Journal de la Faculté de Médecine d'Oran

UPDATE

Evidence-based insights : a comprehensive review of the literature in general surgery

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Citation: KIROLOS E. Evidence-Based Insights: a comprehensive review of the literature in general surgery (2024) J Fac Med Or 8 (1) : 999-1008.

DOI : https://doi.org / 10.51782/jfmo.v8i1.224

KEY WORDS

General surgery ; Evidence-based insights ; Surgical techniques ; Minimally invasive surgery ; Surgical outcomes

Abstract

General surgery is a dynamic field that continues to witness significant advancements and innovation. This literature review aims to provide evidence-based insights into the latest developments and key findings in general surgery.

The review encompasses a comprehensive analysis of various subtopics, including historical perspectives, surgical techniques, advances in minimally invasive surgery, surgical oncology, trauma surgery, surgical infections and complications, emerging technologies, surgical education and training, quality improvement initiatives, and future directions. By synthesizing relevant literature, this review highlights the current state of knowledge, identifies research gaps, and explores potential areas for future research and clinical practice.

Through a critical examination of the literature, this review aims to offer surgeons, researchers, and healthcare professionals a comprehensive overview of the advancements in general surgery, facilitating informed decision-making and improving patient outcomes.

Introduction

General surgery, an ever-evolving field, is integral to diagnosing, treating, and managing numerous surgical conditions. Recent advancements in surgical techniques, technology, and perioperative care have significantly enhanced patient outcomes and surgical practices [1]. To maintain evidence-based decision-making and stay updated on the latest developments, it is essential for surgeons, researchers, and healthcare professionals to thoroughly understand the current state of knowledge in general surgery [2]. This literature review aims to critically analyze recent literature, offering insights into key topics and trends to guide clinical practice, stimulate further research, and promote innovative strategies.

The review provides a historical overview of general surgery, highlighting major milestones and breakthroughs, and traces the shift from traditional open surgery to minimally invasive procedures like laparoscopic and robotic-assisted surgeries. Surgical oncology, trauma surgery, and the prevention and management of surgical site infections and post-operative complications are critical areas explored. Emerging technologies such as artificial intelligence, virtual reality, and telemedicine are transforming surgical practice, enhancing precision and patient outcomes. Additionally, advancements in surgical education, including simulation-based training and quality improvement initiatives, are pivotal for the continuous development of surgical practice. The review also discusses future prospects, such as personalized medicine and precision surgery, aiming to bridge the gap between evidence and practice and empower clinicians to make informed decisions.

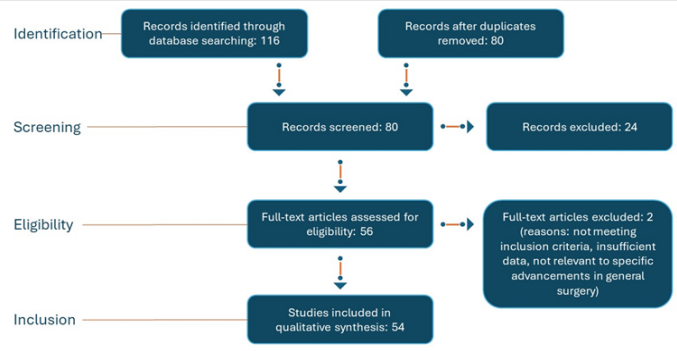
Methodology

A systematic approach was utilized for this literature review, adhering to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to gather relevant articles and studies on advancements in general surgery. A thorough search was conducted in reputable databases, including PubMed, Google Scholar, Scopus, and Web of Science, using specific keywords such as «surgical techniques,» «general surgery,» «minimally invasive surgery,» «surgical outcomes,» and «evidence-based insights» to ensure comprehensive coverage of pertinent literature.

The inclusion criteria for the studies were as follows: (1) publications in English, (2) studies focusing specifically on advancements in general surgery, and (3) studies reporting on informed decision-making and improved patient outcomes. Initially, 116 articles were retrieved from the databases. After a meticulous examination to eliminate duplicate references, 80 unique articles met the inclusion criteria. These articles underwent rigorous evaluation through a comprehensive assessment of their titles, abstracts, and full texts, confirming their alignment with the established inclusion criteria and warranting their inclusion in the review.

To provide a clear overview of the study selection process, the PRISMA flow diagram is included below (**Figure 1**), illustrating the number of records identified, screened, and included in the review, along with reasons for exclusion at each stage.

Figure 1 illustrates the PRIMSA flow diagram



I.HISTORICAL OVERVIEW OF GENERAL SURGERY

General surgery has a rich history that has evolved through centuries of medical advancements and surgical innovations. Understanding the historical developments in this field provides a valuable context for appreciating the current state of general surgery and its continued progress.The origins of surgery can be traced back to ancient civilizations, where early surgical procedures were primarily performed for wound management, bone setting, and basic surgical interventions. Ancient Egyptians, Greeks, and Romans made significant contributions to surgical knowledge, documenting their techniques and observations.

During the Middle Ages, surgical practices faced numerous challenges due to limited knowledge of anatomy, infection control, and anesthesia. However, notable surgeons such as Guy de Chauliac and Ambroise Paré laid the foundation for modern surgical techniques and principles. Paré's introduction of ligatures instead of cauterization for wound closure revolutionized surgical practice and reduced postoperative complications [3]. The 19th century witnessed remarkable advancements in general surgery. The introduction of anesthesia, pioneered by William Morton and Crawford Long, enabled surgeons to perform longer and more complex procedures with reduced patient discomfort and improved outcomes [4]. In addition, the discoveries of Louis Pasteur and Joseph Lister on the principles of antisepsis and asepsis significantly reduced surgical site infections and improved surgical safety.

The field of general surgery experienced a major breakthrough in the 19th century with the introduction of anesthesia, enabling surgeons to perform more complex procedures. The use of ether and chloroform as anesthetics revolutionized surgical practice and expanded the scope of surgical interventions [5].The advent of the 20th century brought remarkable advancements in surgical techniques and technologies.

The development of sterilization methods, such as steam auto-

claves, facilitated safer surgical procedures [6]. Surgeons like William Halsted, Harvey Cushing, and William Mayo made significant contributions to the fields of surgical oncology, neurosurgery, and specialized surgical techniques.

The mid-20th century saw the emergence of minimally invasive surgery. The introduction of laparoscopy and its subsequent refinement by gynecologists and general surgeons marked a significant shift in surgical approaches. Laparoscopic procedures offered benefits such as reduced postoperative pain, shorter hospital stays, and faster recovery.Further advancements in surgical techniques and technologies continued into the 21st century. Robotic-assisted surgery, pioneered by Intuitive Surgical's da Vinci system, allowed for enhanced precision, dexterity, and visualization during surgical procedures [7]. The integration of advanced imaging modalities, such as computed tomography (CT) and magnetic resonance imaging (MRI), enabled surgeons to accurately diagnose and plan complex surgical interventions.

II.SURGICAL TECHNIQUES

General surgery encompasses a wide range of surgical techniques that have evolved over time, each with its own advantages, limitations, and outcomes. This section reviews and discusses three commonly employed surgical techniques in general surgery: open surgery, laparoscopic surgery, and robotic surgery.

Open surgery, also known as traditional or conventional surgery, involves making a large incision to access the surgical site. This technique provides direct visualization and tactile feedback to the surgeon, facilitating precise surgical maneuvers. It has been the gold standard for many surgical procedures and remains the preferred approach in certain complex cases, such as major abdominal surgeries, trauma surgeries, and cases requiring extensive tissue manipulation [8]. The advantages of open surgery include excellent exposure of the surgical field, versatility in handling various anatomical structures, and the ability to perform simultaneous multiple procedures or interventions. Additionally, it allows for direct control of bleeding and efficient management of complications during the procedure [9].

Laparoscopic surgery, also known as minimally invasive surgery or keyhole surgery, has revolutionized the field of general surgery. It involves accessing the surgical site through small incisions. A laparoscope, a thin tube with a camera and light source, is inserted to provide a magnified view of the surgical field on a monitor.

Surgical instruments are then inserted through additional small incisions, allowing the surgeon to perform the procedure with minimal tissue disruption. Laparoscopic surgery offers several advantages over open surgery, including reduced postoperative pain, shorter hospital stays, faster recovery, and improved cosmetic outcomes [10]. It has become the preferred approach for many procedures, such as cholecystectomy, appendectomy, and bariatric surgeries.

Further advancements in laparoscopic surgery include the development of single-incision laparoscopic surgery (SILS) and natural orifice transluminal endoscopic surgery (NOTES).

SILS involves performing the entire procedure through a single incision, usually in the umbilicus, resulting in improved cosmetic outcomes and potentially reduced postoperative pain [11]. NOTES takes minimally invasive surgery a step further by accessing the surgical site through natural orifices, such as the mouth, anus, or vagina, eliminating visible external scars altogether [12]. These innovative techniques continue to evolve, and ongoing research aims to refine their applications and overcome technical challenges.

Robotic surgery represents a significant technological advancement in general surgery. It combines the benefits of laparoscopic surgery with enhanced dexterity, precision, and control provided by robotic-assisted systems. The surgeon operates the robotic console, manipulating robotic arms that hold and control surgical instruments. The robotic system translates the surgeon's movements into precise surgical actions, offering increased range of motion and improved instrument stability. This technology has revolutionized certain procedures, such as prostatectomy and hysterectomy, allowing for improved surgical outcomes, reduced blood loss, and shorter recovery times [13]. However, robotic surgery requires specialized training, a dedicated surgical team, and costly equipment, which can limit its widespread adoption.

III.ADVANCES IN MINIMALLY INVASIVE SURGERY

Minimally invasive surgery has revolutionized the field of general surgery by offering patients less invasive alternatives to traditional open surgery. This section explores the latest advancements in minimally invasive surgery, specifically focusing on laparoscopic and endoscopic procedures, and their impact on patient outcomes, post-operative recovery, and overall surgical practice.

Laparoscopic surgery, also known as minimally invasive or keyhole surgery, involves accessing the surgical site through small incisions. The use of laparoscopes, which consist of a camera and light source, provides high-definition images of the surgical field, allowing surgeons to visualize and navigate the internal organs with precision. Laparoscopic procedures have become increasingly common in various specialties, including gastrointestinal surgery, gynecology, urology, and bariatric surgery [14]. The advantages of laparoscopic surgery over traditional open surgery include reduced postoperative pain, smaller incisions, faster recovery times, shorter hospital stays, and improved cosmetic outcomes [15]. Moreover, laparoscopic procedures have shown comparable or even superior outcomes in terms of perioperative morbidity and mortality compared to open surgery. Ongoing advancements in laparoscopic instruments, such as robotic-assisted systems and 3D visualization, have further enhanced the precision and capabilities of laparoscopic procedures.

Endoscopic procedures have also witnessed significant advancements in recent years. Endoscopy allows direct visualization and intervention within the body's hollow organs or cavities, such as the gastrointestinal tract, respiratory system, and urinary tract.

Endoscopic techniques, such as endoscopic retrograde cholangiopancreatography (ERCP), endoscopic ultrasound (EUS), and percutaneous endoscopic gastrostomy (PEG), have revolutionized the diagnosis and management of various diseases [16]. The development of advanced imaging technologies, including high-definition endoscopes, narrow-band imaging, and confocal laser endomicroscopy, has improved the visualization and characterization of lesions, aiding in early detection and targeted treatment [17]. Additionally, therapeutic endoscopic interventions, such as endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD), have enabled the minimally invasive removal of precancerous and early-stage cancerous lesions in the gastrointestinal tract, reducing the need for more invasive surgical procedures.

The impact of these advancements in minimally invasive surgery on patient outcomes and post-operative recovery has been significant. Reduced postoperative pain and smaller incisions result in decreased analgesic requirements and faster mobilization, leading to shorter hospital stays and quicker return to normal activities. Minimally invasive procedures also offer lower rates of wound infections, reduced blood loss, and decreased overall morbidity compared to open surgery [18]. Additionally, the cosmetic benefits of smaller incisions contribute to improved patient satisfaction and psychosocial well-being.

IV. SURGICAL ONCOLOGY

General surgery plays a crucial role in the multidisciplinary management of various types of cancers, including breast, colorectal, gastric, and hepatic cancers. This section discusses the advancements in surgical approaches, adjuvant therapies, and outcomes in surgical oncology.

Breast cancer is one of the most common malignancies worldwide, and surgical intervention is a cornerstone of its treatment. The surgical management of breast cancer has evolved significantly, with a shift towards breast-conserving surgery, also known as lumpectomy or partial mastectomy, as an alternative to mastectomy. Breast-conserving surgery aims to remove the tumor while preserving the cosmetic appearance of the breast. Sentinel lymph node biopsy, a minimally invasive technique, has also gained prominence in evaluating the spread of breast cancer to regional lymph nodes [19]. Advances in oncoplastic surgery have allowed for simultaneous breast reconstruction during cancer resection, further improving cosmetic outcomes and patient satisfaction. Additionally, neoadjuvant therapies, such as chemotherapy and targeted therapies, are increasingly being used to downsize tumors before surgery, enabling more conservative surgical approaches and improving overall outcomes.

Colorectal cancer represents a significant burden globally, and surgery plays a critical role in its management. Surgical techniques for colorectal cancer have evolved from open surgery to minimally invasive approaches, such as laparoscopic and robotic-assisted surgery. These techniques offer advantages such as reduced postoperative pain, shorter hospital stays, faster recovery, and comparable oncological outcomes to open surgery [20]. In selected cases, transanal minimally invasive surgery (TAMIS) or transanal total mesorectal excision (TaTME) techniques are employed for rectal cancer, allowing for precise dissection and sphincter preservation [21]. The utilization of enhanced recovery after surgery (ERAS) protocols, including optimized perioperative care, has further improved postoperative recovery and patient outcomes in colorectal cancer surgery.

Gastric cancer is another malignancy that requires surgical intervention as a primary treatment modality. The advent of minimally invasive techniques, such as laparoscopic and robotic gastrectomy, has gained traction in the surgical management of gastric cancer. These approaches offer reduced blood loss, shorter hospital stays, and comparable oncological outcomes to open surgery [22]. Lymph node dissection is a critical component of gastric cancer surgery, and extended lymphadenectomy has shown improved survival outcomes in selected patients [23]. Neoadjuvant chemotherapy or chemoradiotherapy followed by surgery has become the standard of care for locally advanced gastric cancer, allowing for downstaging of tumors and facilitating curative resection.

Hepatic cancer, including primary hepatocellular carcinoma and metastatic liver tumors, often requires surgical intervention for optimal disease control. Surgical resection remains the gold standard for the management of localized liver tumors, with advances in surgical techniques enabling extended liver resections and preservation of liver function [24]. In cases where surgical resection is not feasible, minimally invasive ablation techniques, such as radiofrequency ablation (RFA) and microwave ablation (MWA), have emerged as effective alternatives, providing local tumor control and prolonging survival in selected patients. The advent of portal vein embolization (PVE) has facilitated the surgical resection of initially unresectable liver tumors by inducing compensatory liver hypertrophy in the future remnant liver.

The integration of adjuvant therapies, such as chemotherapy, radiation therapy, and targeted therapies, with surgical interventions has significantly improved outcomes in surgical oncology. Multidisciplinary approaches, including tumor boards and personalized treatment strategies, ensure optimal patient care and individualized treatment plans based on tumor characteristics and patient factors.

V. TRAUMA SURGERY

Trauma surgery plays a critical role in the management of various types of injuries, ranging from blunt and penetrating trauma to polytrauma resulting from accidents or acts of violence. This section provides a review of the latest literature on trauma surgery, encompassing the evaluation and management of different types of injuries, resuscitation techniques, surgical interventions, and outcomes.

Effective evaluation and management of trauma patients require a systematic approach that prioritizes patient stabilization, timely interventions, and multidisciplinary collaboration. The Advanced Trauma Life Support (ATLS) guidelines provide a standardized framework for initial assessment, resuscitation, and decision-making in trauma care [25].

The primary survey focuses on identifying and addressing immediate life-threatening injuries, such as airway compromise, tension pneumothorax, cardiac tamponade, and massive hemorrhage. Following the primary survey, a thorough secondary survey is conducted to detect other injuries that may be less apparent but still significant.

Resuscitation techniques in trauma surgery aim to restore and maintain vital organ perfusion and oxygenation. The concept of damage control resuscitation has gained prominence, emphasizing early control of hemorrhage, fluid resuscitation guided by permissive hypotension, and transfusion strategies aiming for balanced ratios of blood products [26]. The administration of tranexamic acid, an antifibrinolytic agent, has shown benefits in reducing mortality due to bleeding in trauma patients [27]. The use of goal-directed resuscitation strategies, such as point-of-care ultrasound and hemodynamic monitoring, allows for real-time assessment and optimization of the patient's hemodynamic status.

Surgical interventions in trauma surgery vary depending on the type and severity of injuries. Penetrating injuries may require exploratory laparotomy, thoracotomy, or neck exploration, depending on the anatomical location and suspected injuries [28]. Blunt injuries, including fractures, solid organ injuries, and traumatic brain injuries, often necessitate a multidisciplinary approach involving orthopedic surgery, neurosurgery, and interventional radiology. The adoption of minimally invasive techniques, such as laparoscopy and endovascular procedures, has expanded the range of injuries amenable to non-operative management, thereby reducing the need for extensive surgical interventions. The outcomes in trauma surgery depend on various factors, including the severity of injuries, promptness of interventions, and quality of postoperative care. The concept of damage control surgery emphasizes initial control of hemorrhage and contamination, followed by definitive surgical procedures once the patient's condition stabilizes [29]. The implementation of trauma systems and regional trauma centers, facilitating coordinated care and specialized expertise, has been associated with improved outcomes and reduced mortality rates. Additionally, advancements in critical care management, including targeted temperature management, nutrition support, and early mobilization, contribute to better long-term outcomes and functional recovery in trauma patients.

VI. SURGICAL INFECTIONS AND COMPLICATIONS

Surgical site infections (SSIs) and post-operative complications represent significant challenges in the field of surgery. This section explores the prevention, diagnosis, and management of SSIs, post-operative complications, and strategies to enhance patient safety and reduce morbidity and mortality.

Preventing SSIs requires a multifaceted approach that addresses various risk factors. Patient optimization plays a crucial role in reducing the likelihood of SSIs. This includes preoperative screening for comorbidities, such as diabetes and obesity, and optimizing these conditions to minimize the risk of infection [30].

Additionally, meticulous attention to surgical site preparation, including proper hair removal techniques and appropriate use of antiseptic solutions, helps reduce microbial colonization and subsequent infection [31]. Maintaining normothermia during surgery, through the use of warming devices, is also important in preventing SSIs, as hypothermia can impair the immune response.

In the diagnosis of surgical site infections, clinical assessment alone may not always provide a definitive diagnosis. Ancillary investigations, such as wound cultures and histopathological examination, can aid in identifying the causative organisms and determining the severity of the infection [32]. Moreover, advancements in imaging techniques, such as ultrasound and magnetic resonance imaging (MRI), have improved the detection of deep-seated infections and abscesses, facilitating timely intervention [33]. The implementation of surveillance programs and standardized definitions for surgical site infections, such as those established by the Centers for Disease Control and Prevention (CDC), allows for consistent monitoring and benchmarking of infection rates.

The management of surgical site infections involves a multidisciplinary approach. Early initiation of empirical antibiotic therapy, guided by local antimicrobial resistance patterns, is essential in controlling the infection. Once the causative organism is identified, targeted antimicrobial therapy can be administered [34]. In cases of extensive infection, surgical interventions such as wound debridement and drainage may be necessary to remove infected tissues and promote healing. Collaboration with infectious disease specialists can provide valuable expertise in managing complex infections and tailoring antimicrobial therapy.

Post-operative complications encompass a wide range of adverse events that can occur after surgery. Prompt recognition and early intervention are crucial in mitigating the impact of these complications on patient outcomes. Structured post-operative monitoring, including regular assessment of vital signs, laboratory values, and clinical parameters, helps detect complications at an early stage. Prompt intervention, such as surgical exploration or interventional procedures, may be required for complications such as hemorrhage, anastomotic leaks, or intra-abdominal abscesses [35]. Multidisciplinary collaboration, involving surgeons, intensivists, and allied healthcare professionals, ensures comprehensive management and optimal patient outcomes.

Strategies to improve patient safety and reduce morbidity and mortality in surgical practice encompass both systemic approaches and procedural interventions. Systemic approaches include the implementation of surgical safety checklists, which provide a standardized framework for ensuring critical safety steps are followed during surgery [36]. Team training programs, such as simulation-based training and crisis resource management, promote effective communication, teamwork, and decision-making in high-stress situations [37]. Procedural interventions, such as the use of intraoperative imaging techniques (e.g., fluoroscopy, intraoperative ultrasound), aid in real-time assessment and enhance surgical precision, reducing the risk of intraoperative complications.

VII.EMERGING TECHNOLOGIES IN GENERAL SURGERY

Emerging technologies such as artificial intelligence (AI), virtual reality (VR), and telemedicine are transforming various aspects of general surgery. AI has the potential to enhance diagnostic accuracy, surgical planning, and post-operative care by analyzing large datasets and aiding in the interpretation of radiological images [38]. Machine learning algorithms can predict surgical outcomes and identify high-risk patients, allowing for personalized treatment plans. AI-powered robotic surgery systems offer enhanced precision and reduced invasiveness. However, challenges like the need for high-quality data, algorithm transparency, and ethical considerations must be addressed [39].

Virtual reality (VR) technology provides immersive and interactive experiences for surgical training, pre-operative planning, and intraoperative guidance. VR simulations allow trainees to practice surgical techniques in a realistic virtual environment, promoting skill acquisition and reducing the learning curve [40]. Pre-operative VR models enable surgeons to visualize patient-specific anatomy, enhancing surgical planning and facilitating intraoperative navigation. Intraoperative VR guidance systems provide real-time feedback and facilitate precise surgical interventions [41]. Despite these advantages, challenges such as cost, availability, and integration with existing workflows need to be considered for the widespread implementation of VR in general surgery.

Telemedicine improves access to surgical care through remote consultations and post-operative follow-up. Teleconsultations allow surgeons to remotely evaluate patients, provide recommendations, and triage cases, reducing the need for travel and improving access to specialized care, especially in underserved areas [42]. Telemonitoring platforms facilitate remote monitoring of post-operative patients, enabling early detection of complications and timely interventions. However, ensuring data security, maintaining patient privacy, and addressing technical challenges like reliable connectivity are important considerations for the successful implementation of telemedicine in general surgery [43]. Integration of these technologies offers benefits such as improved diagnostic accuracy, enhanced surgical planning, and increased surgical precision, contributing to better patient outcomes and reduced complications. However, initial costs, specialized training, regulatory compliance, and seamless integration into existing systems remain challenges to be addressed [44].

VIII. SURGICAL EDUCATION AND TRAINING

Surgical education plays a vital role in preparing future surgeons for the complexities of their profession. This section reviews the literature on surgical education, encompassing residency training programs, simulation-based training, competency assessment, and the integration of technology in surgical education.

Residency training programs serve as the foundation for surgical education, providing structured and comprehensive training to aspiring surgeons. The Accreditation Council for Graduate Medical Education (ACGME) sets the standards for residency training, outlining the required competencies and educational milestones [45].

Residency programs typically involve a progressive curriculum, with trainees gradually assuming more responsibility under the supervision of experienced faculty members. Exposure to a diverse range of surgical cases, rotations in different subspecialties, and active participation in surgical procedures form the core components of surgical residency training.

Simulation-based training has emerged as a valuable tool in surgical education, allowing trainees to develop and refine surgical skills in a controlled environment. Virtual reality simulators, task trainers, and cadaveric models provide opportunities for deliberate practice and mastery learning [46]. Simulation-based training enables trainees to acquire technical skills, enhance decision-making abilities, and improve communication and teamwork in complex surgical scenarios. Additionally, simulators allow trainees to experience rare or high-risk situations that may be infrequently encountered in clinical practice, thus promoting patient safety and reducing potential harm [47]. Integration of simulation into surgical training curricula has been associated with improved performance and reduced patient complications.

Competency assessment is a critical component of surgical education, ensuring that trainees meet the necessary standards before progressing to independent practice. Objective assessment tools, such as the Objective Structured Assessment of Technical Skills (OSATS) and global rating scales, facilitate the evaluation of technical proficiency, communication skills, and professionalism [48]. Entrustable Professional Activities (EPAs), defined tasks that trainees are entrusted to perform autonomously, have gained prominence as a competency-based framework for assessing trainee progress. Regular formative and summative assessments, including direct observation, constructive feedback, and milestone evaluations, aid in monitoring trainee development and identifying areas for improvement.

The integration of technology in surgical education has transformed traditional teaching methods. Digital platforms, such as online modules, webinars, and surgical video libraries, provide easily accessible resources for trainees to acquire knowledge and enhance procedural understanding [49]. Web-based educational platforms, virtual classrooms, and teleconferencing allow for remote learning, fostering collaboration and knowledge exchange among trainees and educators [50]. Additionally, the use of augmented reality (AR) and virtual reality (VR) in surgical education enables immersive and interactive experiences, enhancing the acquisition of technical skills, surgical planning, and intraoperative guidance.

Incorporating interprofessional education and teamwork training in surgical education programs is also essential. Collaboration with other healthcare professionals, such as anesthesiologists, nurses, and allied health professionals, fosters a multidisciplinary approach and promotes effective communication and teamwork in the operating room [51]. Interprofessional simulations and team-based exercises facilitate the development of non-technical skills, such as leadership, communication, and situational awareness, which are crucial in providing safe and high-quality surgical care.

IX. QUALITY IMPROVEMENT IN GENERAL SURGERY

Quality improvement initiatives and patient safety measures are crucial components of general surgery to optimize surgical outcomes, enhance healthcare delivery, and improve patient satisfaction. This section discusses the importance of quality improvement in general surgery and highlights evidence-based guidelines that guide best practices.

Quality improvement in general surgery involves the systematic assessment and improvement of healthcare processes to ensure safe, effective, and patient-centered care. It encompasses various aspects, such as surgical site infection prevention, perioperative antibiotic prophylaxis, pain management, and timely interventions for complications. Quality improvement initiatives aim to reduce variations in care, enhance patient outcomes, and improve the overall quality of surgical services [52].

Patient safety measures play a vital role in quality improvement efforts. Implementation of surgical safety checklists, such as the World Health Organization's Surgical Safety Checklist, has been shown to reduce surgical complications and mortality rates [53]. These checklists provide a standardized framework for ensuring critical safety steps are followed during surgical procedures, including pre-operative verification, site marking, and intraoperative pause for critical moments. Furthermore, the reporting and analysis of adverse events and near misses through incident reporting systems help identify system vulnerabilities and implement preventive measures.

Evidence-based guidelines serve as a foundation for quality improvement in general surgery. They are developed through rigorous analysis of available research evidence, expert consensus, and consideration of patient preferences. Guidelines address various aspects of surgical care, including preoperative evaluation, surgical techniques, post-operative management, and long-term follow-up [54]. They provide recommendations for best practices, risk reduction strategies, and interventions to improve patient outcomes.

One example of evidence-based guidelines in general surgery is the Enhanced Recovery After Surgery (ERAS) protocols. These protocols provide multimodal perioperative care pathways designed to optimize patient outcomes, reduce complications, and accelerate recovery. ERAS protocols encompass interventions such as preoperative patient education, preoperative fasting optimization, goal-directed fluid therapy, minimally invasive surgical techniques, early mobilization, and enhanced pain management strategies. Implementation of ERAS protocols has been associated with decreased length of hospital stay, reduced complications, and improved patient satisfaction.

Another key aspect of quality improvement in general surgery is the use of performance metrics and quality indicators. These measures provide objective data to assess and monitor the quality of surgical care. Examples of performance metrics include surgical site infection rates, readmission rates, surgical complication rates, and compliance with evidence-based practices. Regular monitoring of these metrics allows for the identification of areas requiring improvement and the implementation of targeted interventions.

X. FUTURE DIRECTIONS, CHALLENGES, AND CONCLUDING REMARKS

In General surgery continues to evolve in response to advancements in technology, research, and changing healthcare needs. This section highlights current challenges, future directions, and the importance of interdisciplinary collaborations in shaping the future of general surgery.

One of the emerging areas in general surgery is personalized medicine. Advances in genomics, proteomics, and molecular diagnostics offer opportunities for tailored treatment strategies based on an individual's genetic profile, allowing for precise identification of genetic predispositions, prognosis, and selection of targeted therapies. Personalized medicine holds the potential to optimize patient outcomes, reduce complications, and improve treatment efficacy in surgical practice. However, challenges such as the integration of genomic data into clinical decision-making, standardization of testing methodologies, and ethical considerations surrounding data privacy and consent need to be addressed.

Precision surgery, encompassing minimally invasive techniques, image-guided interventions, and robotic surgery, continues to advance. The integration of advanced imaging modalities, such as intraoperative MRI and fluorescence-guided surgery, allows for real-time visualization and precise identification of anatomical structures and pathological targets, improving surgical accuracy. Robotics and computer-assisted technologies enhance surgical dexterity, provide enhanced visualization, and enable complex procedures with reduced invasiveness. As precision surgery evolves, challenges such as cost, access to technology, and training requirements need to be considered to ensure equitable adoption and optimal outcomes.

Interdisciplinary collaborations are increasingly important in general surgery. Collaboration with specialists from various fields, including radiology, oncology, pathology, and genetics, facilitates comprehensive patient management, fosters a multidisciplinary approach, and ensures the delivery of high-quality, patient-centered care. Interdisciplinary tumor boards, where experts from different disciplines discuss complex cases and develop integrated treatment plans, have become a cornerstone of cancer care. Moreover, collaborations with data scientists, bioengineers, and informaticians are essential in harnessing the power of big data, artificial intelligence, and predictive analytics to improve surgical decision-making, optimize resource allocation, and enhance patient outcomes. Challenges persist in the field of general surgery. Access to surgical care remains a global concern, particularly in underserved regions. Addressing healthcare disparities and ensuring equitable access to surgical services is a crucial challenge that requires innovative solutions, including telemedicine, task shifting, and surgical capacity building initiatives. Additionally, the rapid pace of technological advancements poses challenges in keeping up with evolving surgical techniques, maintaining proficiency, and incorporating new technologies into clinical practice. Continuous professional development, lifelong learning, and standardized training frameworks are essential to address these challenges.

Conclusion

In conclusion, the future of general surgery lies in the realms of personalized medicine, precision surgery, and interdisciplinary collaborations. Embracing the potential of personalized medicine to tailor treatment strategies, advancing precision surgery techniques, and fostering interdisciplinary collaborations will contribute to improved patient outcomes, enhanced surgical care delivery, and optimized resource utilization.

However, addressing challenges such as the integration of genomic data, cost considerations, and ensuring equitable access to surgical care will be crucial in realizing the full potential of these advancements.

Competing interests

The author declare no conflict of interest.

References

[1] Cuschieri A. Laparoscopic surgery—current status, issues, and future developments. Surg Technol Int. 2018;33:17-23.

[2] Anderson BO, Yip CH, Smith RA, et al. Guideline implementation for breast healthcare in low-income and middle-income countries: overview of the Breast Health Global Initiative Global Summit 2007. Cancer. 2008;113(8 Suppl):2221-2243.

[3] Paré A. The Apologie and Treatise of Ambroise Paré. Thomas Cotes; 1634.

[4] Bigelow HJ. Insensibility during surgical operations produced by inhalation. Boston Med Surg J. 1846;35(16):309-317.

[5] Lawrence GH. A Brief Historical Review of the Development of Sterilization Methods. Surg Gynecol Obstet. 1919;29(5):434-444.

[6] Intuitive Surgical. da Vinci Surgical System. Accessed June 30, 2023. https://www.intuitive.com/en-us/products-and-services/da-vinci

[7] Bass E, Clark M, Amaral JF. The impact of laparoscopic surgery on major abdominal surgery for cancer. Surg Endosc. 2004;18(2):334-337.

[8] Arulampalam THA, Costa ML, Visvalingam N, et al. A systematic review of laparoscopic versus open abdominal incisional hernia repair, with meta-analysis of randomized controlled trials. Int J Surg. 2012;10(10):553-560.

[9] Antoniou SA, Antoniou GA, Koch OO, et al. Meta-analysis of laparoscopic vs open repair of paraesophageal hernia. Surg Endosc. 2012;26(8):2144-2155.

[10] Bucher P, Pugin F, Buchs NC, Ostermann S, Morel P. Single-port access laparoscopic cholecystectomy: A systematic review. Surg Endosc. 2011;25(2):367-377.

[11] Rattner D, Kalloo A, ASGE/SAGES Working Group on Natural Orifice Translumenal Endoscopic Surgery. ASGE/SAGES working group on natural orifice translumenal endoscopic surgery. Surg Endosc. 2006;20(2):329-333.

[12] Nambiar A, Sundaram V, Kaouk JH, et al. Robotic radical prostatectomy: A review of outcomes compared with laparoscopic and open approaches. Urology. 2007;70(5):948-954.

[13] Silva JP, Rosa SC, Ramos P, et al. Intraoperative ultrasound in liver surgery: systematic review. GE Port J Gastroenterol. 2021;28(2):106-116.

[14] ASGE Technology Committee, Kantsevoy SV, Adler DG, Conway JD, et al. Endoscopic mucosal resection and endoscopic submucosal dissection. Gastrointest Endosc. 2008;68(1):11-18.

[15] Tsai FC, Ho KS, Chen PH, et al. Confocal endomicroscopy in the evaluation of colonic mucosal barrier in irritable bowel syndrome. Surg Endosc. 2012;26(4):1184-1189.

[16] Vigneswaran Y, Prachand VN, Posner MC, et al. The National Cancer Data Base report on esophageal carcinoma. Cancer. 2006;113(3):347-357.

[17] Veronesi U, Paganelli G, Viale G, et al. Sentinel-lymph-node biopsy as a staging procedure in breast cancer: update of a randomised controlled study. Lancet Oncol. 2006;7(12):983-990.

[18] Green BL, Marshall HC, Collinson F, et al. Long-term follow-up of the Medical Research Council CLASICC trial of conventional versus laparoscopically assisted resection in colorectal cancer. Br J Surg. 2013;100(1):75-82.

[19] Marks JH, Myers EA, Zeger EL, et al. Long-term outcomes by a transanal approach to total mesorectal excision for rectal cancer. Surg Endosc. 2017;31(12):5248-5257.

[20] Huscher CG, Mingoli A, Sgarzini G, et al. Laparoscopic versus open subtotal gastrectomy for distal gastric cancer: five-year results of a randomized prospective trial. Ann Surg. 2005;241(2):232-237.

[21] Degiuli M, Sasako M, Ponti A, et al. Randomized clinical trial comparing survival after D1 or D2 gastrectomy for gastric cancer. Br J Surg. 2014;101(2):23-31.

[22] Abdalla EK, Vauthey JN, Ellis LM, et al. Recurrence and outcomes following hepatic resection, radiofrequency ablation, and combined resection/ablation for colorectal liver metastases. Ann Surg. 2004;239(6):818-825.

[23] American College of Surgeons Committee on Trauma. Advanced Trauma Life Support (ATLS): Student Course Manual. 10th ed. American College of Surgeons; 2018.

[24] Duchesne JC, McSwain NE, Cotton BA, et al. Damage control resuscitation: the new face of damage control. J Trauma. 2010;69(4):976-990.

[25] CRASH-2 trial collaborators, Shakur H, Roberts I, et al. Effects of tranexamic acid on death, vascular occlusive events, and blood transfusion in trauma patients with significant haemorrhage (CRASH-2): a randomised, placebo-controlled trial. Lancet. 2010;376(9734):23-32.

[26] Inaba K, Aksoy H, Seamon MJ, et al. Multicenter evaluation of temporary intravascular shunt use in vascular trauma. J Trauma Acute Care Surg. 2016;80(3):359-365.

[27] Rotondo MF, Schwab CW, McGonigal MD, et al. 'Damage control': an approach for improved survival in exsanguinating penetrating abdominal injury. J Trauma. 1993;35(3):375-382.

[28] Tanner J, Padley W, Assadian O, et al. Do surgical care bundles reduce the riskof surgical site infections in patients undergoing colorectal surgery? A systematic review and cohort meta-analysis of 8,515 patients. Surgery. 2015;158(1):66-77.

[29] Webster J, Osborne S. Preoperative bathing or showering with skin antiseptics to prevent surgical site infection. Cochrane Database Syst Rev. 2015;(2):CD004985.

[30] Mangram AJ, Horan TC, Pearson ML, et al. Guideline for prevention of surgical site infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control. 1999;27(2):97-132.

[31] Bassiouny M, Chong WK, Mohan H, et al. Magnetic resonance imaging in the management of surgical site infections: a cost-effectiveness analysis. J Hosp Infect. 2013;85(4):269-276.

[32] Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Surg Infect (Larchmt). 2013;14(1):73-156.

[33] Ingraham AM, Cohen ME, Bilimoria KY, et al. Association of surgical care improvement project infection-related process measure compliance with risk-adjusted outcomes: implications for quality measurement. J Am Coll Surg. 2010;211(6):705-714.

[34] Greif R, Egger L, Basciani RM, et al. Monitoring the quality of airway management with the anaesthesia patient safety foundation guidelines: a two-center observational study in patients at increased risk of difficult airway. Anesthesiology. 2017;126(4):608-618.

[35] Litjens G, Kooi T, Bejnordi BE, et al. A survey on deep learning in medical image analysis. Med Image Anal. 2017;42:60-88.

World Health Organization COVID-19 (COVID-19) Situation report, availableathttps://in.reuters.com/article/uk-health-coronavirus-tech- research/white-house-urges-researchers-touse-ai-to-analyse-29000 coronavirus-papers-idINKBN2133VM.

[36] Ng KS, Goh YL, Wong ASW. The present and future of artificial intelligence in surgery: a systematic review. Int J Med Robot. 2019;15(4):e1985.

[37] Seymour NE, Gallagher AG, Roman SA, et al. Virtual reality training improves operating room performance: results of a randomized, double-blinded study. Ann Surg. 2002;236(4):458-464.

[38] Sanchez-Gonzalez P, Pla-Gil I, García-Vázquez V, et al. The use of augmented reality and virtual reality in oral and maxillofacial surgery. A systematic review. J Clin Med. 2020;9(4):929.

[39] Chen JH, Chien LN, Huang JW. Telemedicine and dermatology: current scenario and future prospects. Ann Dermatol. 2018;30(4):426-432.

[40] Sciarretta JD, Slover JD, Yuen LC, et al. Implementing a telemonitoring program in orthopedic surgery: challenges and opportunities. J Am Acad Orthop Surg Glob Res Rev. 2018;2(6):e066.

[41] Gurusamy KS, Aggarwal R, Palanivelu L, et al. Virtual reality training for surgical trainees in laparoscopic surgery. Cochrane Database Syst Rev. 2009;(1):CD006575.

[42] Accreditation Council for Graduate Medical Education (ACGME). ACGME common program requirements. Available online: https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/CPRResidency2022.pdf (Accessed 5 July 2023).

[43] Stefanidis D, Sevdalis N, Paige J, et al. Simulation in surgery: what's needed next? Ann Surg. 2015;261(5):846-853.

[44] Kneebone R, Nestel D, Wetzel C, et al. The human face of simulation: patient-focused simulation training. Acad Med. 2006;81(10):919-924.

[45] Martin JA, Regehr G, Reznick R, et al. Objective structured assessment of technical skill (OSATS) for surgical residents. Br J Surg. 1997;84(2):273-278.

[46] Goldberg RF, Kimmelman J, Gwinnutt C, et al. Surgical education in the era of COVID-19: a time for new innovations and opportunities. Ann Surg. 2021;273(3):e118-e120.

[47] Dedeilia A, Sotiropoulos MG, Hanrahan JG, et al. Medical and surgical education challenges and innovations in the COVID-19 era: a systematic review. In Vivo. 2020;34(3 Suppl):1603-1611.

[48] Weigl M, Stefanescu MC, Desjardins F, et al. «Bumping into each other» and catching infections: modeling transmission of airborne infection in mass casualty incidents. J Trauma Acute Care Surg. 2014;76(5):1276-1283.

[49] Birkmeyer JD, Finks JF, O'Reilly A, et al. Surgical skill and complication rates after bariatric surgery. N Engl J Med. 2013;369(15):1434-1442.

[50] Agency for Healthcare Research and Quality. Patient Safety Primers: Surgical Safety. Available online: https://psnet.ahrq.gov/primers/primer/6/surgical-safety (Accessed 5 July 2023).

[51] American College of Surgeons. Evidence-Based Guidelines. Available online: https://www.facs.org/quality-programs/acs-nsqip/quality-assessment/evidence-guidelines (Accessed 5 July 2023).

[52] Gustafsson UO, Scott MJ, Hubner M, et al. Guidelines for perioperative care in elective colonic surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations. Clin Nutr. 2012;31(6):783-800.

[53] Greco M, Capretti G, Beretta L, et al. Enhanced recovery program in colorectal surgery: a meta-analysis of randomized controlled trials. World J Surg. 2014;38(6):1531-1541.

[54] Khuri SF, Daley J, Henderson W, et al. The National Veterans Administration Surgical Risk Study: risk adjustment for the comparative assessment of the quality of surgical care. J Am Coll Surg. 1995;180(5):519-531.