endosc*. 2015;29:289-321.
- Ferzli G, Iskandar M. Laparoscopic totally extra-peritoneal (TEP) inguinal hernia repair. *Ann Laparosc Endosc Surg*. 2019;4:35.

12. Simons MP, Aufenacker T, Bay-Nielsen M, Bouillot JL, Campanelli G, Conze J et al. European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia*. 2009;13:343-403.
13. Choi YY, Kim Z, Hur KY. Learning curve for laparoscopic totally extraperitoneal repair of inguinal hernia. *Can J Surg*. 2012;55:33-36.
14. Suguita FY, Essu FF, Oliveira LT, Iuamoto LR, Kato JM, Torsani MB, et al. Learning curve takes 65 repetitions of totally extraperitoneal laparoscopy on inguinal hernias for reduction of operating time and complications. *Surg Endosc*. 2017;3:3939e3945.
15. Kim DW, Park Y. First experience of junior surgeon with laparoscopic totally extraperitoneal herniorrhaphy: Comparison with experienced surgeon in single institution. *Asian Journal of Surgery*. 2022;45:844e848.
16. Park BS, Ryu DY, Son GM, Cho YH. Factors influencing on difficulty with laparoscopic total extraperitoneal repair according to learning period. *Ann Surg Treat Res*. 2014;87:203e208.
17. The SAGES manual. Springer.1993.
18. Alam N, Sheen AJ. Total extraperitoneal hernia repair and its associated pitfalls. *Mini/invasive Surg*. 2021;5:48.
19. Harkin CP, Sommerhaug EW, Mayer KL. An unexpected complication during laparoscopic herniorrhaphy. *Anesth Analg*. 1999;89: 1576-8.
20. Ferzli GS, Kiel T, Hurwitz JB, Davidson P, Piperno B, Fiorillo MA, et al. Pneumothorax as a complication of laparoscopic inguinal hernia repair. *Surg Endosc*. 1997;11:152-3.

ORIGINAL ARTICLE

The Nassar Scale as an Instrument for Predicting Conversion of Laparoscopic to Open Cholecystectomy

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ABSTRACT

Background: Difficult cholecystectomy, often associated with a heightened risk of complications, poses a significant surgical dilemma. Risk factors, such as patient age, increased body weight, the presence of gallstones, acute cholecystitis, and prior abdominal surgeries, can complicate laparoscopic cholecystectomy and necessitate conversion to an open procedure for safety. The aim of our study was to assess the applicability of the Nassar scale in predicting the need for conversion from laparoscopic to open cholecystectomy.

Material and methods: In our prospective cohort study, we included 85 patients who underwent either emergency or elective laparoscopic cholecystectomy between December 2021 and October 2023. The Nassar scale was used to assess the complexity of laparoscopic cholecystectomy, incorporating parameters such as 'Gallbladder,' 'Cystic pedicle,' and 'Adhesions' to determine a final score ranging from 1 to 5. Statistical analysis involved descriptive and analytical methods, with the significance threshold set at $p < 0.05$.

Results: ANOVA analysis revealed a statistically significant difference in the duration of operative procedures with different Nassar grades ($p < 0.001$). An increase in the Nassar grade by 1 was associated with a statistically significant 6.23-fold increase in the odds of conversion to an open procedure ($p < 0.001$). Receiver Operating Characteristic (ROC) analysis demonstrated a highly significant association ($p < 0.001$) between the Nassar grade and the conversion event, with an Area Under the Curve (AUC) of 0.881 (95% CI 0.79,0.96). The optimal cutoff value, identified as >2.5 , struck a balance between sensitivity (0.86) and 1-specificity (0.23).

Conclusion: Our study underscores the utility of the Nassar scale in surgical practice. It provides valuable insights into assessing the severity of operations, facilitating informed decision-making, and optimizing treatment outcomes for patients undergoing laparoscopic cholecystectomy at our institution.

Keywords: cholecystectomy, laparoscopy, surgical procedures, gallstones

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Introduction

Difficult cholecystectomy implies performing this surgical procedure with an increased risk of complications compared to the standard procedure, and as such represents a challenge in surgical practice¹. It is associated with risk factors such as the patient's age, increased body weight, the presence of gallstones, acute cholecystitis and previous abdominal operations².

Conversion of laparoscopic cholecystectomy to an open procedure is an important aspect of the analysis of difficult cholecystectomy, and occurs in cases when surgeons face intraoperative difficulties and complications during the laparoscopic procedure that make it difficult to complete the operation safely^{3,4}. The Nassar scale is one of the available tools for assessing the severity of laparoscopic cholecystectomy. The scale consists of five grades determined on the basis of the visual characteristics of the intraoperative finding, so that a higher grade means a more difficult (complicated) intraoperative finding^{5,6}. In grade 1, a soft gallbladder is visualized, separated from the surrounding tissue, the cystic pedicle is thin and transparent, while the adhesions are limited to the corner of the gallbladder neck (Hartman's pouch). Grade 2 is characterized by the presence of stones in the gallbladder while the cystic pedicle is covered with fatty deposits. In grade 3, the gallbladder can be "buried" in the liver, with signs of inflammation and adhesions that make access to the cystic pedicle difficult. Grade 4 represents extremely severe cases, with signs of gangrene of the gallbladder, while the adhesions are firm and make it difficult to separate the gallbladder from the surrounding structures.

Grade 5 implies a finding from grade 4 combined with the presence of Mirizzi syndrome type 2 and higher, with cholecystocutaneous or cholecystoenteric fistula⁶.

In a study conducted by Sah NP et al.⁷, it was emphasized that the Nassar scale can be used by surgeons with different experiences to evaluate the

difficulty of laparoscopic cholecystectomy. Their study indicates a significant correlation between the Nassar grade and the need for conversion to open cholecystectomy and the prolonged duration of surgery. Despite the numerically limited sample, the authors were able to confirm the applicability and consistency of the scoring method, suggesting that scoring using the Nassar scale can be used to plan operations better⁷.

The Nassar scale can be used also to assess the severity of the disease better. Despite subjectivity in the application of the scale between individual surgeons, and differences in clinical contexts, the scale is considered a valuable tool for assessing the severity of cholecystectomy⁸.

Within our current clinical practice, it is not customary to use a rating scale to assess the complexity of laparoscopic cholecystectomies or to predict conversion to open surgery. This area requires in-depth analysis, and the results of our research can help to enhance surgeon training and patient safety, contributing to a better understanding and underlining the importance of implementing the Nassar scale in our clinical department.

The aim of our study is to evaluate the application of the Nassar scale in predicting the conversion of laparoscopic cholecystectomy to an open procedure, identify the optimal rating score based on intraoperative findings for this purpose, to explore differences in ratings between emergency and elective patients, and analyze variations in the duration of surgeries among different Nassar score categories.

Material and methods

In our prospective cohort study, we included 85 patients who underwent emergency or elective laparoscopic cholecystectomy from December 2021 to October 2023. All operative procedures were performed by surgeons of the Clinic for General and Abdominal Surgery of the Clinical Center of the University of Sarajevo (CCUS). Patients were previously evaluated

by an anesthesiologist and classified according to the American Society of Anesthesiologists (ASA) physical status classification, with the inclusion of patients with an ASA score of less than or equal to 3. After the operative procedure, surgeons evaluated the complexity of the laparoscopic cholecystectomy according to the Nassar scale, using the parameters “Gallbladder”, “Cystic pedicle” and “Adhesions”, with a final score of 1 to 5. Patients were divided into two main groups according to the need for possible conversion: LC group (laparoscopically completed cholecystectomy) and OC group (need for conversion to an open approach to complete the cholecystectomy). Only patients with postoperatively confirmed benign pathohistological findings, i.e. the presence of calculous cholecystitis or gallbladder polyps, were included in the study. Pathohistological analysis of the samples was performed at the Clinic for Clinical Pathology, Cytology and Human Genetics of the Clinical Center of the University of Sarajevo. The study did not include patients with postoperative pathohistology indicating the presence of carcinoma of the gallbladder or another biliary tract, patients who underwent preoperative ultrasound-guided percutaneous cholecystostomy, or those who had laparoscopic cholecystectomy as part of other laparoscopic procedures. For statistical analysis we used the program IBM SPSS Statistics version 22.0 for Windows. The most important results of the study are presented in tables and figures. The t-test was used to examine differences in the means of continuous variables between two groups, while the ANOVA test was applied to compare the means of the continuous variables between more than two groups. To assess the predictive ability in determining the occurrence of a specific event, we used binary logistic regression. ROC analysis was performed to assess the diagnostic accuracy of the Nassar scale in predicting conversion from laparoscopic to open cholecystectomy. The area under the curve (AUC) was calculated to measure the discriminatory ability of the Nassar scale. The threshold for statistical significance was set at the conventional level ($p < 0.05$).

Results

For different Nassar grades, the duration of the operation was as follows: grade 1 - 50.75 minutes, grade 2 - 57.31 minutes, grade 3 - 73.50 minutes, grade 4 - 110.56 minutes, grade 5 - 211 minutes. The only patient with grade 5 was excluded to allow the ANOVA analysis to be performed. The results of the ANOVA analysis indicate a statistically significant difference in the duration of operative procedures among the different Nassar grades ($p < 0.001$). Post hoc analyses revealed statistically significant differences in the duration of operative interventions between the following Nassar grades: between grades 1 and 3 ($p=0.019$) and 1 and 4 ($p<0.001$); and between grades 2 and 4 ($p<0.001$) and 3 and 4 ($p=0.003$), as shown in Figure 1.

The average Nassar grade in the group of patients undergoing urgent cholecystectomy was 2.58, while in the elective cholecystectomy group it was 1.91. The difference in the average Nassar grade was 1.51. The lowest Nassar grade in the emergency patient group was 1, and the highest was 5. In the group of patients undergoing elective cholecystectomy, the lowest Nassar grade was 1, and the highest was 4. The median Nassar grade was 3 for emergency patients, and 2 for those undergoing elective surgery. An independent samples t-test revealed a statistically significant difference in the Nassar grades between patients undergoing emergency or elective cholecystectomy ($p < 0.001$), which is shown in Figure 2.

In the case of Nassar grade 1, 7.1% of patients required conversion to open cholecystectomy. In grade 2, this percentage was 10.2%, while in grade 3 it reached 22.2%. In grade 4, 66.7% of patients ended up with open cholecystectomy. In Nassar grade 5, all patients required conversion. An increase in the Nassar grade by 1 was followed by a statistically significant 6.23-fold increase in the odds of conversion to an open procedure ($p<0.001$), as shown in Figure 3.

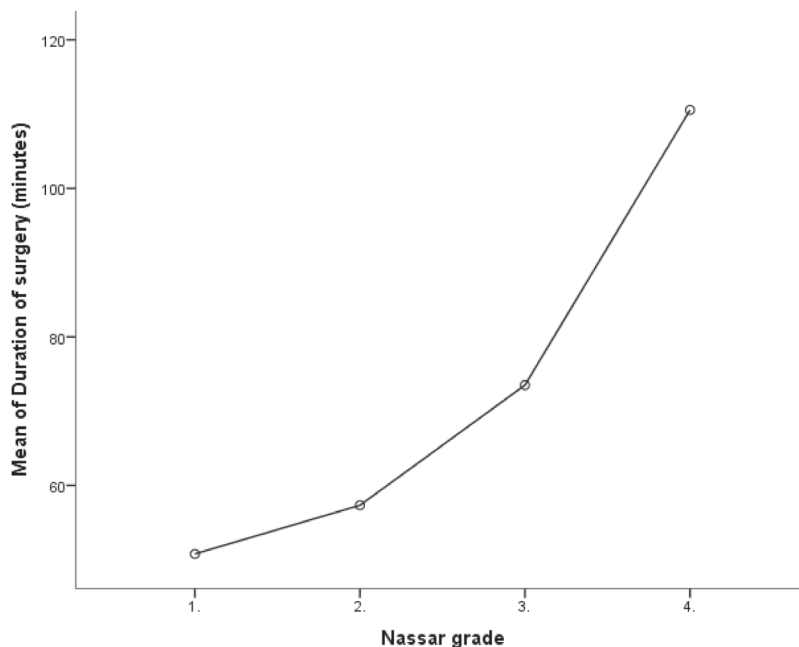


Figure 1. Duration of surgery in minutes relative to the Nassar grade.

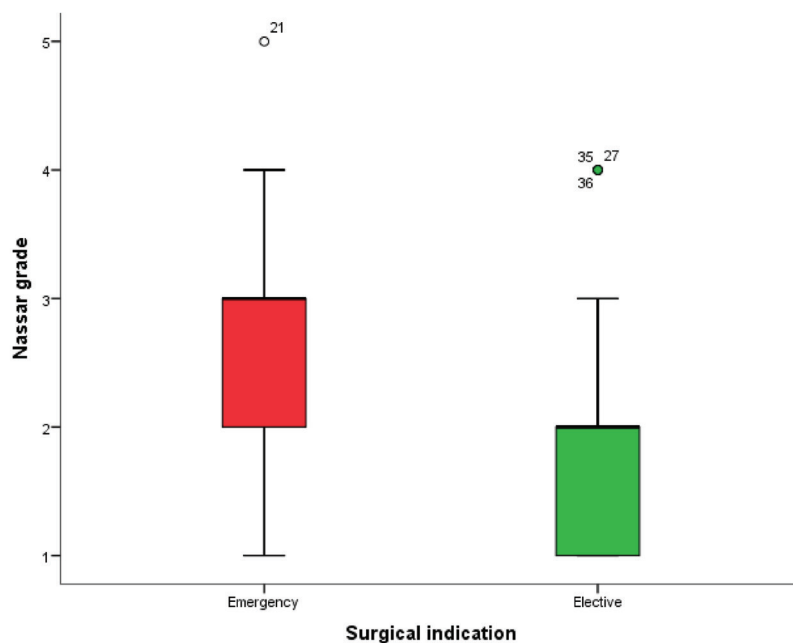


Figure 2. Nassar grade in relation to surgical indication.

ROC analysis was conducted to evaluate the diagnostic accuracy of the Nassar Score in predicting the conversion from laparoscopic to open

cholecystectomy. The Area Under the Curve (AUC) was computed to measure the model's discriminatory capacity, resulting in an AUC of 0.881 (95%

CI: 0.79-0.96). The analysis demonstrated a highly significant association ($p < 0.001$) between the Nassar grade and the conversion event. The optimal

cut-off value, identified as >2.5 , struck a balance between sensitivity (0.86) and 1-specificity (0.23), as shown in Figure 4.

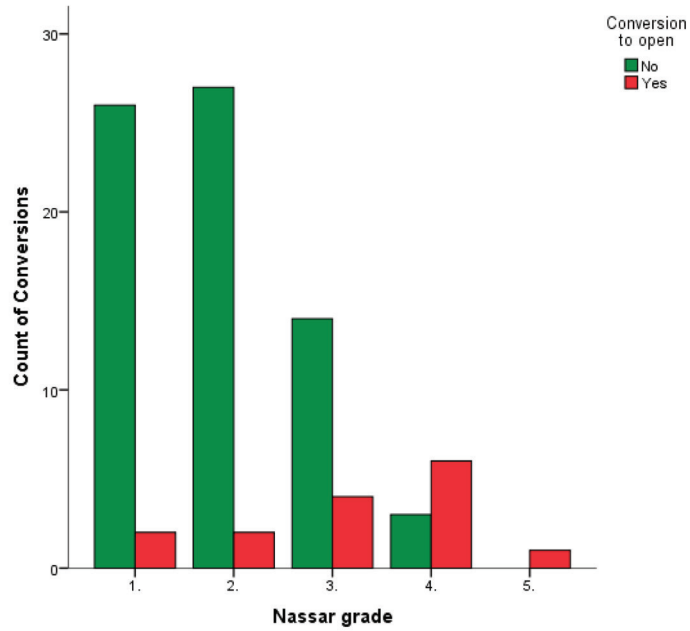


Figure 3. Conversion rates from laparoscopic to open cholecystectomy based on Nassar grade.

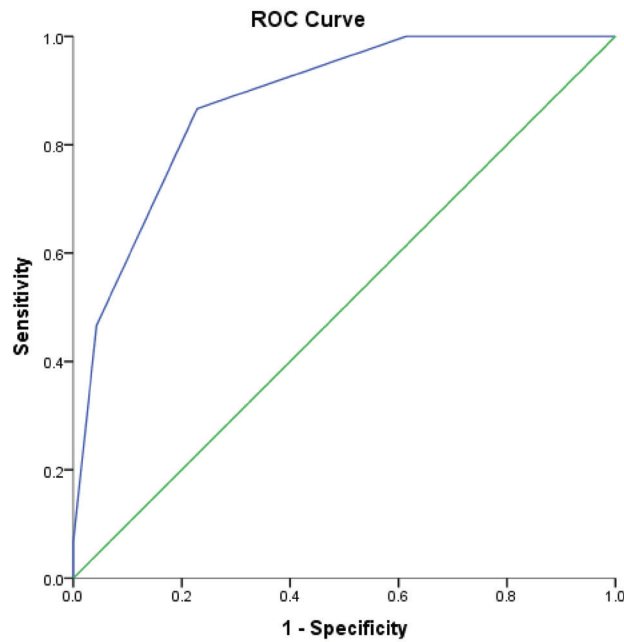


Figure 4. ROC Curve for Nassar Score with AUC Assessment.

Discussion

Our study investigated the ability of the Nassar scale to predict the conversion of laparoscopic cholecystectomy to an open procedure. We found that the risk of conversion increased significantly with an increase in the Nassar grade, with identification of the threshold value on the scale for its implementation. The significance of our finding is that it emphasizes the role of using the Nassar scale in surgical practice, and enhances risk management during this medical procedure.

Using a prospective approach to analyse all grades on the Nassar scale, we sought to achieve consistent and reliable results, in order to investigate the practical application of this scale in our clinical practice.

Gupta et al.⁹ defined surgeries as difficult if it took more than 60 minutes to complete the cholecystectomy, which is consistent with our findings, suggesting that the longer duration of surgery correlates with higher Nassar grades. Kemal et al.¹⁰ used the duration of the operation to classify the severity of cholecystectomy, dividing these operations into “difficult” and “very difficult” according to the duration of the cholecystectomy and complicating factors. Our research supports the use of the duration of surgery as a relevant indicator of the severity of laparoscopic cholecystectomy, since the longer duration of surgery correlates with higher Nassar grades. It is important to note limitations in the application of the time criterion, including differences in surgeon experience and variations in the interpretation of time thresholds. Furthermore, it is important to note that our study did not analyze intraoperative complications as a separate factor for assessing the severity of cholecystectomy, but relied solely on parameters from the Nassar scale as a measure of the difficulty of laparoscopic cholecystectomy.

Emergency patients had significantly higher Nassar grades compared to patients undergoing elective surgery. While no studies comparing Nassar grade levels based on the type of surgical indication for cholecystectomy were found, previous research indicated

a potential connection between complications during laparoscopic cholecystectomy and variations in C-reactive protein (CRP) levels, with notable discrepancies in CRP values and conversion criteria across different studies¹⁻¹⁴. While our study did not specifically investigate the relationship between CRP levels and conversion, this aspect warrants attention in future research to understand better how CRP may be linked to the Nassar scale. This is particularly important given that CRP is commonly used as an indicator of the severity of acute cholecystitis¹⁵.

Similar to a study conducted in 2022, our research also confirms that the highest conversion rates are observed in grade 4, with all patients in grade 5 requiring conversion⁷. Our study goes a step further by employing logistic regression, which reaffirms the statistically significant 6.23-fold increase in the conversion risk for each increment in the Nassar score. Both our study and the 2022 study stand out for their prospective approach and similar inclusion criteria, focusing primarily on patients with benign gallbladder conditions, while excluding malignant biliary tract diseases.

Although the AUC values in our study (0.881) are somewhat lower compared to the previous studies (0.903 and 0.973), all three studies confirm the high discriminating ability of the Nassar scale in predicting conversion^{7,8}. Another contribution of our study is the determination of the optimal ‘cut-off’ value for the Nassar grade to predict conversion, which, specifically, was found to be greater than 2.5.

There are significant limitations of our study that should be considered. The limited number of patients included precludes deeper analyses, including regression models to identify parameters from the Nassar scale in predicting conversion. The lack of consideration of intraoperative complications limits our understanding of the effect of the duration of the operative procedure on the Nassar scale. Also, we did not monitor long-term outcomes, such as postoperative complications and quality of life, which makes a more complete interpretation of the results difficult. The absence of a control group that would imply

cholecystectomy without the use of the Nassar scale makes it difficult to compare and prove the benefits of its use. The time limitation of the study may further limit the general applicability of the results to a wider population. It is especially important to emphasize that we did not take into account differences in the experience of surgeons in laparoscopic cholecystectomy, although all the authors of the study were either operators or first assistants.

Further investigations are needed to analyze the impact of preoperative CRP levels and intraoperative complications on the duration and conversion of laparoscopic cholecystectomy, as assessed with the Nassar score. Tracking long-term outcomes and the quality of life for patients undergoing these procedures, along with the introduction of a control group not utilizing the Nassar score, is essential for a more comprehensive assessment of its effectiveness. Additionally, comparing different surgeons, with a specific focus on the application of the Nassar score, will contribute to a better understanding of the influence of their experience on laparoscopic cholecystectomy outcomes.

In conclusion, this study identified the optimal Nassar grade for predicting conversion of laparoscopic cholecystectomy to an open procedure, confirming the reliability of this scale. Also, we found significant differences in the average Nassar scores between emergency and elective cholecystectomies, and in the duration of operative procedures among different grades. These findings confirm the importance of using the Nassar scale in surgical practice, which significantly improves our ability to assess the severity of operative findings, make correct decisions and optimize the outcome of treatment of patients undergoing laparoscopic cholecystectomy at our institution.

Conflict of interests

The authors have no relevant financial or non-financial interests to disclose.

Patient Consent Form: All participants were informed about subject of the study.

Author's Contribution: Edin Hodžić: Data curation, Visualization, Investigation, Writing-Reviewing. Sadat Pušina: Software, Investigation, Validation. Adi Mulabdić: Conceptualization, Methodology, Writing-Original draft. Adnan Kulo: Visualization, Investigation, Supervision. Salem Bajramagić: Conceptualization, Methodology, Writing-Original draft preparation, Supervision. Mirhan Salibašić: Data curation Investigation. Emsad Halilović: Data curation, Investigation. Amila Feto: Data curation, Investigation. Samir Delibegović Writing-Reviewing.

References

1. Jameel SM, Bahaddin MM, Mohammed AA. Grading operative findings at laparoscopic cholecystectomy following the new scoring system in Duhok governorate: Cross Sectional Study. *Annals of Medicine and Surgery*. 2020;60:266-70. doi:10.1016/j.amsu.2020.10.035
2. Chandio A, Timmons S, Majeed A, Twomey A, Aftab F. Factors influencing the successful completion of laparoscopic cholecystectomy. *JSLs*. 2009;13:581-6. doi:10.4293/108680809x1258998404560
3. Jethwani U, Singh G, Mohil R, Kandwal V, Razdan S, Chouhan J, et al. Prediction of difficulty and conversion in laparoscopic cholecystectomy. *OA Minimally Invasive Surgery*. 2013;1(1). doi:10.13172/2054-2666-1-1-650
4. Stanisić V, Milicević M, Kocev N, Stanisić B. A prospective cohort study for prediction of difficult laparoscopic cholecystectomy. *Annals of Medicine and Surgery*. 2020;60:728-33. doi:10.1016/j.amsu.2020.11.082
5. Mushtaque M, Kema A, Khanday S, Bacha U. Difficult laparoscopic cholecystectomy and postoperative requirement of analgesics: An observational study. *Saudi Journal of Laparoscopy*. 2019;4(1):24. doi:10.4103/sjl.sjl_7_19
6. Nassar AH, Ashkar KA, Mohamed AY, Hafiz AA. Is laparoscopic cholecystectomy possible without

- video technology? Minimally Invasive Therapy. 1995;:63-5. doi:10.3109/13645709509152757
7. Sah NP, Gupta RK, Awale L, Deo KB, Sah RP, Kumar A, et al. Operative difficulty grading scale for laparoscopic cholecystectomy at a tertiary care hospital in eastern Nepal. *Journal of Kathmandu Medical College*. 2022;58-67. doi:10.3126/jkmc.v11i1.45497
 8. Griffiths EA, Hodson J, Vohra RS, Marriott P, Karbeh T, Zino S, et al. Utilisation of an operative difficulty grading scale for laparoscopic cholecystectomy. *Surgical Endoscopy*. 2018;33:110-21. doi:10.1007/s00464-018-6281-2
 9. Gupta S, Anand K, Paliwal P, Baghel AS. Validation of intra-operative scoring system for difficult laparoscopic cholecystectomy. *International Surgery Journal*. 2022;9:1842. doi:10.18203/2349-2902.isj20222939
 10. Kamal A, El-Matary M, Fadl E, Gebril N. Accuracy of randhawa and Pujahari preoperative scoring system in prediction of difficult laparoscopic cholecystectomy in Egyptian population. *Ain Shams Medical Journal*. 2021;72:163-71. doi:10.21608/asmj.2021.167373
 11. Kaushik B, Gupta S, Bansal S, Yadav BL, Bharti D, Kalra D, et al. The role of C-reactive protein as a predictor of difficult laparoscopic cholecystectomy or its conversion. *International Surgery Journal*. 2018;5:2287. doi:10.18203/2349-2902.isj20182239
 12. Arora BS, Sen P, Singh RK, Biswal I, Paruthy SB. HSCRP levels as predictor of difficult laparoscopic cholecystectomy- current status evaluation experience in a teaching institution. *International Surgery Journal*. 2017;4:1345. doi:10.18203/2349-2902.isj20171139
 13. Onoe S, Maeda A, Takayama Y, Fukami Y, Kaneoka Y. A preoperative predictive scoring system to predict the ability to achieve the critical view of safety during laparoscopic cholecystectomy for acute cholecystitis. *HPB*. 2017;19:406-10. doi:10.1016/j.hpb.2016.12.013
 14. Kutluer N. Complications during laparoscopic cholecystectomy performed due to acute cholecystitis. *Laparoscopic Endoscopic Surgical Science*. 2020; doi:10.14744/less.2020.25901
 15. Kabul Gurbulak E, Gurbulak B, Akgun IE, Duzkoylu Y, Battal M, Fevzi Celayir M, et al. Prediction of the grade of acute cholecystitis by plasma level of C-reactive protein. *Iranian Red Crescent Medical Journal*. 2015;17(4). doi:10.5812/ircmj.17(4)2015.28091

PROFESSIONAL PAPER

Robot-assisted colorectal operations compared to the laparoscopic approach

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ABSTRACT

Background: The minimally invasive approach has become increasingly interesting in the treatment of patients with colorectal cancer. The purpose of this study is to analyze the differences between laparoscopy and robotics used in colorectal cancer in terms of oncologic and clinical outcomes in a small general hospital.

Methods: We analyzed and compared two group of patients operated robotically and laparoscopically. 85 patients operated robotically (49% female, 51% male). The average age was 63.5 years, 110 patients operated laparoscopic operations (64% male, 36% female), the average age was 65.5 years.

Results: In all patients radical resection was performed. The average number of isolated lymph nodes in the robotic method was 19, while in laparoscopic method there were 155. The hospitalization was shorter in the robotic surgery patients (average 7.3 days), on the other hand the duration of the robotic operations was longer than the laparoscopic operations. Intraoperative blood loss was smaller in the robotic method (50-120 ml) in comparison with laparoscopic method (100-300 ml). Conversion to open surgery was lower when using the robotic method (4,5%) than in laparoscopic method (7%). Laparoscopic method has more frequent complications 9 (10,3%) while robotic method 4 (9%). In 10 years follow up 9 laparoscopically operated died (10,3%), (5 due to cardiovascular disease, 4 due to progression of disease). In this period, 3 robotically operated patients died (6%), one due to progression of the disease, the others due to cardiovascular disease. The most common operation was right hemicolectomy (46%) by laparoscopic procedure, and using the robotic method it was anterior resection of the rectum (54%).

Conclusion: RCS is a promising technique and is a safe and effective alternative to LCS for colorectal surgery. The advantages of RCS include reduced EBLs, lower conversion rates and shorter times to recovery of bowel function. Further studies are required to define the financial effects of RCS and the effects of RCS on long-term oncological outcomes.

Keywords: robotic surgery, colorectal cancer, oncological outcomes.

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Introduction

The minimally invasive approach has become increasingly interesting in the treatment of patients with colorectal cancer. Robotic surgery for colorectal cancer has been widely accepted in recent years^{1,2}. Reports on robotic surgery usually come from large hospitals, but it is interesting to show experiences from small general hospitals.

The purpose of this study is to analyze the differences between laparoscopy and robotics used in colorectal cancer in terms of oncologic and clinical outcomes. We present our initial the results of robotic operations of the large intestine, with special regard to the patient undergoing robotic surgery of the colon for rectum cancer and a comparison with laparoscopy.

Methods

We analyzed and compared two group of patients operated robotically and laparoscopically. 85 patients operated robotically (49% female, 51% male). The average age was 63.5 years, 110 patients operated laparoscopic operations (64% male, 36% female), the average age was 65.5 years.

Surgery

Robotic surgery was performed according to the standards described elsewhere [2-4]. For the surgery we used the Da Vinci Si platform. The patient was positioned in the lithotomy anti-Trendelenburg position. The ports were positioned as depicted in Figure 1.



Figure 1. Port positioning for the Da Vinci Si platform.

The surgery was performed by a specially trained dedicated team, under the leadership of the head surgeon, IC. The positioning of the DaVinci Si system and the operating team is presented in Figure 2.



Figure 2 a,b,c. The positioning of the DaVinci Si platform.

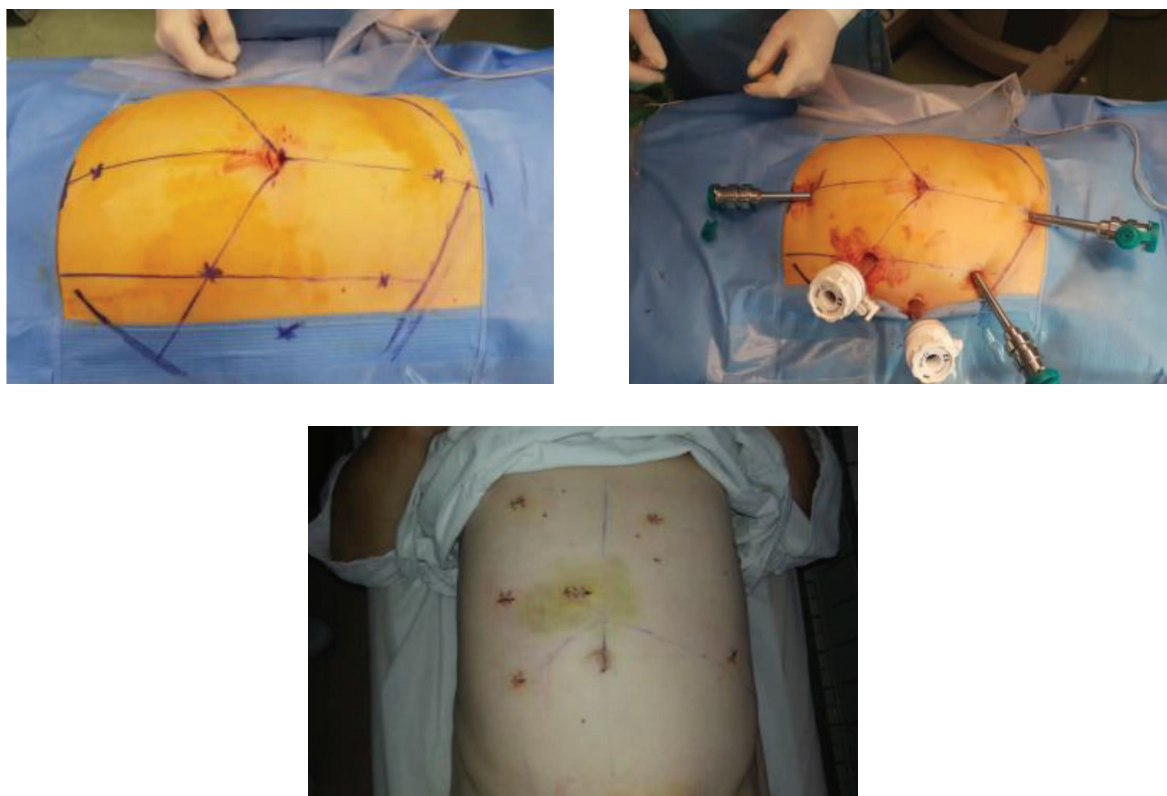


Figure 3 a,b,c. Port placement for robotic right hemicolectomy and postoperative view of the patient after robotic surgery.

Data sources

All data were stored prospectively in the department's database. In addition, we used the hospital's data registry to collect additional demographic data such as comorbidities, previous medical history, and histology results. The data acquisition was done under strict central supervision. Only the permanent employees of the Department for Abdominal and General Surgery in Celje Teaching Hospital had access to these databases. The quality of data acquisition and surgical quality control was assessed externally. The acquired procedural data was sent to ABA Medica (Gagnano, Italy). ABA Medica analyzed the data, and only certified robotic surgeons were allowed to send and request the data. For this study, all data were blinded. The study was approved by the local ethics committee.

Data processing

The retrieved data were coded and analyzed by designated surgeons for robotic surgery (IC and OS). The patients were grouped by pathology and how the surgery was performed. The continuous data were presented as mean±SD, while the discrete variables were presented as %. All graphs were plotted with Microsoft Excel for Windows, version 2022 (Microsoft, Washington, USA).

Results

Patients

The average age of the operated patients was similar in both groups (63 years), however more patients in the laparoscopic group were male compared to the robotic

group (64% vs 51%). Seven patients in the robotic group had received preoperative radio-chemotherapy for rectal cancer. Patients in the laparoscopic group tended to have more accompanying diseases. The most prevalent pathology was adenocarcinoma in both groups. The most common operation in the laparoscopic group was the right hemicolectomy, compared to sigmoid resection in the robotic group. More patients

had an anterior resection in the robotic group (54% vs 14%). The proportion of low anterior resection was similar in both groups (7% in the robotic vs. 5% in the laparoscopic group). The TNM stage was similarly distributed in both groups. Stage pT3N0M0 was the most prevalent. In both groups, UICC stage III was the most prevalent. The clinical and pathological characteristics are presented in Table 1.

Table 1. Patients' characteristics, pathology and operative results

	Robotic surgery	Laparoscopic surgery
ASA		
I	37%	7%
II	62%	51%
III	1%	40%
	0%	2%
Indication for surgery		
Adenocarcinoma	76.6%	74.1%
Adenoma	11.6%	15.2%
Polipectomia	10%	7.1%
Diverticulitis	1.7%	3.5%
Tumor location		
Right colon	21%	45%
Left colon	4%	7%
Sigmoid colon	13%	24%
Rectosigmoid junction	40%	15%
Rectum	22%	9%
Types of operations		
Right hemicolectomy	22%	46%
Left hemicolectomy	5%	9%
Sigmoid resections	12%	26%
Anterior rectal resection	54%	14%
Low anterior resection	7%	5%
T stage		
1	9%	17%
2	39%	35%
3	46%	44%
4	6%	4%
N stage		
0	40%	54%
1	36%	37%
2	24%	9%
UICC stage		
I	51%	30%
II	15%	33%
III	34%	37%
IV	0%	0%
Tumor Grade		
I	15.8%	7.8%
I-II	11.5%	17.9%
II	67.6%	67.2%
III	5%	6.2%

Perioperative results

The average console time in robotic surgery was 186.6 minutes, which was comparable to the operation time in laparoscopic surgery. The range of intraoperative blood loss in the robotic group was 50 – 150 ml, which was lower than in laparoscopic surgery (100-300 ml). The average number of lymph nodes extracted was comparable in both groups (18 in the robotic vs. 16 in the laparoscopic group). Patients in the robotic group resumed oral diet faster (3.7 days vs. 4.6 days) and had a significantly shorter hospital stay compared to the laparoscopic group (7.5 days vs. 10.3 days). Morbidity was comparable in both groups, while the conversion rate was lower in the robotic group (4.5% vs. 7%) (Table 2).

Discussion

Robotic surgery for colorectal cancer has been widely accepted and embraced in recent years³⁻⁵. It offers many decisive advantages over laparoscopic surgery and makes difficult cases safer to operate. The Department for Abdominal and General Surgery at Celje Teaching Hospital introduced robotic colorectal surgery to Slovenia in 2014. At that time this was a novel surgical procedure in Slovenia and opened the region for wider acceptance of robotic surgery in other centers. In the present paper, we present the initial experience of robotic colorectal surgery at the Department for Abdominal and General Surgery

in Celje, and compare the results with laparoscopic colorectal operations.

Patients in the robotic group, although of comparable age to the laparoscopic group, were in better general health. This might be due to the fact that in the initial period of the introduction of robotic surgery patient selection might have been present. Even so, the distribution of presenting pathology and the stage distribution of tumors were similar. We could therefore argue that, although patients might have been in a better general condition in the robotic group, we did not select easier patients with early cancer for robotic surgery. Therefore, we feel that the two groups are comparable. This is also true in relation to patients who received anterior and low anterior resections. In both groups, these operations were similarly distributed and hence comparable.

Regarding the perioperative results, we can confirm that the morbidity in patients who underwent robotic surgery was comparable to the laparoscopic procedures. Although these results present the initial period of the introduction of the robotic platform for colorectal patients, we can show that this method is safe and feasible, and the procedure takes a comparable time to perform. Similar results were obtained in other pioneer studies^{3,6,7}. Spinoglio et al. showed that robotic surgery is comparable to laparoscopy in regard to safety⁸. We agree with Yasir et al. who stated that

Table 2. Laparoscopic/ Robotic procedure

	Laparoscopic procedure	Robotic procedure
Duration of operation (min)	187.6 min.	186.6 min (operation on console)
Intraoperative blood loss (ml) average	100-300 ml	50-150 ml
Average number of lymph nodes	16.5	18.5
Time to resumption of regular diet(days)	4.6	3.7 days
Time to passage of a stool (days)	4.1 days	4.5 days
Length of stay in hospital (days)	10.3 days	7.5 days
Complications(n%)	(10.3%)	(9.0%)
Conversion to open surgery (n%)	(7%)	(4.5%)

the use of the robotic platform is intuitive and has a short learning curve for an experienced laparoscopist [6]. Our results are in line with this observation since we were able to lower the perioperative morbidity rates despite this being the initial period.

Robotic platforms not only have articulated instruments allowing better surgical dexterity, but the decisive advantage is that surgery is also easier in small operative fields, such as the pelvis. As the male pelvis can be narrow, visibility, especially in obese patients, can be difficult. These issues are even more challenging to overcome in laparoscopic surgery. Robotic surgery has decisive advantages, with superior 3D visibility, motion scaling and angulation. This is possibly the reason for the smaller blood loss and lower conversion rates in the robotic group. Similar results were observed in other studies⁸⁻¹⁴.

We believe that less intraoperative bleeding and more precise dissection in the robotic group were the main factors that led to the faster postoperative resumption of digestive functions. Patients in the robotic group passed a stool and restarted an oral diet earlier, which eventually led to a shorter hospital stay compared to the laparoscopic group. Similarly, Spinoglio et al. observed significantly shorter hospital stays in the robotic group compared to laparoscopic surgery⁸.

This study presents only the initial experience of robotic surgery, therefore there might be some bias in respect to patient selection. We still believe that our results firmly support the further use of robotic surgery in colorectal cancer patients. Robotic surgery allows surgeons to perform complex surgical tasks in confined surgical fields, which brings decisive advantages to demanding patients, reducing the need for conversions, blood loss, and other intraoperative complications. Additionally, shorter hospital stays could also reduce the total costs of treatment, thereby justifying the higher costs of the robotic platforms compared to laparoscopy. Perhaps it is important to recognize the limitations and benefits of both laparoscopic and robotic surgery, determine a suitable minimally invasive surgical approach, and ultimately choose the ideal surgical technique most appropriate for the specific surgical indication.

Conflict of interests

The author has no relevant financial or non-financial interests to disclose.

Patient Consent Form: All participants were informed about subject of the study.

References

1. Feng Q, Yuan W, Li T, Tang B, Jia B, Zhou Y, et al. REAL Study Group. Robotic versus laparoscopic surgery for middle and low rectal cancer (REAL): short-term outcomes of a multicentre randomised controlled trial. *Lancet Gastroenterol Hepatol.* 2022;7:991-1004. doi: 10.1016/S2468-1253(22)00248-5.
2. Baek SJ, Piozzi GN, Kim SH. Optimizing outcomes of colorectal cancer surgery with robotic platforms. *Surg Oncol.* 2021;37:101559. doi: 10.1016/j.sur-onc.2021.101559.
3. Kim CW, Baik SH. Robotic rectal surgery: what are the benefits? *Minerva Chir.* 2013;68:457-69.
4. Feng Q, Yuan W, Li T, Tang B, Jia B, Zhou Y et al. Robotic versus laparoscopic surgery for middle and low rectal cancer (REAL): short-term outcomes of a multicentre randomised controlled trial. *Lancet Gastroenterol Hepatol.* 2022;7:991-1004. doi: 10.1016/S2468-1253(22)00248-5.
5. Sheng S, Zhao T, Wang X. Comparison of robot-assisted surgery, laparoscopic-assisted surgery, and open surgery for the treatment of colorectal cancer: A network meta-analysis. *Medicine (Baltimore).* 2018;97:e11817. doi: 10.1097/MD.00000000000011817.
6. Weber PA, Merola S, Wasielewski A, Ballantyne GH. Telerobotic-assisted laparoscopic right and sigmoid colectomies for benign disease. *Dis Colon Rectum.* 2002;45:1689-94; discussion 1695-6. doi: 10.1007/s10350-004-7261-2.
7. D'Annibale A, Morpurgo E, Fiscon V, Trevisan P, Sovernigo G, Orsini C et al. Robotic and

- laparoscopic surgery for treatment of colorectal diseases. *Dis Colon Rectum*. 2004;47:2162-8. doi: 10.1007/s10350-004-0711-z.
8. Spinoglio G , Bianchi PP, Marano A, Priora F, Lenti LM, Ravazzoni F et al. Robotic Versus Laparoscopic Right Colectomy with Complete Mesocolic Excision for the Treatment of Colon Cancer: Perioperative Outcomes and 5-Year Survival in a Consecutive Series of 202 Patients. *Ann Surg Oncol*. 2018;25:3580-3586. doi: 10.1245/s10434-018-6752-7.
 9. Rawlings AL, Woodland JH, Vegunta RK, Crawford DL. Robotic versus laparoscopic colectomy. *Surg Endosc*. 2007;21:1701-8. doi: 10.1007/s00464-007-9231-y.
 10. Araujo SEA, Seid VE, Klajner S. Robotic surgery for rectal cancer: current immediate clinical and oncological outcomes. *World J Gastroenterol*. 2014;20:14359-70. doi: 10.3748/wjg.v20.i39.14359.
 11. Cui Y, Li C, Xu Z, Wang Y, Sun Y 5, Xu H, Li Z et al. Robot-assisted versus conventional laparoscopic operation in anus-preserving rectal cancer: a meta-analysis. *Ther Clin Risk Manag*. 2017;13:1247-1257. doi: 10.2147/TCRM.S142758. eCollection 2017.
 12. G Wilder F, Burnett A, Oliver J, Demyen MF, Chokshi RJ. A Review of the Long-Term Oncologic Outcomes of Robotic Surgery Versus Laparoscopic Surgery for Colorectal Cancer. *Indian J Surg*. 2016;78:214-9. doi: 10.1007/s12262-015-1375-8.
 13. Trinh BB, Hauch AT, Buell JF, Kandil E. Robot-assisted versus standard laparoscopic colorectal surgery. *JLS*. 2014;18:e2014.00154. doi: 10.4293/JLS.2014.00154.
 14. Young M, Pigazzi A. Total mesorectal excision: open, laparoscopic or robotic. *Recent Results Cancer Res*. 2014;203:47-55. doi: 10.1007/978-3-319-08060-4_6.

Laparoscopic appendectomy in obese patients - experience from small, general hospital

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ABSTRACT

Background: Acute appendicitis (AA) is the most common cause of acute abdominal pain in the general population. In the past 30 years, obesity has become twice as common. Emergency surgery services are more often faced with obese patients with acute abdominal pain whose origin is AA. That is why we wanted to compare our results with data from the literature on laparoscopic surgery of obese patients with AA.

Materials and methods: This is a retrospective study, which includes the population of obese patients who underwent surgery at our facility during the period from 1.1.2018. to 31.12.2022. Data were taken from our patients' electronic records. Patients were included in the study who had body mass index (BMI) 30 and more, without any serious comorbidity. Exclusion criteria were: younger than 20 years, previous laparotomy, periappendicular infiltration, unregulated hypertension and diabetes mellitus, and morbidity obesity (BMI 40 and above). We analyzed demographic data, the length of surgery, PH findings of appendicitis, consumption of analgesics, beginning of peristalsis, length of stay and postoperative complications.

Results: In the period in question the laparoscopic approach was used in surgery on 190 patients in the treatment of AA. 20 obese patients (10.52%) were included in our study. There were 11 male and 9 female patients, whose average age was 42 years. The duration of the operation was 55 minutes, the most frequent PH finding was phlegmonous inflammation of the appendix in 12 patients. The appearance of peristalsis was on the first postoperative day, consumption of analgesics was two ampullas of metamizole on the day of the operation. The length of stay was 3 days, and there were two abscesses as postoperative complications.

Conclusion: The laparoscopic approach has many advantages that are even greater in the obese population in relation to those of normal weight. The operation takes less time, postoperative pain is reduced, recovery after laparoscopic appendectomy is faster, and there are fewer postoperative complications. This approach should be used more often.

Keywords: laparoscopy, appendicitis and obesity

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Introduction

Acute appendicitis (AA) is the most common cause of acute abdominal pain requiring surgery. It is the most frequent surgical disease with an incidence between 150 and 228/100 000, more often in males but without a significant difference¹. It occurs most often in the second and third decade of life. AA is a rare disease in the older population (sixth, seventh, eight decades). About 8% of the general population has AA during their life according to many epidemiological studies². Hernia repair is the most common operation in the world, while appendectomy is in second place in general surgery in the world. Laparoscopic appendectomy (LA) in the era of the minimal invasive approach has become dominant in relation to open appendectomy (OA), through a McBurney incision, in the past 10-15 years². OA has become rare and is used in cases with gangrenous appendix bases (when the application of Hem-o-lok clips is not secure), the retrocecal position of the appendix, a hostile abdomen (numerous previous abdominal operations), in cases of conversion from LA when there is unclear cecal pathology, suspicion of a neoplastic process, periappendicular infiltration, and also in cases of an old perforation of the appendix with diffuse peritonitis. In the presence of signs of diffuse peritonitis in our hospital, we perform a medial infraumbilical laparotomy, not a Mc Burney incision. We hope to achieve better visualisation, lavage and a better position of the drain in these cases.

The frequency of obesity (body mass index (BMI) 30 and more) has doubled in the last 30 years, especially in the Western world³. Obese patients with acute abdominal pain whose origin is AA are increasingly encountered by the emergency surgery services. It is difficult to establish a diagnosis in these patients. The diagnostic accuracy is lower in obese patients with AA than in the population with normal body weight with the same disease. Physical examination is difficult because the depth of the abdominal wall decreases signs of peritoneal tenderness. Echosonography is not accurate enough because meteorismus and intraabdominal fat may cause difficulties. A CT scan remains the diagnostic choice in obese patients with AA. Of course,

laboratory tests such as the parameters of the acute phase of inflammation (LKC, CRP, procalcitonin) can indicate an acute abdominal surgical process. At our hospital we perform about 250 appendectomies per year. In November 2017 we started performing LA. Every year after that, the number of LA surgeries has increased. Last year, about 60% of all appendectomies were LA at our facility. The proportion of obese patients in the population who undergo surgery for appendicitis acuta is about 10%. Also, the frequency of obesity in the general population in our region is between 10 and 11%. The advantages of the laparoscopic approach mentioned in literature are numerous: less trauma to the tissue of the abdominal wall, faster recovery, fewer complications, local, systemic and surgical site infections (SSI), less deep vein thrombosis (TDV), shorter length of stay, better outcome and better cosmetic effect^{3,4,5}. These advantages of the minimal invasive approach are even greater and more important in the obese population with AA, and there is a significant difference in some of these variables when comparing LA and OA in the population with normal weight. Obese patients obviously have more benefits from LA than patients with normal BMI⁶.

The purpose of this study was to compare our results with data from the literature in laparoscopic surgery on obese patients with AA, to check the benefits of laparoscopic appendectomy in obese patients in small, general hospitals.

Material and methods

This was a retrospective study which encompassed the population of obese patients who underwent laparoscopic appendectomy in the period from 1.1.2018 to 31.12.2022 at Doboj General Hospital. Data were obtained from the patients' electronic records. The data we analyzed were demographic data, surgical record, the duration of surgery, PH findings, postoperative course, consumption of analgesics, and length of stay (LOS). Also we gathered information during clinical monitoring, such as the occurrence of peristalsis and complications. We compared the results obtained

with data from the literature. The study included obese patients with BMI 30 and higher, older than 20 years, without significant comorbidities. The exclusion criteria were: patients younger than 20 years, previous laparotomy, periappendicular infiltration, an unregulated chronic disease such as hypertension, diabetes mellitus, chronic obstructive pulmonary disease (COPD), and, finally morbid obesity (BMI 40 and above).

In the five year period in question 20 obese patients were included of the 190 who underwent LA. In total 1170 patients underwent laparoscopic and open appendectomy. There were 10.52% obese patients in the LA group. In most of the obese patients who underwent OA we used a medial laparotomy. We used the McBurney incision sporadically. All LAs in obese patients were performed after short preoperative preparation, in the left lateral and mild Trendelenburg position, which we used to achieve better visualization and an easier approach to the ileocecal region.

We used three ports: umbilical, 10 mm, suprapubic, 5 mm and left lateral, 10 mm. After creating a pneumoperitoneum using a Veres needle, we inserted the camera and two ports. Using a Harmonic scalpel (Ethicon, Endosurgery, Cincinnati, OH) we dissected the mesoappendix and approached the appendiceal

base, which we closed using Hem-o-lok clips size L or XL (Hem-o-lock, Weck Closure Systems, Research Triangle Park, NC, USA). In some cases we used titanium clips (Braun, Germany). Usually we placed two clips on the base and one above it, then removed the appendix.

We measured the duration of the operation from the first incision of the skin to completing the final suture on the skin. We monitored postoperative complications for 30 days after operation, by check ups in the surgical out-patients' clinic and by telephone.

Results

In the period from 1.1.2018 to 31.12.2022 at Doboj General Hospital we admitted 20 obese patients with symptoms of acute appendicitis. There were eleven males and nine females. The average age of the patients was 42 years (+/- 15.8). The phlegmonous type of inflammation was predominant (Table 1). The average duration of the operation was 55 minutes (from 20 to 135 minutes).

During the postoperative period after LA, there was minimal use of analgetics, early appearance of peristalsis, short LOS and rare complications (Table 2).

Table 1. Patho-histological results in obese patients

Patho-histological tests	
Appendicitis catarrhalis (non-complicated)	5
Appendicitis phlegmonosa (non-complicated)	12
Appendicitis gangraenosa perforativa (complicated)	3

Table 2. Postoperative follow up

Application of analgetics	Appearance of peristalsis	Length of stay (LOS)	Complications	SSI (surgical site infection)	Ileus
Two ampullas of metamizole i.v. or neodolpasse	First postop. day in 80% of patients	3 days (two to five days)	2 cases of abscess	0	0

Discussion

According to most studies, the male population suffers from AA more often than women, but the difference is not significant, at about one to two percent more than female¹. The average age of our patients was somewhat higher than in the literature, because two patients were older than 60 years, and the sample was small. In our population, most patients were in the second and third decades of life, which is the same as in the literature². The duration of surgery is an interesting variable, because it depends on the patients (depth of the abdominal wall, a large amount of fatty tissue) and also the experience of the surgeon. Some studies showed that the duration of surgery (LA) in obese patients is shorter than OA^{2,8}. Clarke et al. showed the opposite results in their article, the prolonged time of LA in obese patients in relation to OA in the same population³. Meta analyses have given the advantage to LA in obese patients in this category (duration of operation), but in line with the experience of the surgical staff^{9,10}. Our result (the average duration of the operation was 55 minutes) is very good compared to the literature. PH findings are as expected, most show phlegmonous inflammation. We emphasize the difficulty of establishing a diagnosis of AA in obese patients. In addition to the physical examination, laboratory findings (leukocytes, C reactive protein, procalcitonin) and echosonography, we increasingly use CT scans when we suspect AA. Physical examination is less sensitive because peritoneal tenderness is not as strong. As a result there is a somewhat higher number of mild, catarrhal inflammations, while the number of complicated AA is expected. Use of analgesics was significantly lower than in the population with normal weight. Most often two ampullas of metamizole or two infusions of neodolpasse were sufficient on the day of the operation and the first postoperative day. On the second postoperative day analgesics were administered at the patients' request. This is in accordance with the literature data^{4,5}. We are especially proud of the appearance of peristalsis on the first postoperative day in 80% of patients. This means the early peroral intake of food, the early mobilization of patients and a shorter

length of stay. Peristalsis occurred a few days later in complicated cases with generalized peritonitis, but that was expected. This result is somewhat better than in the literature where peristalsis is described on the second postoperative day in 80-90% of all cases of obese patients⁷. A shorter length of stay and similar frequency of complications are described in the literature in the obese population who underwent LA in relation to those who underwent OA (McBurney), and in relation to the population of normal weight who treated using LA⁵⁻⁷. Complications are rare in this population (obese patients with LA)¹⁰⁻¹². Ozozan et al. cite similar LOS but better outcomes of LA in obese patients. An American study from 2012 showed that LOS was 1-2 days shorter and summary morbidity was lower by 57% in obese patients treated by LA in relation to those treated by OA⁷. These results are reasonable when we consider the 4-6 cm operative wound from a McBurney incision, or a medial infraumbilical laparotomy in comparison to 2.5 cm (total length of three ports - 10 mm, 10 mm and 5 mm) during LA. In our data, LOS was similar, and the number of complications was smaller. We had two abscesses which were resolved using a conservative approach with antibiotics, and there was no need for reintervention. Both of those abscesses appeared after complicated appendicitis, in one case we did not insert a drain, in the other we did, but the outcome was the same. There were no surgical site infections, nor postoperative ileus during 30 day follow up. This is the same as in the literature, and the good result is the consequence of ensuring closure of the appendiceal stump with plastic clips (Hemo-o-lok). They are inert and cause the least possible reaction in tissue¹².

In the literature (systematic reviews and meta analyses) LA was first compared with OA in a population with normal BMI. After that there were publications which compared LA and OA in obese patients. The differences between these two approaches were greater in the group of obese patients because there is less trauma to the tissue of a thicker abdominal wall, a smaller possibility of wound infection, faster mobilization of patients, and therefore less danger of postoperative ileus and deep vein thrombosis^{9,11,13}.

Limitations of the study: The small sample, impossibility of comparison with an obese group who underwent OA because many of them underwent medial laparotomy under the clinical conditions of acute abdomen.

Conclusion: Laparoscopic appendectomy has advantages in relation to open appendectomy which especially benefit the population of obese patients, such as the shorter duration of surgery, shorter LOS, less consumption of analgesics and rare postoperative complications. Generally, LA give a better outcome and should be applied in future as much as possible.

Conflict of interests

The authors have no relevant financial or non-financial interests to disclose.

Patient Consent Form: All participants were informed about subject of the study.

Author's Contribution: Zoran Matković: Data curation, Visualization, Investigation, Writing-Reviewing. Nataša Đekić Matković: Conceptualization, Methodology, Writing- Original draft preparation, Supervision. Jovica Mišić: Investigation, Writing-Reviewing. Miloš Milićević: Visualization, Investigation, Supervision.

References

1. Wicramasinghe DP, Xavier C, Samarasekera DN. The Worldwide Epidemiology of Acute Appendicitis: an Analysis of the Global Health data Exchange dataset. *World J Surg.* 2021;45: 1999-2008.
2. Hussein AH, El-Baaly A, Ghareeb WM, Madbouly K, Gabr H. Outcome and quality of life in obese patients underwent laparoscopic vs. Open appendectomy. *BMC Surg.* 2022;23:22:282.
3. Clarke T, Katkhouda N, Mason RJ, Cheng BC, Olasky J, Sohn HJ, et al. Laparoscopic versus open appendectomy for the obese patients: a subset analysis from a prospective, randomised, double-blind study. *Surg Endosc.* 2011;25:1276-80.
4. Ozozan OV, Guldogan CE, Gundogdu E, Ozmen MM. Obesity and appendicitis: Laparoscopy versus open technique. *Turk J Surg.* 2020;18;36:105-109.
5. Varela JE, Hinojosa MW, Nguyen NT. Laparoscopy should be the approach of choice for acute appendicitis in the morbidly obese. *Am J Surg.* 2008;196:218-22.
6. Ignacio RC, Burke r, spencer D, Bissell C. Dorsainvil C, Lucha PA. Laparoscopic versus open appendectomy: what is the real difference? Results of a prospective randomised double-blinded trial. *Surg Endosc.* 2004;18:334-7.
7. Masson RJ, Moazzez A, Moroney JR, Katkhouda N. Laparoscopic vs open appendectomy in obese patients outcomes using the American College of Surgeons National Surgical Quality Improvement Program database. *J am Coll Surg.* 2012;215:88-99.
8. Corneille MG, Steigelman MB, Myers RJ, et al. Laparoscopic appendectomy is superior to open appendectomy in obese patients. *Am J Surg* 2007;194:877-81.
9. Saurelander S, Jachinski T, Neugebauer EA. Laparoscopic versus open surgery for suspected appendicitis.(review). *The Cochrane collaboration.* John Willey and Sons. 2010;10:1-139.
10. Katar MK, Baser m, Ersoy PE. Appendectomy in Patients with Morbid Obesity: Laparoscopic versus Conventional Techique. *Med Sci Monit.* 2020;26:e928067-1-e928067-5.
11. Dasari BVM, Baker J, Markar S, Gardner K. Laparoscopic appendectomy in obese is associated with improvements in clinical outcome systematic review. *Int J Surg.* 2015;13:250-256.
12. Delibegovic S, Matovic E. Hem-o-lok plastic clips in securing of the base of the appendix during laparoscopic appendectomy. *Surg Endosc.* 2009;23:2851-2854.
13. Bennett J, Boddy A, Rhodes M. Choice of approach for appendectomy. A meta- analysis of open versus laparoscopic appendectomy. *Surg Laparosc Endosc Percutan Tech.* 2007;17:245-255.

South-East European Endo-Surgery / INSTRUCTIONS TO AUTHORS

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Golub R, Siddiqui F, Pohl D. Laparoscopic versus open appendectomy: a meta analysis. *J Am Coll Surg.*1998;186:545-553.

VOLUME WITH SUPPLEMENT

Glauser TA. Integrating clinical trial data into clinical practice. *Neurology.* 2002;58(12 Suppl 7):S6-12.

CONGRESS PROCEEDINGS PAPER

Delaney C, Weese JL, Hyman NH for the Alvimopan Post-operative Ileus Study Group. Prospective, randomized, double-blind, multicenter, placebo-controlled study of alvimopan, a novel peripherally-acting new opioid antagonist, for postoperative ileus after major abdominal surgery (Study 14CL302). Abstract No. S41. Paper presented at the annual meeting of the American Society of Colon and Rectal Surgeons. 2004.

—BOOKS

INDIVIDUAL AUTHOR

Murray PR, Rosenthal KS. *Medical microbiology.* 4th ed. St. Louis: Mosby; 2002.

EDITOR AS AUTHOR

Sugarbaker PH. Observations concerning cancer spread within the peritoneal cavity and concept supporting an ordered pathophysiology. In: Sugarbaker PH, ed. *Peritoneal carcinomatosis: principle of management.* Boston, Massachusetts: Kluwer; 1996. P.79-100.

INSTITUTION AS AUTHOR

Royal Adelaide Hospital; University of Adelaide, Department of Clinical Nursing. *Compendium of nursing research and practice development, 1999-2000.* Adelaide (Australia): Adelaide University; 2001.

CHAPTER IN THE BOOK

Witmann DH, Walker AP, Condon RE. Peritonitis and intraabdominal infection. In: Schwartz SI, Shires GT, Spencer FC, eds. *Principles of Surgery.* New York: McGraw-Hill; 1994. P.1449-83.

CONGRESS BOOK OF ABSTRACTS

Delaney C, Weese JL, Hyman NH for the Alvimopan Post-operative Ileus Study Group. Prospective, randomized, double-blind, multicenter, placebo-controlled study of alvimopan, a novel peripherally-acting new opioid antagonist, for postoperative ileus after major abdominal surgery (Study 14CL302). Abstract No. S41. Paper presented at the annual meeting of the American Society of Colon and Rectal Surgeons. 2004.

DISSERTATIONS

Delibegovic S. Evaluacija prognostičkih modela u kritičnih bolesnika sa sekundarnim peritonitisom (disertacija). Tuzla: Univerzitet u Tuzli; 2000. P.1-101.

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CD-ROM

Anderson SC, Poulsen KB. Anderson's electronic atlas of hematology [CD-ROM]. Philadelphia: Lippincott Williams & Wilkins; 2002.

WEB ARTICLE FROM A JOURNAL

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INTERNET MONOGRAPH

Foley KM, Gelband H, editors. Improving palliative care for cancer [monograph on the Internet]. Washington: National Academy Press; 2001 [cited 2002 Jul 9]. Available from: <http://www.nap.edu/books/0309074029/html/>.

INTERNET DATA BASE

Open database:

Who's Certified [database on the Internet]. Evanston (IL): The American Board of Medical Specialists. c2000 - [cited 2001 Mar 8]. Available from:

<http://www.abms.org/newsearch.asp>

Closed database:

Jablonski S. Online Multiple Congenital Anomaly/Mental Retardation (MCA/MR) Syndromes [database on the In-

ternet]. Bethesda (MD): National Library of Medicine (US). c1999 [updated 2001 Nov 20; cited 2002 Aug 12]. Available from: http://www.nlm.nih.gov/mesh/jablonski/syndrome_title.html

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CONFLICT OF INTERESTS

Individuals who helped in study or manuscript preparations and are not listed as co-authors, should be listed at the end of manuscript under the heading „Acknowledgements“.

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