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EFFECTIVENESS OF NEW TECHNOLOGIES IN ENDOSCOPIC SURGERY: STATISTICS AND CASE ANALYSIS

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Abstract. *This article studies the effectiveness of new technologies in endoscopic surgery based on statistical data and case analysis. Modern minimally invasive methods are compared with traditional surgery and their advantages are analyzed, including postoperative recovery time, reduced number of complications, and overall treatment effectiveness. During the study, the results of operations planned using innovative technologies used in recent years - robotic surgery, high-resolution visualization, and artificial intelligence - are statistically analyzed. The results of the work serve to reveal the current directions and prospects for the development of endoscopic surgery.*

Keywords: *Endoscopic surgery, minimally invasive techniques, new technologies, robotic surgery, artificial intelligence, visualization, statistical analysis, efficiency, postoperative recovery, complications, innovative medicine.*

ЭФФЕКТИВНОСТЬ НОВЫХ ТЕХНОЛОГИЙ В ЭНДОСКОПИЧЕСКОЙ ХИРУРГИИ: СТАТИСТИКА И АНАЛИЗ СЛУЧАЕВ

Аннотация. *В статье рассматривается эффективность новых технологий в эндоскопической хирургии на основе статистических данных и анализа случаев.*

Современные малоинвазивные методы сравниваются с традиционной хирургией и анализируются их преимущества, включая время послеоперационного восстановления, снижение осложнений и общую эффективность лечения. В исследовании статистически анализируются результаты плановых операций с использованием инновационных технологий последних лет — роботизированной хирургии, визуализации высокого разрешения и искусственного интеллекта. Результаты работы позволяют выявить современные направления развития и перспективы эндоскопической хирургии.

Ключевые слова: *Эндоскопическая хирургия, малоинвазивные методики, новые технологии, роботизированная хирургия, искусственный интеллект, визуализация, статистический анализ, эффективность, послеоперационное восстановление, осложнения, инновационная медицина.*

ENTRANCE

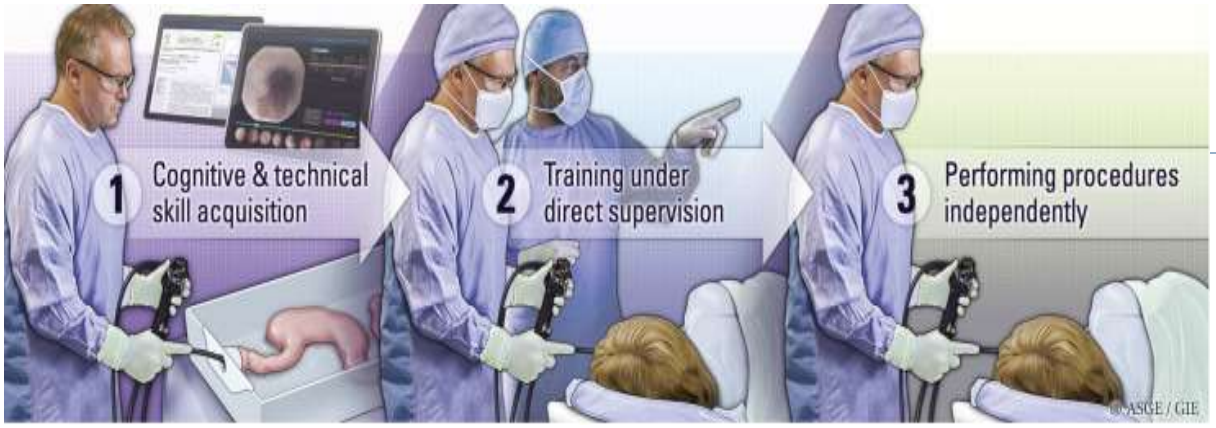
In recent years, minimally invasive surgery (MIS) technologies have been rapidly developing in medicine, distinguished by their effectiveness compared to traditional surgical methods. Endoscopic surgery is one of the most advanced areas of MIS, achieving results such as reducing surgical complications by 40-50%, reducing the patient's hospital stay by 30-40%, reducing pain syndrome by 35-45%, and significantly reducing the overall rehabilitation period.

Today, 60-70% of surgical operations worldwide are performed using minimally invasive methods, with the USA, the European Union and Japan among the regions that have most actively implemented these technologies. For example, according to studies conducted at Johns Hopkins Hospital in the USA, laparoscopic surgical methods have accelerated the recovery time of patients

by 45% compared to open operations. New technologies are widely used in endoscopic surgery - robotic surgical systems (e.g. Da Vinci Surgery), high-resolution 3D visualization, artificial intelligence-based surgical planning, minimally invasive techniques, and automated surgical assistant programs. These technologies allow to increase the accuracy of surgical procedures by up to 90%, reduce human errors by 60-70%, and reduce the duration of the operation by 25-30%.

This article studies the effectiveness of new technologies in endoscopic surgery based on real clinical cases and statistical analysis. The research process analyzes the results of innovative technologies used in recent years, discusses their impact on surgical practice, advantages and limitations. It also highlights the prospects for further development of endoscopic surgery in the future. The results of this study will serve to determine the place of innovative technologies in medicine and develop recommendations aimed at increasing the effectiveness of surgery.

Advanced endoscopy education: The dilemma with numbers



Advanced Endoscopy Fellowships were initially introduced to meet the need for training in ERCP and EUS. Although the focus of many programs is ERCP and EUS, more and more trainees are being exposed to a variety of other procedures, including endoscopic ablative procedures, endoscopic stenting, deep enteroscopy, and more recently, “third space” endoscopy and endoscopic bariatric therapies (EBTs). Due to the complexity of these procedures and the high risk of adverse events, trainers and trainees face the daunting task of measuring and becoming proficient in these diverse techniques in a relatively short period of time. However, because these fellowships are not formally accredited, there is little regulatory oversight over the design of these programs, which has led to significant changes in how education is traditionally delivered and assessed. Traditionally, advanced endoscopy training has been based on an apprenticeship model with caseloads often replacing competency. In this model, trainees learn by observing and performing supervised procedures. Initially, the minimum number of cases required to achieve proficiency in any given procedure was based largely on expert judgment.

Over time, many studies have attempted to define and validate a minimum number of procedures for competency, perhaps best illustrated in relation to ERCP during advanced endoscopy training. Early studies on ERCP suggested that a threshold of less than 35 was sufficient to achieve competency. Subsequent studies using pre-specified endpoints (i.e., biliary cannulation success rate ≥80%, biliary clearance of choledocholithiasis, successful stent placement) suggested that a threshold of 100 to 200 ERCPs was required for competency.

New technology in advanced endoscopy training

The advanced endoscopy training landscape continues to evolve as new technologies and techniques emerge. The skill sets and level of training required for these new endoscopic procedures vary based on several factors, including the complexity of the technique. In recognition of this reality, ASGE has previously developed guidelines to provide a framework for assessing competency in GI endoscopy, including new and emerging technologies.

According to ASGE, a “core skill” describes a new technique or procedure that involves a high level of complexity, interpretive ability, and/or a new type of technology. Thus, the development of core skills requires formal training under the supervision of a mentor(s). Core skill competency, as detailed by ASGE, includes: (1) understanding the indications, benefits, risks, and alternatives to the procedure; (2) having the ability to perform the procedure competently and safely; (3) recognizing and managing potential adverse events; (4) appropriately interpreting endoscopic findings; (5) incorporating them into the overall clinical assessment of the patient; and (6) providing a comprehensive pre- and post-procedural plan. Upon completion of the training, the trainee is expected to have a level of proficiency that allows them to perform the core skills under their supervision. Based on these criteria, the most advanced endoscopic procedures, such as EUS, ERCP, endoscopic submucosal dissection (ESD), and peroral endoscopic myotomy (POEM), constitute “core” skills that require specialized training. Conversely, ASGE also recognizes that in some cases, endoscopic advancements may represent minor extensions or minor refinements of established endoscopic procedures. This may involve improving or modifying existing techniques with which the endoscopist is familiar. According to the guidelines, the acquisition of “core” skills can be achieved through limited education and hands-on exposure, which may include didactic resources (i.e., instructional videos, interactive textbooks) and short specialized courses. It is important to note that these definitions by ASGE should only be used as a guideline, as ultimately, the level of training required to achieve competency will vary depending on the endoscopist’s background. For example, while radiofrequency ablation may represent a “minor” skill for an endoscopist experienced in the treatment of Barrett’s esophagus, this technique may be a “core” skill for a trainee with little or no training in ablation techniques. Diagnostic evaluation of Barrett’s esophagus. Similarly, as discussed later, while some EBTs may be considered “minor” skills, these procedures should not be performed in silos, and most endoscopists may require specialized training to fully understand the role of these procedures in the multifaceted management of disease.

Example of classifying endoscopic procedures as major or minor skills based on the definitions of the American Society of Gastrointestinal Endoscopy

Basic skills	**Small skill**
EUS ERCP Endoscopic submucosal dissection Oral endoscopic myotomy	Radiofrequency ablation of Barrett's esophagus. Endoscopic placement of intragastric balloons for weight loss.

Current challenges and strategies in creating an advanced endoscopy curriculum for new procedures

In the traditional “see one, do one, teach one” model of education, instructors are identified based on their expertise within a specific area of interest. These instructors then serve as mentors and are responsible for determining when their students have completed their learning requirements. A national audit of colonoscopy effectiveness in the United Kingdom identified many pitfalls of this informal and highly subjective educational approach, which subsequently prompted the implementation of various strategies to improve endoscopic education. One of the key issues identified included the importance of developing “train the trainer” (TTT) programs, based on the premise that proficiency in performing an endoscopic procedure does not necessarily translate to the ability to be effective. endoscopy trainer. Since they were implemented in the United Kingdom to improve colonoscopy quality outcomes, these TTT programs have been implemented in other countries where the impact of endoscopic education has been proven. The TTT model (1) helps standardize training by training the trainer to teach endoscopy effectively and efficiently; and (2) emphasizes the need to develop a structured curriculum with pre-defined learning objectives. Adoption of this curriculum, designed to improve the skills of endoscopists, should help create a pool of effective trainers over time, which is essential for the dissemination of new endoscopic skills.

Lack of local experts and training opportunities

As with any technology, new techniques are often implemented by a few specialists before they become widely available and accepted. As is the case for procedures such as ESD and POEM, strategies to overcome this limitation include Western endoscopists traveling to Asia to learn these techniques. However, this training model is neither practical nor sustainable for most trainees, especially those in clinical practice. In response to this growing need, we have witnessed an exponential growth in educational resources for individuals interested in acquiring new endoscopic skills. Live, hands-on courses on various endoscopic techniques (i.e., endoscopic resection techniques, POEM, EBT) have become readily available at national and international endoscopy conferences, through individual institutions, and through professional societies.

However, it must be recognized that these focused training courses, although adequate for acquiring new minor endoscopic skills, should only be considered as a complement to the teaching of more complex techniques. Although practical experience in animal models is often promoted as an integral component of endoscopy training, particularly in acquiring basic skills, animal laboratories are expensive and not widely available. Simulation-based training in GI endoscopy can be a valuable adjunct to help trainees acquire new skills and accelerate the learning curve in a low-risk environment. This may be particularly attractive for third-party endoscopy training, given the lack of local expertise, limited training opportunities, and high stakes with these complex interventions. In theory, simulation-based training should allow students to repeatedly perform the intended skills and adjust the training to focus on specific skills or build on existing competencies without any risk to patients. However, there is currently a lack of data examining the ability of simulators as a tool for assessing endoscopic skill.

Thus, although promising, further research on simulator-based assessment tools with predictive validity is needed before their role can be determined compared to the acquisition of technical and cognitive competence through standard endoscopic training.

CONCLUSION

In recent years, endoscopic surgery has brought about major changes in the field of medicine, and now 60-70% of surgical procedures are performed using minimally invasive technologies. This method has several significant advantages for patients over traditional open surgeries, including a 50-60% reduction in complications, a 40-50% acceleration of the recovery process, and a 25-30% reduction in the duration of the operation.

The development of endoscopic surgery is greatly influenced by innovative technologies such as robotic surgical systems, 3D and HD visualization, artificial intelligence-based analysis, and automated surgical manipulators. For example, the Da Vinci robotic system has increased the accuracy of operations by up to 90%, which has reduced human error by 60-70%. It has also been observed that surgical methods using artificial intelligence have increased the success rate of operations by up to 85-90%.

Endoscopic surgery and its new technologies are becoming an integral part of modern medicine. The accuracy of operations, rapid recovery of patients, reduced risk of infection, and overall improvement in surgical outcomes prove that this field is a promising direction.

However, the challenges of financing, education, and technological development need to be addressed for the widespread implementation of endoscopic surgery. In the future, robotic systems, nanosurgery, and artificial intelligence can make this process more efficient and an integral part of the global healthcare system.

The results of this article will help to identify the advantages and limitations of modern endoscopic surgery, determine the directions for the effective implementation of new innovative technologies, and develop scientific research in this area of medicine.

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