Volume 1 • Issue 2

Topics in Biomedical Research and Education

Official Journal
Research and Education Institute in Biomedical Sciences

ISSN: 2945-0675

2023

Topics in Biomedical Research and Education

Quarterly Scientific Publication of REIBS
Research and Education Institute in Biomedical Sciences

Submissions
https://reibs.org.gr/topics-in-biomedical-research-and-education

Instructions for Authors
https://reibs.org.gr/instructions-to-authors

Publisher/Owner
RESEARCH AND EDUCATION INSTITUTE IN BIOMEDICAL SCIENCES
92-94 Kolokotroni str.
GR-185-35 Pireaus, Attika, Greece
Tel: +30.6986564295
E-mail: irebiomeds@gmail.com

Open Access Journal
ISSN: 2945-0675

April-June 2023 | Volume 1, Issue 2

CONTENTS

Editorial

AI in Laparoscopic Surgery Training

Dimitrios Filippou

Research and Education Institute in Biomedical Sciences (REIBS), Piraeus-Athens, Greece
School of Medicine, National and Kapodestrian University of Athens, Athens, Greece

Artificial intelligence (AI) is increasingly being integrated into various fields of medicine, including training in laparoscopic surgery. Laparoscopic surgery is a minimally invasive surgical technique that involves the use of small incisions and specialized tools to perform surgical procedures. Laparoscopic training is essential to ensure that surgeons can perform these complex procedures with the highest level of skill and safety. Here are some of the benefits of using AI for laparoscopic surgery training:

Improve skill acquisition. Artificial intelligence can provide realistic simulations of laparoscopic surgery, allowing surgeons to practice and hone their skills in a virtual environment. This can lead to faster skill acquisition as surgeons can perform more operations without the need for a live patient. In addition, AI-based simulations can provide surgeons with feedback and guidance, helping them identify areas for improvement. One of the main advantages of using AI in laparoscopic surgery training is the ability to provide personalized guidance. AI systems can analyze student performance and provide specific feedback and suggestions to help them improve. This personalized instruction helps students develop their skills more quickly and efficiently and improve their performance in the OR. AI systems can also be used to identify patterns in surgeries and provide insights into best practices and potential areas for improvement. By analyzing large datasets of surgical procedures, AI systems can identify common errors and provide guidance on how to avoid them. This helps students develop their skills more quickly and efficiently and improve their performance in the operating room. Another advantage of using AI in laparoscopic surgery training is the ability to provide real-time feedback. The AI system can analyze students' performance during the procedure and provide real-time information and guidance. This helps students correct errors as they occur and develop their skills more quickly and effectively. Despite the many potential benefits of using AI in laparoscopic surgery training, there are challenges that need to be addressed. Technical limitations, such as the need for precise tracking of surgical instruments, can affect the effectiveness of these systems. In addition, ethical considerations such as the potential for over-reliance on technology and the need for human oversight must be taken into account.

Improve efficiency. AI can streamline the training process for laparoscopic surgery by automating certain tasks, such as creating a personalized training plan or tracking a student's progress. This frees up trainers to focus on other aspects of training, such as training students in person.

Enhance Safety. Laparoscopic surgery is inherently risky, and the use of artificial intelligence in training can help reduce the risk of surgical errors. By providing realistic simulations and feedback, AI can help surgeons identify potential risks and practice risk mitigation techniques.

Cost Effectiveness. Training in traditional laparoscopic surgery can be expensive due to the need for live patients, specialized equipment, and experienced instructors. AI-based simulations can significantly reduce training costs while providing a more consistent and standardized training experience.

The application of artificial intelligence and digital technologies is increasingly gaining the attention of experts and universities around the world. Surgeons learn about a useful tool that promises to transform current surgical approaches and improve the efficiency and safety of surgical care worldwide. But what are the most promising applications of AI in surgical training and practice? Here are some of the main applications of AI in laparoscopic surgery:

Simulations. AI-based simulations can provide students with a realistic and immersive environment to practice and hone their skills. These simulations replicate complex surgical scenarios, allowing students to learn and practice in a safe and controlled environment. In addition, AI can provide students with real-time feedback, helping them identify areas for improvement.

Personalized training. Artificial intelligence can be used to create a personalized training plan for each learner, taking into account their skill level, experience and learning style. This helps to increase the effectiveness of the training as each learner can focus on the areas where they most need improvement.

Surgical planning. AI can be used to plan and optimize surgical procedures, taking into account factors such as the patient's anatomy, the surgical site, and the skill level of the surgical team. This helps reduce the risk of surgical errors and complications. AI can also play a role in preoperative planning. By analyzing medical records, scans and other patient data, AI algorithms can help surgeons plan the most effective surgical approach and predict potential complications even before surgery begins. However, it is important to note that AI is not designed to replace human surgeons. Instead, AI is designed to augment and assist surgeons in their work. Human expertise and judgment are always essential to the success of any surgical procedure, and AI should be used as a tool to support and enhance the work of skilled surgeons.

Robotics. Surgical robots with artificial intelligence are becoming more common in laparoscopic surgery, allowing surgeons to perform complex procedures with greater precision and control. These robots can be programmed to perform specific tasks, such as sewing or manipulating tissue, freeing up the surgeon's hands for other tasks.

Data analysis. AI can be used to analyze surgical data, such as video recordings of procedures or patient outcomes, to identify patterns and trends. The data can be used to improve surgical techniques, improve training programs, and develop new surgical tools and techniques.

The most popular applications of modern technology that use AI algorithms are virtual reality simulations and augmented reality visualizations. Their main applications include education and training, and until recently they were not used for diagnostic or treatment purposes.

Virtual reality (VR) simulations are becoming an increasingly popular tool in endoscopic surgery. Laparoscopic surgery is a minimally invasive surgical technique that requires a high level of skill and precision, so it is important that surgeons receive extensive training before performing these procedures on patients. Traditionally, training in laparoscopic surgery involves hands-on experience with live patients, which can be very time-consuming,

expensive and risky. However, with the advent of virtual reality simulation technology, surgeons can now practice and hone their skills in a safe and controlled environment. In a virtual reality simulator, a surgeon puts on a headset and uses specialized tools to perform virtual surgery on a computer-generated patient. Simulation software provides a realistic and interactive environment that allows surgeons to practice different surgical techniques and procedures. Surgeons also receive real-time feedback on their performance, allowing them to identify areas of improvement and improve their skills over time. One of the greatest benefits of VR simulation in laparoscopic surgery training is the ability to replicate the variety of scenarios and complications that can arise during a real surgical procedure. Surgeons can practice managing unexpected events, such as bleeding or organ damage, in a safe and controlled environment, improving their confidence and decision-making skills. In addition, virtual reality simulations offer a cost-effective way to train surgeons. Because the simulation can be repeated as many times as necessary, surgeons can practice until they are confident and ready to operate on live patients. This helps reduce the number of complications and errors during the actual surgery, improve patient outcomes and reduce healthcare costs.

Augmented reality (AR) technology has revolutionized the field of endoscopic surgery by providing students with a highly interactive and immersive experience. AR technology improves the visualization of anatomy and surgical procedures, increases the precision of surgery and reduces the risk of complications. Using AR visualization in laparoscopic surgery allows students to practice complex surgical procedures in a safe and controlled environment without the need for real patients. Using augmented reality, students can view and interact with virtual 3D models of organs and tissues, providing a more realistic and detailed representation of the surgical field. Augmented reality displays also allow for real-time feedback, allowing participants to accurately measure their performance and adjust their technique accordingly. This technology can be used in both basic and advanced surgical training, providing novice and experienced surgeons with a powerful tool to hone their skills. In addition, augmented reality visualization can improve the overall efficiency of surgical procedures by reducing operating time and reducing the risk of complications. Technology can also improve communication and collaboration between surgical teams, resulting in a more coordinated and efficient workflow. Overall, the use of AR visualization in laparoscopic surgery training is an invaluable tool to improve surgical precision, reduce the risk of complications, and improve the overall efficiency of surgical procedures. As augmented reality technology continues to evolve, it will undoubtedly become an essential part of surgical training and practice.

Haptic feedback devices. Tactile feedback devices are becoming an increasingly popular training tool in endoscopic surgery. These devices provide the user with a sense of touch, allowing them to feel feedback from the virtual environment in which they develop. In laparoscopic surgery, haptic feedback devices can provide a more realistic simulation of the surgical environment, helping students develop skills and improve performance. One of the main benefits of haptic feedback devices in laparoscopic surgery training is the ability to improve patient safety. Using haptic feedback devices, students can practice surgical techniques in a safe and controlled environment without the risk of harming real patients. This allows them to gain confidence and experience before performing the

procedure on real patients. Another advantage of haptic feedback devices is the ability to reduce surgical errors and complications. By providing real-time feedback to users, these devices can help students identify and correct errors when they occur. This can lead to better surgical results and fewer complications after surgery. Tactile feedback devices can also personalize student learning. By adjusting the level of feedback and the difficulty of the simulation, the device can adapt to the user's skill level, providing a personalized training experience. This helps students develop at their own pace and develop their skills in the most effective way. While haptic feedback devices offer many advantages in laparoscopic surgery training, there are also challenges that need to be addressed. Technical limitations, such as the need for precise tracking of surgical instruments, can affect the effectiveness of these devices. Ethical considerations, such as the possibility of surgical desensitization, must also be taken into account.

Intelligent tutoring systems. An Intelligent Learning System (ITS) is a computer system that uses artificial intelligence (AI) to provide users with personalized and adaptive education. In laparoscopic surgery training, ITS can be an invaluable tool for students to develop skills and improve performance. A major advantage of ITS in endoscopic surgery training is the ability to provide individualized instruction. By adapting to the individual needs of users, these systems can personalize the training experience to improve learning outcomes. Intelligent Transportation Systems (ITS) can adjust difficulty, provide performance feedback, and suggest improvements based on user performance. Another advantage of ITS is the ability to provide real-time feedback to users. In laparoscopic surgery, students must be able to perform the procedure quickly and accurately. The Intelligent Transfer System (ITS) provides immediate feedback on a learner's performance, allowing them to correct mistakes and improve skills more quickly. ITS can also be used to improve the efficiency of traditional training methods in endoscopic surgery. By integrating ITS into existing training programs, students receive more customized and personalized training. This results in better retention of knowledge and skills and better intraoperative performance. Despite the many potential benefits of ITS for laparoscopic surgery training, there are challenges that need to be addressed. Technical limitations, such as the need for precise tracking of surgical instruments, can affect the effectiveness of these systems. In addition, ethical considerations such as the potential for over-reliance on technology and the need for human oversight must be taken into account.

Machine Learning Algorithms. Machine learning (ML) algorithms are becoming an increasingly popular training tool for laparoscopic surgery. These algorithms use large data sets to train models that can analyze and explain surgical procedures, allowing students to learn from past cases and improve their skills. One of the main advantages of ML algorithms in laparoscopic surgery training is the ability to quickly and accurately analyze large amounts of data. By analyzing past surgical cases, these algorithms can identify patterns and provide insights into best practices and potential areas for improvement. This allows students to learn realistic surgical procedures and develop their skills more effectively. Another advantage of machine learning algorithms is the ability to provide personalized instructions. By analyzing learner performance and identifying areas for improvement, these algorithms can tailor the training experience to improve learning

outcomes. This results in better retention of knowledge and skills and better surgical performance. ML algorithms can also be used to improve the efficiency of traditional training methods in endoscopic surgery. By integrating machine learning algorithms into existing training programs, students can receive more personalized and adaptive training. Despite the many potential advantages of ML algorithms for endoscopic surgery training, there are some challenges that need to be addressed. Technical limitations, such as the need for large data sets and advanced computing power, can affect the efficiency of these algorithms. In addition, ethical considerations such as potential bias must be taken into account when analyzing datasets. We strongly believe that machine learning algorithms have the potential to revolutionize laparoscopic surgery training. By analyzing large data sets, providing personalized guidance, and improving the efficiency of existing training methods, machine learning algorithms can help students develop their skills and improve their performance in the operating room. As research and development continues, machine learning algorithms may become an important tool in surgical training in the future.

Artificial intelligence challenges in laparoscopic surgery training. Despite the many potential benefits of using AI in laparoscopic surgery training, some challenges must also be addressed. Some of these challenges include technical limitations, ethical considerations, and the need for ongoing research and development. A major technical limitation of AI in laparoscopic surgery training is the need for precise tracking of surgical instruments. This requires sophisticated tracking systems that can precisely monitor the position and movement of instruments during surgery. If the tracking system is not accurate, the AI system's feedback and recommendations can be useless or even harmful. Another challenge with using AI for laparoscopic surgery training is the potential for over-reliance on the technology. Students may over-rely on AI systems for guidance and feedback, resulting in a lack of critical thinking and decision-making skills. Additionally, there may be concerns that the analysis of datasets used by AI systems is biased, which may affect the accuracy and effectiveness of the recommendations made. Technical considerations are also important factors to consider when using AI in laparoscopic surgery. For example, there may be concerns about patient privacy and the security of sensitive medical data. Additionally, there may be concerns that AI systems could replace human teachers, leading to job losses in the medical field. Finally, further research and development is needed to further improve the effectiveness of AI in laparoscopic surgery training. This includes developing more sophisticated monitoring systems, improving the algorithms used in artificial intelligence systems, and conducting rigorous clinical trials to assess the safety and effectiveness of these systems.

In conclusion, the incorporation of AI into training for laparoscopic surgery has the potential to revolutionize the way surgeons are trained. By providing realistic simulations, personalized instructions and automated monitoring, AI can help surgeons gain the skills and experience needed to perform laparoscopic surgery with the highest level of safety and efficiency.

References

1) Moglia A, Georgiou K, Georgiou E, Satava RM, Cuschieri A. A systematic review on artificial intelligence in robot-assisted surgery.

Int J Surg. 2021 Nov; 95: 106151. doi: 10.1016/ j.ijsu.2021. 106151

2) Levi Sandri GB, Abu Hilal M, Dokmak S, Edwin B, Hackert T, Keck T, Khatkov I, Besselink MG, Boggi U; E-AHPBA Innovation & Development Committee. Figures do matter: A literature review of 4587 robotic pancreatic resections and their implications on training. J Hepatobiliary Pancreat Sci. 2023 Jan;30(1):21-35. doi: 10.1002/jhbp.1209

3) Humm G, Harries RL, Stoyanov D, Lovat LB. Supporting laparoscopic general surgery training with digital technology: The United Kingdom and Ireland paradigm. BMC Surg. 2021 Mar 8;21(1):123. doi: 10.1186/s12893-021-01123-4

4) Wee IJY, Kuo LJ, Ngu JC. A systematic review of the true benefit of robotic surgery: Ergonomics. Int J Med Robot. 2020 Aug;16(4):e2113. doi: 10.1002/rcs.2113

5) Batista Rodríguez G, Balla A, Corradetti S, Martinez C, Hernández P, Bollo J, Targarona EM. What have we learned in minimally invasive colorectal surgery from NSQIP and NIS large databases? A systematic review. Int J Colorectal Dis. 2018 Jun;33(6):663-681. doi: 10.1007/s00384-018-3036-4

6) Bric JD, Lumbard DC, Frelich MJ, Gould JC. Current state of virtual reality simulation in robotic surgery training: a review. Surg Endosc. 2016 Jun;30(6):2169-78. doi: 10.1007/s00464-015-4517-y

Letter to the Editor

From the Ethics of Hippocrates to the Deontology of Scientific Research & Writing

Victoria Polydorou

European University Cyprus, School of Medicine, Nicosia, Cyprus.

Correspondence Address: Victoria Polydorou MD, PhD, European University Cyprus, School of Medicine, Nicosia, Cyprus, Email address: V.Polydorou@euc.ac.cy

Dear Editor

The moral principles that control or influence a person's behaviour or the conducting of an activity is what we call *Ethics*.[1] In the western world the basis of ethics has more or less been shaped by the *Christian laws* of the *Old and New Testament*. In Medical practice *Hippocrates* with the *Hippocratic Oath*, is the one who provided physicians with regulations and "algorithms" of deontology more than 2000 years ago.

In the original version of the oath, the physician swore by a number of healing gods (by Apollo, Asclepius, Hygieia and Panacea), to uphold a number of professional ethical standards. The Hippocratic oath ensures the respect of students towards those who teach medicine as well as respect among colleagues and towards patients.[2]

With the Hippocratic Oath doctors swear to share knowledge, provide only helpful remedies, cause no harm or hurt and protect patients from hurt or injustice, lead a flawless personal as well as professional life setting a good example, refrain from sexual misconduct towards patients, exercise gender equality and equality of men (either free or slaves), and finally exercise medical confidentiality.[2,3]

The *Hippocratic Oath* is perhaps the most widely known of Greek medical texts. It first appeared at around 400 BC.[3] Over the centuries it has been reviewed and rewritten often in order to suit the values of different cultures influenced by Greek medicine or to fit with changes in modern medical practice. In 1948 it was revised and adopted by the World Medical Association and is still used in the graduation ceremonies of medical schools around the world.[4,5] Why? Because it is a code of professional ethics and deontology and provides the guidelines for medical conduct towards patients, teachers and among colleagues. It is noteworthy that declarations worldwide are based upon the content of the *Oath*. 2500 years ago, being the first to use observation of the body as a basis for medical knowledge, Hippocrates led the way to medical research and scientific thought.[3, 5]

Today medical researchers around the globe make new knowledge available through publishing their research. Apart from presenting research, sharing and promoting knowledge, if one thinks of why scientists publish today, notions such as remaining alert, sharing ideas, expressing an opinion, rising discussion, upgrading a scientific branch, reporting a case, claiming originality of an idea, applying for a promotion or maintaining a position, reputation and gaining income, might come to mind.

Whatever the motivation for writing, scientists should abide by bioethics` regulations and legislation available shaping the ethics and deontology of research, writing and publishing of scientific work. So according to legislation and regulations available worldwide, a publication should be characterized by scientific originality and research results reported should be clear and reliable. Scientific research should be based upon data whose liability can be easily audited and it should lead to new knowledge aiming to improve public health. Appropriate infrastructure and accurate design of a study is a prerequisite. Volunteers when involved should participate after informed consent has been obtained and anonymity should be kept for protection of

personal data. Minimizing the risk of participants/ patients and researchers as well as ethical use of experimental animals (replacement, reduction of pain and anxiety, refinement) is imperative.[6]

Laws and regulations that apply to biomedical research are observed by Ethics` Committees worldwide that look into the deontology of a research project. Ethics Committees function according to and refer to relevant laws and regulations in place concerning research. Integrity of research and reporting according to ethical standards is a prerequisite for manuscripts to be submitted for publication.[7] Construction of data or observations that never occurred (fabrication), changing or omitting research results to support a hypothesis or claim (falsification), representing the work of others as one`s own work (plagiarism) and conflict of interest are examples of misconduct in research, writing and publishing scientific work, that can be successfully prevented.[8]

In the history of medical research ethics, the *Nuremberg Code* can be considered as a milestone, because it has served as an "*ethical map*", an outline, and the principles that warrant the rights and wellbeing of the subjects in medical research nowadays have been drawn from. In August 1947, in Nuremberg, Germany the American judges of the "*Doctors' Trial*" (a trial during which Nazi doctors were convicted for conducting inhuman and lethal experiments using human subjects in the concentration camps), composed the *Nuremberg Code*. The *Nuremberg Code* stresses the voluntary consent of human subjects participating in research as a prerequisite, as well as their right to withdraw from the experiment at any time if felt so by them. According to the Nuremberg Code an experiment should aim at and anticipate results that are for the benefit of society. Experiments that could possibly cause death or disabling injury should not take place and all aspects should be considered to ensure the protection and safety of the experimental subjects. Unnecessary physical and mental suffering and injury are unacceptable. Also experiments should be conducted only by qualified scientists, that are prepared at all times to end the experiment if it is likely to cause injury, disability or death to the subject.[6] Although the Nuremberg Code was one of the first attempts to state the principles that should involve human experimentation, it had relatively little effect on practice, because of its historical link to the Nazi war crimes.[9]

In June1964 the *World Medical Association (WMA)* at its 18th assembly in **Helsinki, Finland**, adopted the *Declaration of Helsinki* which is a statement of ethical principles for medical research involving human subjects, including research on identifiable human material and data. Although the *Declaration of Helsinki* is not a legal document it has served as a guide for local law making. The *Declaration of Helsinki* is a respected institution and one of the most influential documents in research ethics, having withstood a number of revisions since its conception in 1964. Its basic principles include respect for human life, the right for self-determination and informed consent, the researchers` duty being the patients benefit, and putting patients` health first.[10]

In Greece *Ethics and Deontology Committees* for research in Universities and Research Institutes are responsible for ensuring that clinical research is conducted to the highest standards of human research ethics and abides by legislation and bioethics` regulations concerning scientific research. Clinical trials on drugs or other therapies, epidemiological studies, behavioral studies in humans, studies concerning groups such as children, prisoners or people with a psychiatric condition, studies in groups with special gender or cultural characteristics, studies concerning the human embryo, research on vertebrate animals, research on rare species (animalsCc or plants) and research on genetically modified organisms and microorganisms must abide by the various laws, directives and conventions available, as for example the *European Convention on Human Rights and Biomedicine* (*Oviedo Convention*), law 2472/1997 on the protection of individuals with regard to the processing of personal data, *UNESCO Universal Declaration on the Human Genome and Human Rights , UN Convention on Biological Diversity, directive 2001/20/EC*.

Moreover the *Hellenic National Bioethics and Technoethics Commission* is an independent advisory body created during the pandemic, with a role to review and consult on complicated matters that are otherwise difficult to address.[11]

Reading the *Hippocratic Oath* and having in mind the various modern time laws and conventions, one realizes that the ethical values applied to research and scientific publishing today, are actually summarized and contained in the following three quotes from the Hippocratic Oath:

"I will follow that system of regimen which, according to my ability and judgment, I consider for the benefit of my patients, and abstain from whatever is deleterious and mischievous…"

"Whatever, in connection with my professional practice or not, in connection with it, I see or hear, in the life of men, which ought not to be spoken of abroad, I will not divulge, as reckoning that all such should be kept secret…"

"With purity and with holiness I will pass my life and practice my Art…" [3]

The first quote refers to causing no harm and promoting health, the second to confidentiality and the third to exemplary professional life. Going through laws, conventions and declarations regulating scientific research and publishing, it is evident that 2500 years later, these Hippocratic values are present in modern texts, remaining worldwide and timeless and Hippocrates himself, through the Hippocratic Oath, still represents the humane and ethical aspects of the medical profession.

References

1. Oxford Advanced Learner's Dictionary, 7th Edition; Sally Wehmeier, Colin McIntosh, Joanna Turnbull.
2. Laskaratos I. History of Medicine. Vol I Paschalidis Medical Publications, Athens 2003; 179-180.
3. Britannica, The Editors of Encyclopaedia. "Hippocratic oath". *Encyclopedia Britannica*, 5 Sep. 2022, www.britannica.com/topic/Hippocratic-oath.
4. World Medical Association.Decl-of-Geneva-v1948.www.wma.net/wp-content/uploads/2018/07/Decl-of-Geneva-v1948-1.pdf
5. Isaacs, D., The Hippocratic Oath. Journal of Paediatrics and Child Health, 2011, 47: 321-321.
6. Shuster E. PhD. Fifty Years Later: The Significance of the Nuremberg Code. N Engl J Med 1997 Nov 13; 337:1436-1440
7. International Committee of Medical Journal Editors. Recommendations. https://www.icmje.org/recommendations/
8. Charles Gross. Scientific misconduct. Annual Review of Psychology. 2016; 67:693-711.
9. Goodyear MD, Krleza-Jeric K, Lemmens T. The Declaration of Helsinki. BMJ. 2007 Sep 29;335(7621):624
10. World Medical Association. Ethics Unit. *Declaration of Helsinki* 2022. www.wma.net/e/ethicsunit/helsinki.htm
Hellenic Republic National Commission for bioethics and Technoethics. Legislation. Biomedicine. https://bioethics.gr/en/nomothesia-56

Short Communication

Platelet count as predictor of 30-day survival after intracerebral hemorrhage

Despoina Avramidou, Vasileios Papadopoulos

Department of Internal Medicine, Xanthi General Hospital, Xanthi, Greece

Correspondence Address: Vasileios Papadopoulos, MD, PhD, 2, Staliou str – 67132 Xanthi, Greece, email: vaspapmd@gmail.com

Intracerebral hemorrhage (ICH) is a major public health concern leading to high rate of mortality as well as disability [1]. Many risk factors for ICH have been described including old age, male sex, arterial hypertension, diabetes mellitus, and high alcohol intake [2, 3]. Moreover, anticoagulants and antiplatelets have also been documented to increase the risk for ICH [4].

The role of platelets in the pathophysiology of (ICH) has not been clarified yet. It has been demonstrated that platelet count (PLT) was significantly lower in hemorrhagic strokes when compared with controls [5]. Moreover, PLT has been proposed as an independent predictor of poor outcome at time of discharge in cerebellar hemorrhage [6]. Interestingly, the presence of thrombocytopenia (PLT < 150 x 10^3/μL) itself did not affect the functional outcome after ICH, regardless of antiplatelets administration [7]. However, whether PLT can be a prognosticator of survival after ICH remains obscure.

We have retrospectively enrolled 60 patients, aged 75.9 ± 12.0 years, who had been admitted to Xanthi General Hospital for ICH between January 2018 and May 2021. Demographics, medical record, vital signs, arterial blood gas test, complete blood count, blood biochemistry, and CT scan test were collected for each patient. PLT at admission (PLT_1) and 24 hours later (PLT_2) were evaluated as potential predictors of 30-day survival after ICH. Descriptive statistics are provided either as means along with their relevant standard deviations, or percentages, for scale and nominal variables respectively. Survival data are given as medians along with their 25th and 75th percentiles (Q1 and Q3, respectively). All patients were censored, either at the time of their death, or at the 31st day after admission. Kaplan Meier (KM) curves were used to depict survival data; the log-rank test was used to determine the univariate significance of the study variables. Cox proportional hazards regression analysis was performed to explore the potential correlations between independent variables and survival data. All reported p values are two-sided. The level of statistical significance was set to p=0.05. All numerical values are given with at least two significant digits. Statistical analysis was performed with the use of IBM SPSS Statistics software, version 26.0, for Windows. MedCalc software, version 20.218, was preferred for visualization of results. The study was approved by the Scientific Board of Xanthi General Hospital (Decision No. 103/May 17, 2021).

Thirty patients (50%) succumbed within the first 30 days. The median survival time during the first month after admission was 25 days (Q1: 11 days; Q3: 30 days).

PLT_1 values were 232,000 ± 86,000/μL and 211,000 ± 60,000/μL (P=0.251), while PLT_2 values were 240,000 ± 63,000/μL and 203,000 ± 60,000/μL (P=0.012), for survivors and non-

survivors, respectively; these results are schematically presented as boxplots. (*Figure 1*)

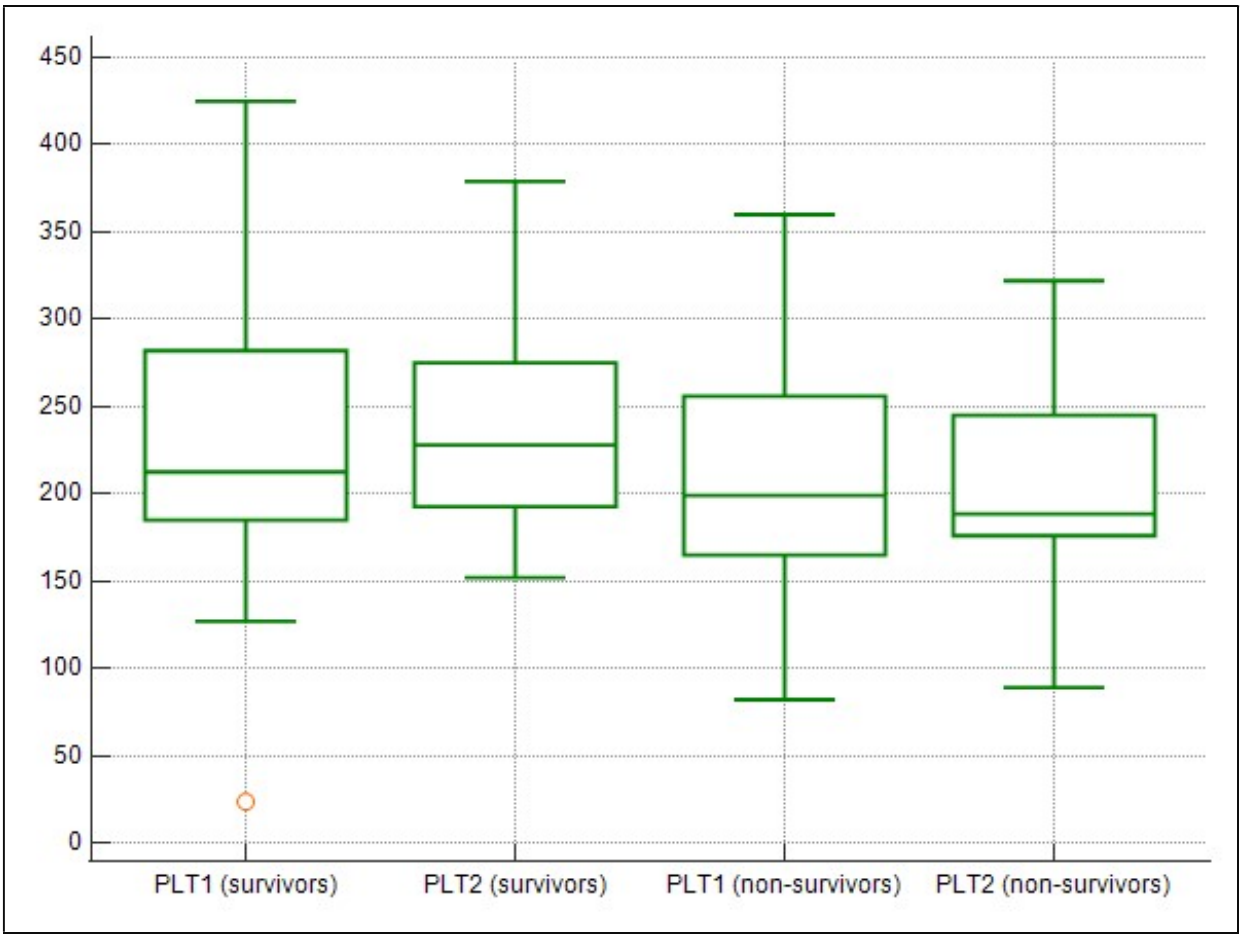

Figure 1. *Boxplots presenting PLT_1 and PLT_2 values in survivors and non-survivors; PLT values (y-axis) are given in $10^3/\mu L$.*

Using Cox proportional hazards regression univariate analysis, it has been shown that 30-day survival after ICH was positively correlated with PLT_2 (P=0.012), hemoglobin levels at admission (P=0.020), and oxygen saturation at admission (P=0.015). Moreover, 30-day survival was negatively correlated with age (P=0.001), blood glucose levels at admission (P=0.043), medical history of diabetes mellitus (P=0.014), and medical history of arterial hypertension (P=0.036). Of note, PLT_1 was comparable between survivors and non-survivors (P=0.251).

The use of a Cox-regression proportional hazards multivariate analysis model demonstrated that increased PLT_2 was independently correlated with 30-day survival after ICH, considering all other parameters as potential confounders (HR: 0.986 per unit $10^3/\mu L$; 95% CI: 0.978-0.994, P<0.001). All necessary details are provided in *Table 1.*

Table 1. *Patients' characteristics as well as Cox regression univariate and multivariate analysis based on 30-day survival status.*

Parameters	Mean±SD; N(%)†	Survived (n=30)	Succumbed (n=30)	P‡	HR; ±95%CI§	P§
Gender						
Men	28 (46.7)	14 (46.7)	14 (46.7)			
Women	32 (53.3)	16 (53.3)	16 (53.3)	0.834		
Age (years)						
Mean ± SD	75.9 ± 12.0	70.8 ± 11.2	81.0 ± 10.5	0.001	1.035; 0.992-1.080	0.115
Diabetes						
Yes	10 (16.7)	1 (3.3)	9 (30.0)		1.000	
No	50 (83.3)	29 (96.7)	21 (70.0)	0.014	0.651; 0.216-1.960	0.445
Hypertension						
Yes	42 (70.0)	17 (56.7)	25 (83.3)		1.000	
No	18 (30.0)	13 (43.3)	5 (16.7)	0.036	0.183; 0.055-0.614	0.006
Antiplatelets						
Yes	14 (23.3)	7 (23.3)	7 (23.3)			
No	46 (76.7)	23 (76.7)	23 (76.7)	0.949		
Anticoagulants						
Yes	7 (11.7)	3 (10.0)	4 (13.3)			
No	53 (88.3)	27 (90.0)	26 (86.7)	0.995		
Temperature (^{o}C)						
Mean ± SD	36.2 ± 0.4	36.1 ± 0.3	36.2 ± 0.5	0.186		
Pulse rate (min^{-1})						
Mean ± SD	86.8 ± 16.5	84.8 ± 17.2	88.7 ± 15.9	0.451		
SBP (mmHg)						
Mean ± SD	170 ± 29	173 ± 31	168 ± 28	0.565		
DBP (mmHg)						
Mean ± SD	94.2 ± 14.3	94.7 ± 15.4	93.7 ± 13.4	0.611		
Hemoglobin (g/dL)						
Mean ± SD	13.3 ± 1.4	13.7 ± 1.1	12.9 ± 1.5	0.020	0.554; 0.401-0.766	<0.001
Glucose (mg/dL)						
Mean ± SD	124 ± 46	111 ± 25	138 ± 57	0.043	1.000; 0.989-1.011	0.994
Creatinine (mg/dL)						
Mean ± SD	0.97 ± 0.91	1.03 ± 1.15	0.90 ± 0.60	0.667		
CRP (mg/dL)						
Mean ± SD	1.45 ± 1.53	1.13 ± 1.53	1.77 ± 1.49	0.206		
pH						
Mean ± SD	7.40 ± 0.07	7.41 ± 0.06	7.40 ± 0.08	0.717		
sPO_2 (%)						
Mean ± SD	95.0 ± 2.9	95.8 ± 1.5	94.2 ± 3.6	0.015	0.854; 0.750-0.973	0.018
PLT_1 ($10^3/\mu L$)						
Mean ± SD	222 ± 74	232 ± 86	211 ± 60	0.251		
PLT_2 ($10^3/\mu L$)						
Mean ± SD	223 ± 64	240 ± 63	203 ± 60	0.012	0.986; 0.978-0.994	<0.001

SD: Standard Deviation, † For scale and nominal variables, respectively,
‡ P-value based on univariate Cox regression analysis,
§ HR along with ±95% CI and P-value based on multivariate Cox regression analysis

To further assess an easy and clinically useful tool for using PLT_2 as a predictor of 30-day survival, we used 225,000/μL, being the mean of the PLT_2 covariate, as derived from the Cox proportional hazards regression univariate analysis. Patients with PLT_2 ≥225,000/μL had a hazard ratio (HR) of 0.991 (95% CI: 0.984-0.998) per unit (10^3/μL) to succumb within the first 30 days after admission for ICH (HR<1 favors 30-day survival). The result was statistically significant (P=0.048) using the Log-Rank test; the relevant Kaplan-Meier curve is provided as *Figure 2*.

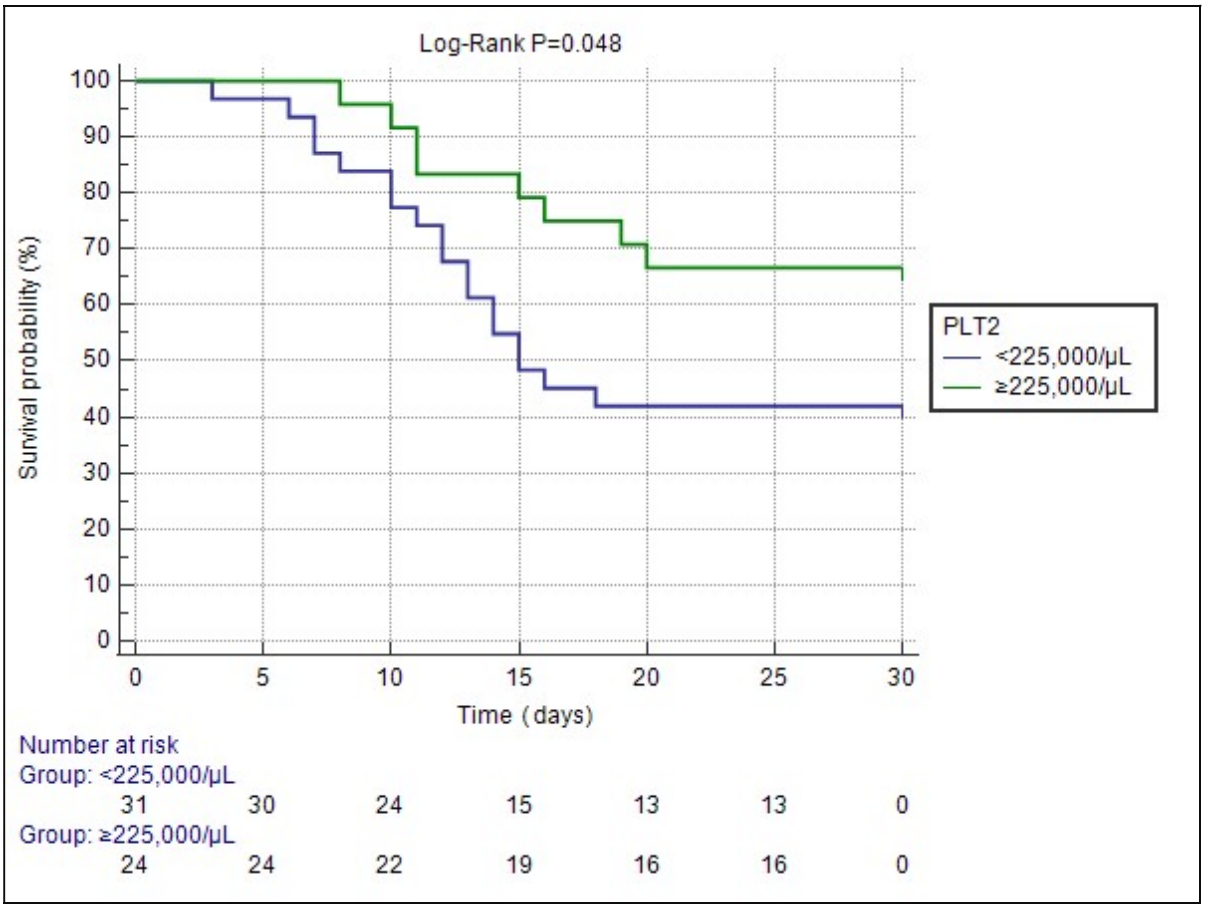

Figure 2. *Kaplan-Meier curve depicting survival function according to selected PLT_2 cutoff; ICH patients with PLT_2 ≥225,000/μL presented favorable 30-day survival when compared to patients with PLT_2 <225,000/μL (Log-Rank P=0.048).*

Based on our results, we propose that PLT_2 might be further investigated as an early predictor of 30-day survival after ICH. Moreover, in the light of absence of independent correlation between PLT_1 and 30-day survival, it is reasonable to hypothesize that the crucial parameter of platelet involvement in ICH might not be their initial number *per se*, but rather their alterations due to vascular damage and/or activation.

References

1. Qureshi AI, Mendelow AD, Hanley DF. Intracerebral haemorrhage. Lancet. 2009 May 9;373(9675):1632-44. doi: 10.1016/S0140-6736(09)60371-8. PMID: 19427958; PMCID: PMC3138486.

2. Ariesen MJ, Claus SP, Rinkel GJ, Algra A. Risk factors for intracerebral hemorrhage in the general population: a systematic review. Stroke. 2003 Aug;34(8):2060-5. doi: 10.1161/01.STR.0000080678.09344.8D. Epub 2003 Jul 3. PMID: 12843354.

3. Emerging Risk Factors Collaboration; Sarwar N, Gao P, Seshasai SR, Gobin R, Kaptoge S, Di Angelantonio E, Ingelsson E, Lawlor DA, Selvin E, Stampfer M, Stehouwer CD, Lewington S, Pennells L, Thompson A, Sattar N, White IR, Ray KK, Danesh J. Diabetes mellitus, fasting blood glucose concentration, and risk of vascular disease: a collaborative meta-analysis of 102 prospective studies. Lancet. 2010 Jun 26;375(9733):2215-22. doi: 10.1016/S0140-6736(10)60484-9. Erratum in: Lancet. 2010 Sep 18;376(9745):958. Hillage, H L [corrected to Hillege, H L]. PMID: 20609967; PMCID: PMC2904878.

4. Zeng Z, Chen J, Qian J, Ma F, Lv M, Zhang J. Risk Factors for Anticoagulant-Associated Intracranial Hemorrhage: A Systematic Review and Meta-analysis. Neurocrit Care. 2023 Jan 20. doi: 10.1007/s12028-022-01671-4. Epub ahead of print. PMID: 36670269.

5. Sadeghi F, Kovács S, Zsóri KS, Csiki Z, Bereczky Z, Shemirani AH. Platelet count and mean volume in acute stroke: a systematic review and meta-analysis. Platelets. 2020 Aug 17;31(6):731-739. doi: 10.1080/09537104.2019.1680826. Epub 2019 Oct 26. PMID: 31657263.

6. Lin CY, Chang CY, Sun CH, Li TY, Chen LC, Chang ST, Wu YT. Platelet count and early outcome in patients with spontaneous cerebellar hemorrhage: a retrospective study. PLoS One. 2015 Mar 17;10(3):e0119109. doi: 10.1371/journal.pone.0119109. PMID: 25781880; PMCID: PMC4364557.

7. Mrochen A, Sprügel MI, Gerner ST, Sembill JA, Lang S, Lücking H, Kuramatsu JB, Huttner HB. Thrombocytopenia and Clinical Outcomes in Intracerebral Hemorrhage: A Retrospective Multicenter Cohort Study. Stroke. 2021 Jan;52(2):611-619. doi: 10.1161/STROKEAHA.120.031478. Epub 2021 Jan 12. PMID: 33430632.

Case Report

A rare case of Small Bowel Rupture due to a Richter-like hernia following a pelvic fracture

Christos Moutsos[1], Christos Farazi-Chongouki [2], Anestis Ninos[1], Evangelos Iliopoulos[1], Gerasimos Douridas[1]

[1]*Surgical Department, Thriasio General Hospital of Elefsina,* [2]*Emergency Department, Thriasio General Hospital of Elefsina*

Correspondence Address: Christos Farazi-Chongouki, Dept. of Surgery, Thriasio General Hospital of Elefsina, Athens, Greece, Email: cfarazi@yahoo.gr

Abstract

*Background***.** Pelvic fractures are severe injuries often associated with multiple systematic injuries. The most common related complications are: bleeding, retroperitoneal hematoma, other intra-abdominal and urogenital injuries. There are also rare types of pelvic fracture complications such as ureteral obstruction, bowel entrapment, external iliac artery injury and open scrotal sac injury. Traumatic hernias on pelvic injuries sites are an extremely rare entity.

Case presentation. A 79-years old woman was admitted to the Accident and Emergency Department suffering from a left pubic rami fracture with active retroperitoneal bleeding from the left obturator artery following a fall from her own height. Bleeding was managed with intravascular embolization. Her initial uneventful clinical course was discontinued by relapsing episodes of bowel obstruction and eventually lethal septic syndrome due to bowel perforation due to a Richer-like-hernia as it turned out. Despite rescue laparotomy during which an enterectomy, lavage and laparostomy were performed the patient passed out in the midst of decaying multiple organ failure syndrome.

Conclusion. Traumatic hernias associated with pelvic fractures complicated with bowel entrapment, is a rarity. Although there are few reports for bowel entrapment into traumatic cavities of such hernias, the presence of Richter-like traumatic hernia has no record in the literature until today. Every surgeon dealing with trauma should be aware of the existence of such a rare complication and have a low threshold for early surgical intervention.

Keywords: traumatic Richter's hernia, rare pelvic fracture complications, bowel perforation.

Introduction

Pelvic fractures are often caused by high-energy injuries such as those suffered in traffic accidents and fall and account for 5%-8% of all fractures. Common complications of pelvic fractures comprise of visceral injury, hemorrhage, genitourinary injury and pulmonary embolism. Trauma induced herniation is rare, especially in association with pelvic fractures and might have a potentially lethal course thus early diagnosis and targeted treatment is crucial.[1]

The first report of a Richter's hernia was attributed to Fabricius Hildanus in 1606.[2] *(Figure 1)* The description of that case, in his own saying, translated from the original Latin origin, goes as follows:

"*Gangrene resulting from an intestinal hernia with perforation and subsequent cure*".[3]

A Richter's hernia is defined as an abdominal hernia, in which only part of the circumference of the bowel is entrapped and strangulated in the hernia orifice. *(Figure 2)* Although, almost any part of the gastrointestinal tract has been reported in Richter's hernias cases, it is the distal ileum that is affected mostly.[4-8] August Richter, who first described this condition, states that the precondition for the formation of this type of herniation is determined by the size and consistency of the hernia orifice. *(Figure 3)* It must be big enough to ensnare the bowel wall, but small enough to prevent protrusion of an entire loop of the intestine, and the margin of the hernia's ring must be firm or, in Richter's words, "possess strong spring-force".[9] Richter's hernias tend to progress more rapidly to gangrene than ordinary strangulated ones.[10]

Figure 1. Fabricius Hildanus (1560-1632)

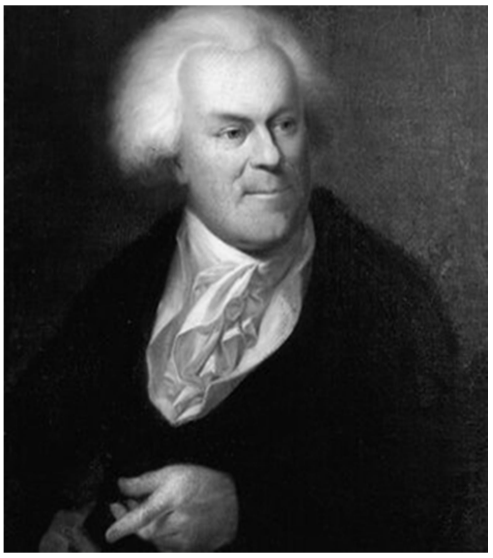

Figure 3. August Gottlob Richter (1742-1812)

Apart from Richter's hernia, that which is a rare entity, there are many other more commonly known causes of small bowel perforation encountered in everyday clinical practice. Among others, the most frequent are erosions from duodenal ulcerations, tumors, infection or abscess, Meckel's diverticulum, hernia with strangulation, inflammatory bowel disease, mesenteric ischemia, foreign bodies, obstruction, medication or radiation related causes, iatrogenic ruptures and trauma.[11]

In this case report we describe a very rare case of small bowel perforation due to a Richter-type-herniation through a non-anatomical hernia orifice, created by a pubic bone fracture, following a fall from own height. Reviewing of the literature detected few similar cases, but none referring to a Richter's-like traumatic hernia incarceration of small bowel.

Case report

A 79-years old woman presented at the emergency department of our hospital after a fall from her own height. Her medical history consisted of atrial fibrillation and severe degree mitral valvural disease. She was on acenocoumarol in a dose of 2 mg/OD. On presentation she was unable to stand up and was experiencing severe pain in the pelvis and lower abdomen. When she arrived in the emergency department, the vital signs were: BP 100/70mmHg, HR 110/min, SpO2 98%. On admission blood count revealed an Hgb of 9.3 mg/dl. Following resuscitation with crystalloids, x-rays showed a pubic bone fracture on the left side. *(Figure 4)* Repetition of blood count pointed out a drop in Hgb to 8.1mg/dl. The patient was transfused with RBCs and a CT-scan revealed extensive hematomas spreading throughout the pelvic floor, the left obturator muscle and adjacent extraperitoneal area. Active bleeding from the left obturator artery was detected and managed with trans-arterial coils embolization. Following proper resuscitation, the patient was admitted to surgical department.

After seven days of hospitalization, the patient presented with symptoms and signs indicative of bowel obstruction (vomiting, abdominal distention) primarily treated conservatively: placement of nasogastric tube, IV fluids, antibiotics, painkillers, metoclopramide and low-molecular weight heparin. Ileus was initially attributed to prolonged bedrest and retroperitoneal haematomas. Although bedridden due to pelvic fracture, she gradually resumed oral liquid diet passing flatus her bowel partially recovering from paresis.

Figure 3. Pelvic X-Ray showing the left pubic bone fracture.

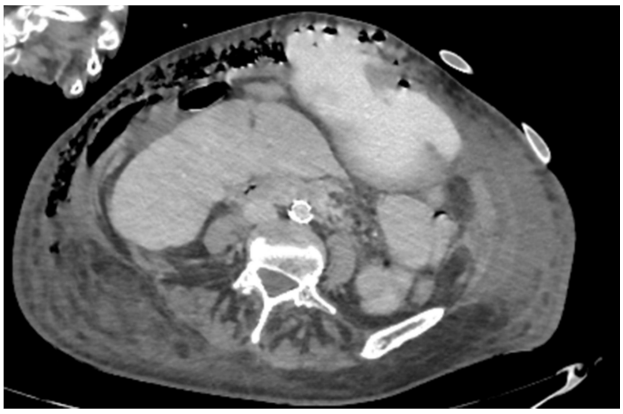

Figure 4. CT scan demonstrating subcutaneous emphysema along with presence of orally contrast agent between the abdominal wall layers.

Ten days later ileus relapsed. She also had a septic profile with fever, elevated white blood cell counts, CRP and atypical abdominal pain without Bloomberg's sign. There was remarkable palpable crepitus consisted with subcutaneous emphysema, especially in the right side of the abdomen. A CT-scan revealed distended small bowel loops, fluid collections in the pelvic floor and in between abdominal wall layers, especially in the left side, and alarming presence of free air within rectus sheath bilaterally. *(Figure 5)* Based on the aforementioned clinical and radiological findings, an emergency exploratory laparotomy was decided.

While abdominal wall was incised in the middle line, fecal-purulent material gashed from concomitant anatomic wall layers. A Richter-like hernia was discovered inside a cavity created in the abdominal wall by the pelvic fracture. A non-anatomical orifice had been created by the bone fractural spur entrapping and strangulating tangentially half of the circumference of a bowel loop. *(Figure 6)* The bowel became ischemic in its strangulated length, perforated and its content spilled within the abdominal wall layers, especially between the peritoneum and the transversalis fascia (Fig. 7). Surprisingly, the intraperitoneal cavity was free of any contamination or peritonitis.

A segmental enterectomy and side-to-side anastomosis with staplers was performed, as also meticulous lavage of the contaminated areas. A laparostomy with a Bogota-bag technique was performed and vacuum drains were placed in the affected cavity, for daily cleaning care of the abdominal wall and prevention of abdominal compartment syndrome. The patient was transferred to the intensive care, but unfortunately, she passed away in the 10th postoperative day, due to irreversible multiple-organ failure syndrome.

Discussion

The definition criteria of traumatic hernia proposed by Clain in 1964 are as follows: 1) the hernia must have appeared immediately after trauma and 2) the patient must have consulted a doctor soon enough for signs of the trauma to be identifiable12. However, many cases that did not fulfill these criteria have subsequently been reported.

Therefore, Sahdev proposed new criteria of traumatic hernia in 1992 as follow: 1) the patient has no history of any hernia, 2) it is obvious that the patient has suffered an injury, 3) the appearance of herniation can occur even at a delayed stage after trauma, and 4) a hernia sac can be present13. Our case apart from the hernia sac meets all of the above criteria.

Figure 5. Intraoperative picture demonstrating the newly formed extraperitoneal cavity, due to the pelvic fracture.

Figure 6. Intraoperative picture demonstrating the perforated Richter's hernia.

Sir Frederick Treves, the famous London surgeon, who saved King Edward VII's life, when he was diagnosed with appendicitis, distinguished Richter's hernia from herniation of a Meckel diverticulum, which was classically described be Littre.[14] Treves credited Richter with the distinction of having given the first scientific description of this particular lesion and suggested the term that we all use today.[15] For more than 100 years there was a great confusion among surgeons about the nomenclature of these hernias. They were described without a specific term or special name or were categorized with Littre's hernia.

Little new information has been added since then and the reports of Treves remain classic and stand still in time.[16-17] Approximately, 10% of strangulated hernias are Richter's hernias.[18-19] The diagnosis may be difficult due to lack of specific symptoms and signs and may remain presumptive even after imaging workout, until clearly confirmed intraoperatively.

Dull abdominal pain, slight malaise, nausea and vomiting may be the first symptoms rather vague than severe in quality because underlying bowel obstruction is rarely complete (tangential entrapment of bowel loop thus allowing part of the lumen patent). Local signs may be absent and if present are easily overlooked.[16]

The most constant physical finding remains the tenderness or swelling over a potential hernia orifice. In neglected or overlooked cases, where surgery was performed after days or not at all, with perforation of the strangulated part of the bowel, the outcome may be devastating and lethal for the patient, due to gangrene and high toxin load. The good clinical scenario for the patient is the formation of an enterocutaneous fistula, which was first described from Hildanus in 16062, as there is no contamination in the intraperitoneal cavity and peritonitis.[15-18]

However, in the case of our patient, the traumatic hernia led to the development of a

"blind" fistula between the abdominal wall layers and especially between the peritoneum and transversalis fascia. A significant quantity of fecal material accumulated between abdominal wall layers before a septic syndrome became apparent. A broken pubis led to the formation of a non-anatomical new space or "orifice", where the anti-mesenteric border of a loop of the terminal ileum was incarcerated extraperitoneally. Although the time of the incarceration could be combined with the first symptoms of ileus at the 7th day of hospitalization, it was only when the perforation and the septic profile of the patient ten days after (fever, abdominal pain, metabolic acidosis, slight tachycardia, slight fall of blood pressure, elevated WBCs and CRP) dictated the need for exploratory laparotomy.

Conclusion

In most cases, pelvic fractures follow a predictable course and heals uneventfully. Traumatic hernia following pelvic fractures is a rare complication, which can lead to bowel entrapment and perforation extraperitoneally. Since Richter's hernia is more difficult in diagnosis, a traumatic Richter's-like hernia will reveal late symptoms of bowel necrosis and perforation, as described in our case. A high clinical suspicion of this entity may lead to early surgical exploration and prevent severe complications, which may result in an unfortunate loss of life.

References

1. Ryota Tanaka, Hisashi Nagahara, Kiyoshi Maeda et al. A case of bowel perforation due to traumatic hernia at a pelvic fracture site: a case report and review of the literature. *BMC Surgery* (2017) 17:81

2. Fabricius Hildanus. Observationum et Curationum Chirurgicarum Centuriae. Basileae: Sumptibus Ludovici Regis; 1606(1st ed):159.

3. Wolfgang Steinke, Rene Zellweger. (2000). Richter's Hernia and Sir Frederick Treves: An original clinical experience, review and historical overview. Annals of Surgery Vol. 232, No. 5, 710-718

4. Tito WA, Allen WC. Richter and Littre Hernia. In: Nyhus JB, Condon RE, eds. Hernia, 3rd edition, Philadelphia: Lippincott; 1989:305–310.

5. Giokas G, Karakousis CP. Richter hernia of the stomach. J Surg Oncol 1998; 69(1):51–53.

6. Duari M. Strangulated femoral hernia: a Richter's type containing caecum and base of appendix. Postgrad Med J 1966; 42:726–728.

7. Rowe PH, Hunter-Craig C. Richter's hernia in a direct inguinal sac in a female. J R Coll Surg Edinb 1984; 29:264.

8. Newerla GJ, Connally EF. Gangrenous appendicitis in femoral hernia of Richter's type. Am J Surg 1943; 61:154–156.

9. Richter AG. Abhandlung von den Bruchen. Gottingen: Johann Christian Dieterich; 1785.

10. Horbach JM. Invagination for Richter-type strangulated hernias. Trop Doct 1986; 16(4):163–168.

11. Brown, C. V. R. (2014). Small Bowel and Colon Perforation. Surgical Clinics of North America, 94(2), 471–475.

12. Clain A. Traumatic hernia. B J Surg. 1964; 51:549–50.

13. Sahdev P, Garramone RR, Desani B. Traumatic abdominal hernia. Report of three cases and review of the literature. Am J Emer Med. 1992;10:237–41.

14. Littre A. Observation sur une nouvelle espece de hernie. Paris: Mem. de l'Acad. Royal des Sciences; 1700:300.

15. Treves F. Richter's hernia or partial enterocele. Med Chir Tr 1887; 17:149 –167.

16. Kadirov S, Sayfan J, Friedman S, Orda RJ. Richter's hernia: a surgical pitfall. Am Coll Surg 1996; 182(1):60–62.

17. Fuckiger R, Huber A. Die Richter'sche Hernie. Der Chirurg 1993; 64:822– 826.

18. Frankau C. Strangulated hernias: a review of 1487 cases. Br J Surg 1931; 19:176 –191.

19. Gillespie RW, Glas WN, Mertz GH, Musselman M. Richter's hernia: its etiology, recognition and management. Arch Surg 1956; 73: 590–594.

Short Review – Historical Article

Cretan Venizeleion Hospital heist. A glance from within Heraklion newspapers to demonstrate an unexpected bond between a hospital and the local community

Gregory Tsoucalas

History of Medicine and Medical Deontology Department, Medical School, University of Crete, Heraklion, Greece

Corresponding Address: *Gregory Tsoucalas, Medical School of the University of Crete, 71003 PC, Voutes, Heraklion Crete, Greece.*

It was 1936 when the Union of American Cretans had decided for the establishment of a new Hospital in Heraklion city to honor former Prime Minister of Greece Eleftherios Kyriakou Venizelos (1864-1936). In 1949 the Hellenic state, members of the American Cretans and Municipality of Heraklion, had concluded for a memorandum for the hospital to be built in a municipal plot. In 1953 the hospital was named as Pancretio Venizeleio Tuberculosis Hospital (Greek: Παγκρήτιο Βενιζέλειο Νοσοκομείο Φυματιωντών) dedicated to patients suffering from the pulmonary disease of tuberculosis, operating as a sanatorium.

In 1967, 200 patient beds were added to its power and it turned to a general hospital for Heraklion citizens named General Hospital of Heraklion. Meanwhile, some years later, during 1973, an addition of beds combined with the absorption of Pananeio Hospital resulted for the hospital to grow up further.[1] As the eldest big hospital in the city, enjoys the preference of the citizens and various commentaries in the local newspapers. One incident which attracted huge readability and strong interest was the robbery of the 16th December 1988.[2]

It was the day when 15.000.000 drachmas were in the cash desk for the personnel payment when 4 hooded robbers, with a "Sicilian" surprising entrance in 12.20, within 5 minutes they had concluded their well-planned operation. With only the hearing of a twice shout "robbery" all attending had tried to find refuge in nearby rooms. One had approached the cashier and ordered him to put the money in a white sac. They had escaped with a brown Datsun Cerry (Greek Nissan Factory), rented from a local bureau of an international company. One of the administrative employees had tried to phone police department but the line was busy. The car was found burned. The robbers moved to another car to avoid pursuit, a blue or white Fiat. Some witnessed only 3 to have escaped with the car and the 4th with a motorcycle. Some of the robbers with an Alfa Romeo had travelled the next few hours towards Chania city. All reported to be between 25 and 35 years of age, having as demonstrated later, fake documents and passports.

The authorities feared initially for a terrorist group which was searching for funds. Police officer Mpinihakis organized the search and within 5 days they had arrested the first 2 robbers having in their possession guns, transmitters and a police uniform. The brain of the robber's team was one of the arrested, while the second was a relative who in his car kept a big summary of the money. The other 3 robbers, known to the police after the interrogation of the first arrested, were wanted all around Greece. A conflict started between them, a procedural dispute, a clash of

persons and lawyers for whom to blame. The money summary was later reported to be 17 million or even 18 million. Among the key witnesses was a hospital physician who gave descriptions for the robbers.

Other newspapers reported that the time of the robbery was 12.40 precisely, in the evening. Some reporters noted that the robber just asked the cashier for the money, while others recorded that the cashier was beaten in the head and forced to open the safe. This incident is memorized yearly in the local newspapers.[2-3]

In August 2000 police officer Lianeris, who was the interrogator narrated once more the story, testifying that he was blackmailed by the robbers to cover up the operation. All 4 were convicted and moved to Neapoli Cretan Prison.[4]

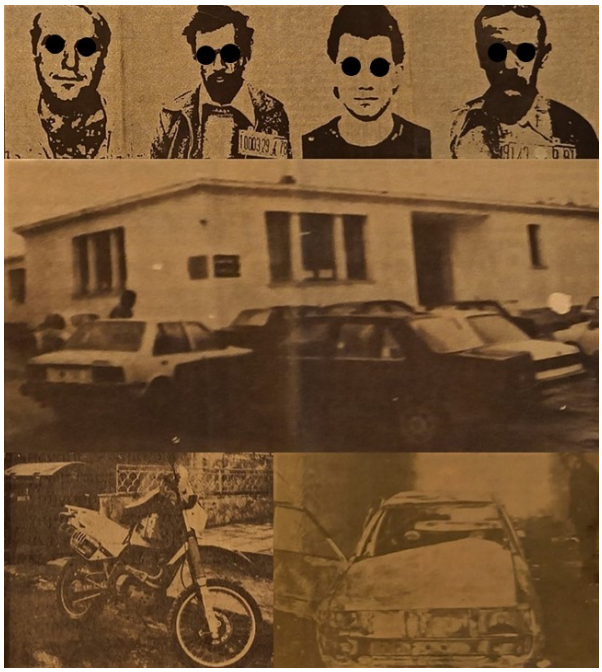

Figure 1. *The 4 robbers accused (some characteristics are covered), the hospital building were the robbery took place, the allegedly used motorcycle and the burned Datsun as they were pictured and printed in the 1988 newspapers. Photoshoot by Nicolaos Maltezakis.*

We must emphasize that soon after the robbery the administrative manager of the hospital asked for an armed guard to protect the money and payment department, until a bank payment system to be established. It is noted that hospital guards had not been armed. He avoided to even mention the person as a policeman, even though in Greece armed guards were (and are) prohibited by law. The payments continued of course the next months with no armed guards. The second peculiarity was the wide spectrum of testimonies among the witnesses. All attending the robbery, or seeing the cars or even wanted a moment of publicity, gave information or interviews in the newspapers, sometimes controversial. The plan of the robbery implied that an inner side help may had been in place. The difference for the amount of money reported also raises questions, as 3 million drachmas in paper money is a serious issue. Hospital employees had continued to offer their services even though they had remained unpaid for a reasonable time period.[2-3] The fact that decades after the robbery reports reach readers and are accepted with great interest, testifies the bond between common people and Venizeleion Hospital. A community may be defined as a place, or as a sense of attachment to the place. To the later definition, all are included, material and thoughts, rendering Venizeleion hospital to stand among people as the spirit of the community.[4-5]

Public health ethicists consider the new public health concept as a shift towards an interaction between local community and local health institutions. [6] A health institution, a hospital in this case, offers security to the users, needs community support and lives among the thoughts of the local community. All issues of such an institution, even though they escape the sphere of health services,

wrest public opinion and endure in the memory of all those who live around it.

References

1. Kokkonas N. A short History of the Hospitals of Crete. Chalkiadakis, Rethymno, 1987.

2. Patris [Πατρίς] Newspaper. Vikelaia Library, Heraklion, serial number of the papers used 12704, 12711, 12713, 12714, 12715 & 12718, 1988.

3. Democratis [Δημοκράτης] Newspaper. Vikelaia Library, Heraklion serial number 34551, 1988.

4. Patris [Πατρίς] Newspaper. Vikelaia Library, Heraklion, 26th if august 2000.

5. Rollins J. Purpose-built Art in Hospitals. Art with Intent. Emerald Publishing, Bingley, 2021.

6. Skinner D, Franz B, Kelleher K, Penfold R. Community perceptions of hospitals and shared physical space: a qualitative study. Cult Med Psychiatry 2018;42(1):131-158.

Review Article

Botulinum toxin in Recurrent Postoperative Hernias

Sinou Natalia [1,2], Sinou Nikoleta [1,2] , Filippou Dimitris [1,2]

[1] *Medical School, National and Kapodistrian University of Athens,*

[2] *Research and Education Institute of Biomedical Science*

Corresponding Address: Natalia Sinou, sinou.natalia@gmail.com

Abstract

Incisional hernias constitute a complex issue in the field of general surgery. The traditional invasive techniques of the hernias repairing are partially efficient as there are many recurrences. The further operations lead to numerous problems such as contamination, morbidity and damaging the tissues. A very promising method to overcome the problems mentioned above was the introduction of the usage of Botulinum toxin A in the treatment of recurrent hernias.

Aim of the present systematic review is to evaluate the possible application of the Botulinum toxin type A before surgery and the disadvantages of this method. Detailed research was conducted via the PubMed database using the keywords: “Recurrent” AND “Postoperative” AND “Hernias” AND “Botulinum toxin”. No further filters were applied.

The existing experience suggests that Botulinum toxin A supports the uneventful postoperative recovery after hernia surgery offering decreased tension to suture line tension without perturbing the structure and physiology of the abdominal wall. However, it has been spontaneously associated with minor complications mainly from the respiratory system.

KeyWords: botulinom toxin, postoperative hernias, recurrent hernias

Introduction

Open abdominal surgeries can lead to various complications, with ventral hernias being one of the most prevalent. Roughly 30% of patients may be affected by these hernias, which can negatively impact their quality of life both aesthetically and due to issues like abdominal compartment syndrome.[1] The likelihood of ventral hernia occurrence increases in patients with risk factors, such as obesity, diabetes, smoking, malignancy, infection, emergency intervention, use of steroids and immunomodulatory factors, or a previous laparotomy.[2] Managing incisional hernias presents a complex challenge in the field of surgery. Traditional invasive techniques, like abdominal wall reconstruction and hernia repair, offer only partial effectiveness and can result in numerous recurrences. Repairing recurrent hernias through repeated operations carries the risk of damaging and thickening tissue even further. Additionally, in more complicated cases of hernias requiring bridging, there are concerns about recurrence, contamination, and morbidity [3]. The component separation approach is often considered the gold standard for certain types of hernias, while the Rives-Stoppa retromuscular technique is preferred for others because they allow for tension-free closure and preservation of abdominal physiology. However, even these techniques do not guarantee success, as recurrence, contamination, and surgical complications remain potential risks. Other methods like myocutaneous fascial speculums and pneumoperitonisation have proved ineffective in expanding the abdominal wall.

The primary cause of ventral hernias is often the anti-diametric movement of abdominal muscles. However, a promising alternative to surgical intervention is the non-surgical approach known as Botox based technique. This innovative technique leverages botulinum toxin type A, produced by the clostridium botulinum, to reduce the tension exerted by these muscles, inducing temporary paralysis that addresses the underlying

cause.[4] This technique is particularly effective for large incisional hernias and those that have lost domain.[5] Aim of the present systematic review is to evaluate the possible use of botulinum toxin type A preoperatively as well as to present the advantages and the disadvantages of this technique.

Materials and methods

Thorough research was conducted by using the PubMed database's published bibliography. The search was conducted using keywords such as "Recurrent", "Postoperative", "Hernias", and "Botulinum toxin". Relevant data was extracted using a standard data elicitation form and following PRISMA-ScR guidelines. Out of the 34 records identified through the initial PubMed search, no additional ones were found through references review as they were similar to the initial ones. Furthermore, 24 full-text articles were assessed for eligibility and out of these, 10 were excluded due to non-relevant title and abstract. All 24 references assessed for eligibility were deemed relevant and fulfilled the above mentioned criteria, and hence were used in this study.

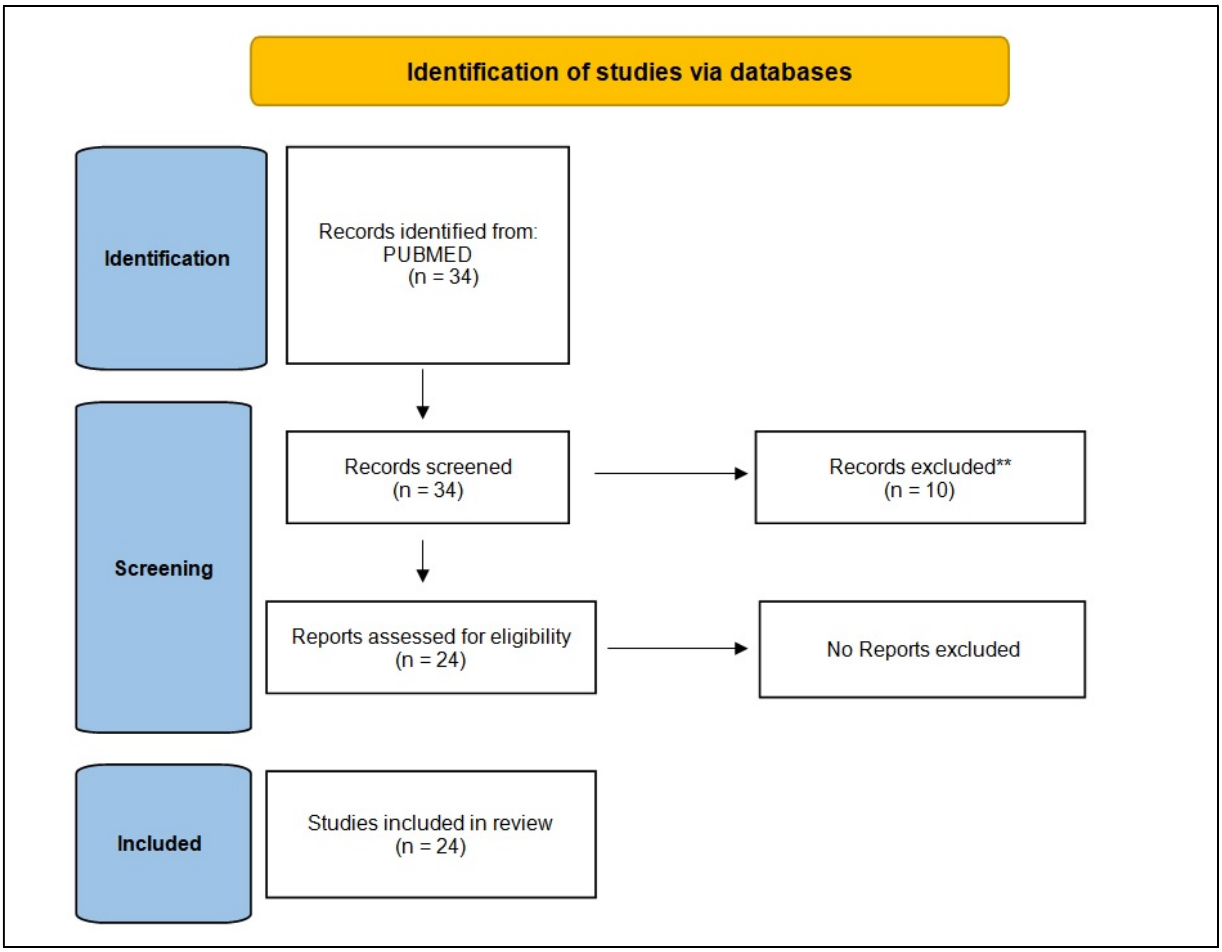

Figure 1. Botulinum toxin in Recurrent Postoperative Hernias - PRISMA

Discussion

Botulinum toxin type A, or BTA, possesses a broad range of medical applications, including the treatment of strabismus, muscular pain, dystonia syndromes, esophagus achalasia, hyperhidrosis, and aesthetic procedures [2]. This clostridium

botulinum-derived substance works by inhibiting the release of acetylcholine from the neuromuscular junction, resulting in muscle paralysis and elongation. Its effects become evident within 2-3 days and peak within 2 weeks, with a duration of up to 6 months that declines gradually. Infusing the toxin into the abdominal wall muscles produces a relaxed state that tightens and repairs a hernia without resorting to invasive component separation. This approach preserves the abdominal wall's physiology and myofascial structures [6]. As it is described in an interesting report the toxin is injected in an outpatient setting approximately four weeks before the impending operation. [7] Under high-resolution ultrasound, five specific points are identified in patients who are positioned laterally. Two of these points are located between the upper iliac crest and rib margin in the mid-axillary line, while the remaining three points are situated between the anterior axillary line and midclavicular line, between the costal margin and superior iliac crest. The procedure is performed bilaterally, and each point is injected with 5ml of a solution containing 500 units of BTA dissolved in 50ml of 0.9% saline solution. This chemical technique results in paralysis that lasts up to four-six months and begins approximately two weeks after injection. The diminished tension caused by the BTA enables efficient repair. However, as there is no clinical effect in the first 48 hours, the use of negative pressure ligatures is recommended to prevent abdominal wall contraction [8]. More invasive techniques can be safely applied with guaranteed permanent results once the toxin's effects are visible, as confirmed by CT scans. The muscle did not swell during the preoperative BTA application, as stated in the first report [9]. Another advantage of BTA lies in the flaccid paralysis of the lateral abdominal muscles, allowing the closure of large hernias without excessive tension, reducing the likelihood of ventilation duration or postoperative complications such as abdominal hypertension and respiratory disorders [10]. BTA is preferred over invasive procedures for patients with spastic muscles disorders [8]. Additionally, BTA can be used as complementary treatment to progressive preoperative pneumoperitoneum (PPP) when it is insufficient [11]. Lastly, BTA can also be employed postoperatively to alleviate pain.

*Disadvantages***.** Despite its widespread use for medical purposes, the botulinum toxin A has several drawbacks that prevent its broad application. High cost is a major barrier to access, with some insurance companies declining coverage for the repair of large ventral hernias. Moreover, some patients have reported temporary concerns, such as weakened breath, sneezing, and coughing, due to the flaccidity of the abdominal muscle wall.[14,15} Furthermore, some patients experienced a feeling of fullness and bloating after the onset of BTA action, with others reporting pain, bruising, and detention sensations following toxin injection.[13,16,19] Multiple reports confirm that the normal functioning of the abdominal muscles involves contraction, aiding movement and stabilizing the spine and torso. However, the use of BTA can hinder these muscles, causing back pain through invasive component separation and chemical paralysis. Additionally, the BTA can relax the lateral abdominal wall muscles, leading to altered respiratory physiology and resulting in dyspnea. [13,17,18,20]. Animal experiments support the claim that BTA inhibits pain, signal, and perception transmitters beyond blocking acetylcholine secretion. [2,7]. Patients who are hemodynamically stable [8] and non-smokers, during the application period, are the only eligible candidates for BTA treatment. Moreover, the weight loss of obese patients is a prerequisite for BTA therapy. However, BTA is known to cause anaphylaxis due to its constituents and exacerbate Myasthenia Gravis, making it an absolute contraindication [6]. Lastly, patients who undergo BTA must undergo long-term follow-up to mitigate any potential side effects. [10,15].

Botulinum toxin type A is an effective and safe technique that is easily tolerated and has reversible effects without permanent complications. Separating the chemical components with BTA allows for closure without tension, without disrupting the abdominal wall's structure or physiology. Previously thought unmanageable hernias can now be cured using this technique, thanks to BTA's ability to induce relaxation and elongation. This eliminates the need for surgical expansion of the abdominal cavity and reduces pain and muscle tension in the postoperative period. However, BTA may cause inconvenience to patients such as temporary concerns, weak breathing, coughing, bloating, pain, and difficulty breathing. BTA should only be used in hematologically stable patients who do not smoke or are not obese.[21-24].

Conclusions

The healing process is safeguarded for a considerable duration due to the effects of Botox. Additionally, the utilization of Botox obstructs the occurrence of postoperative issues including necrosis, fibrosis, recurrency, and morbidity. Despite being a relatively new approach, thorough monitoring and observation are imperative before any conclusions about potential complications can be determined.

References

1. Deerenberg EB, Shao JM, Elhage SA, Lopez R, Ayuso SA, Augenstein VA, Heniford BT. Preoperative botulinum toxin A injection in complex abdominal wall reconstruction- a propensity-scored matched study. Am J Surg. 2021 Sep;222(3):638-642. doi: 10.1016/j.amjsurg.2021.01.010.

2. Elstner KE, Jacombs AS, Read JW, Rodriguez O, Edye M, Cosman PH, Dardano AN, Zea A, Boesel T, Mikami DJ, Craft C, Ibrahim N. Laparoscopic repair of complex ventral hernia facilitated by pre-operative chemical component relaxation using Botulinum Toxin A. Hernia. 2016 Apr;20(2):209-19. doi: 10.1007/s10029-016-1478-6.

3. Deerenberg EB, Elhage SA, Shao JM, Lopez R, Raible RJ, Kercher KW, Colavita PD, Augenstein VA, Heniford BT. The Effects of Preoperative Botulinum Toxin A Injection on Abdominal Wall Reconstruction. J Surg Res. 2021 Apr;260:251-258. doi: 10.1016/j.jss.2020.10.028.

4. Bueno-Lledó J, Martinez-Hoed J, Torregrosa-Gallud A, Menéndez-Jiménez M, Pous-Serrano S. Botulinum toxin to avoid component separation in midline large hernias. Surgery. 2020 Sep;168(3):543-549. doi: 10.1016/j.surg.2020.04.050.

5. Rodriguez-Acevedo O, Elstner KE, Jacombs ASW, Read JW, Martins RT, Arduini F, Wehrhahm M, Craft C, Cosman PH, Dardano AN, Ibrahim N. Preoperative Botulinum toxin A enabling defect closure and laparoscopic repair of complex ventral hernia. Surg Endosc. 2018 Feb;32(2):831-839. doi: 10.1007/s00464-017-5750-3.

6. Mourad AP, De Robles MS, Winn RD. Low-Dose Pre-Operative Botulinum Toxin A Effectively Facilitates Complex Ventral Hernia Repair: A Case Report and Review of the Literature. Medicina (Kaunas). 2020 Dec 28;57(1):14. doi: 10.3390/medicina57010014.

7. Bueno-Lledó J, Torregrosa A, Jiménez R, Pastor PG. Preoperative combination of progressive pneumoperitoneum and botulinum toxin type A in patients with loss of domain hernia. Surg Endosc. 2018 Aug;32(8):3599-3608. doi: 10.1007/s00464-018-6089-0.

8. Ibarra-Hurtado TR, Nuño-Guzmán CM, Miranda-Díaz AG, Troyo-Sanromán R, Navarro-Ibarra R, Bravo-Cuéllar L. Effect of botulinum toxin type A in lateral abdominal wall muscles thickness and length of patients with midline incisional hernia secondary to open abdomen management. Hernia. 2014 Oct;18(5):647-52. doi: 10.1007/s10029-014-1280-2.

9. Ibarra-Hurtado TR, Nuño-Guzmán CM, Echeagaray-Herrera JE, Robles-Vélez E, de Jesús

González-Jaime J. Use of botulinum toxin type a before abdominal wall hernia reconstruction. World J Surg. 2009 Dec;33(12):2553-6. doi: 10.1007/s00268-009-0203-3.

10. Elstner KE, Read JW, Rodriguez-Acevedo O, Cosman PH, Dardano AN, Jacombs AS, Edye M, Zea A, Boesel T, Mikami DJ, Ibrahim N. Preoperative chemical component relaxation using Botulinum toxin A: enabling laparoscopic repair of complex ventral hernia. Surg Endosc. 2017 Feb;31(2):761-768. doi: 10.1007/s00464-016-5030-7.

11. Tashkandi A, Bueno-Lledó J, Durtette-Guzylack J, Cayeux A, Bukhari R, Rhaeim R, Malinovski JM, Kianmanesh R, Renard Y. Adjunct botox to preoperative progressive pneumoperitoneum for incisional hernia with loss of domain: no additional effect but may improve outcomes. Hernia. 2021 Dec;25(6):1507-1517. doi: 10.1007/s10029-021-02387-8.

12. Soltanizadeh S, Helgstrand F, Jorgensen LN. Botulinum Toxin A as an Adjunct to Abdominal Wall Reconstruction for Incisional Hernia. Plast Reconstr Surg Glob Open. 2017 Jun 21;5(6):e1358. doi: 10.1097/GOX.0000000000001358.

13. Farooque F, Jacombs AS, Roussos E, Read JW, Dardano AN, Edye M, Ibrahim N. Preoperative abdominal muscle elongation with botulinum toxin A for complex incisional ventral hernia repair. ANZ J Surg. 2016 Jan-Feb;86(1-2):79-83. doi: 10.1111/ans.13258.

14. van Rooijen MMJ, Yurtkap Y, Allaeys M, Ibrahim N, Berrevoet F, Lange JF. Fascial closure in giant ventral hernias after preoperative botulinum toxin a and progressive pneumoperitoneum: A systematic review and meta-analysis. Surgery. 2021 Sep;170(3):769-776. doi: 10.1016/j.surg.2021.03.027.

15. Elstner KE, Read JW, Saunders J, Cosman PH, Rodriguez-Acevedo O, Jacombs ASW, Martins RT, Ibrahim N. Selective muscle botulinum toxin A component paralysis in complex ventral hernia repair. Hernia. 2020 Apr;24(2):287-293. doi: 10.1007/s10029-019-01939-3.

16. Seretis F, Chrysikos D, Samolis A, Troupis T. Botulinum Toxin in the Surgical Treatment of Complex Abdominal Hernias: A Surgical Anatomy Approach, Current Evidence and Outcomes. In Vivo. 2021 Jul-Aug;35(4):1913-1920. doi: 10.21873/invivo.12457.

17. Yurtkap Y, van Rooijen MMJ, Roels S, Bosmans JML, Uyttebroek O, Lange JF, Berrevoet F. Implementing preoperative Botulinum toxin A and progressive pneumoperitoneum through the use of an algorithm in giant ventral hernia repair. Hernia. 2021 Apr;25(2):389-398. doi: 10.1007/s10029-020-02226-2.

18. Elstner KE, Read JW, Rodriguez-Acevedo O, Ho-Shon K, Magnussen J, Ibrahim N. Preoperative progressive pneumoperitoneum complementing chemical component relaxation in complex ventral hernia repair. Surg Endosc. 2017 Apr;31(4):1914-1922. doi: 10.1007/s00464-016-5194-1.

19. Bueno-Lledó J, Torregrosa A, Ballester N, Carreño O, Carbonell F, Pastor PG, Pamies J, Cortés V, Bonafé S, Iserte J. Preoperative progressive pneumoperitoneum and botulinum toxin type A in patients with large incisional hernia. Hernia. 2017 Apr;21(2):233-243. doi: 10.1007/s10029-017-1582-2.

20. Catalán-Garza V, Peña-Soria MJ, Sáez-Carlin P, Cabeza-Gómez JJ, García-Fernández A, Torres-García AJ. Long-term results of botulinum toxin type A in complex abdominal wall repair and review of the literature. Updates Surg. 2020 Dec;72(4):1201-1206. doi: 10.1007/s13304-020-00775-w.

21. Bueno-Lledó J, Carreño-Saenz O, Torregrosa-Gallud A, Pous-Serrano S. Preoperative Botulinum Toxin and Progressive Pneumoperitoneum in Loss of Domain Hernias-Our First 100 Cases. Front Surg. 2020 Feb 28;7:3. doi: 10.3389/fsurg.2020.00003.

22. Weissler JM, Lanni MA, Tecce MG, Carney MJ, Shubinets V, Fischer JP. Chemical component separation: a systematic review and meta-analysis of botulinum toxin for management of ventral hernia. J Plast Surg Hand Surg. 2017 Oct;51(5):366-374. doi: 10.1080/2000656X.2017.1285783.

23. Tang FX, Zong Z, Xu JB, Ma N, Zhou TC, Chen S. Combination of Preoperative Progressive Pneumoperitoneum and Botulinum Toxin A Enables the Laparoscopic Transabdominal Preperitoneal Approach for Repairing Giant Inguinoscrotal Hernias. J Laparoendosc Adv Surg Tech A. 2020 Mar;30(3):260-266. doi: 10.1089/lap.2019.0669.

24. Tang FX, Ma N, Huang E, Ma T, Liu CX, Chen S, Zong Z, Zhou TC. Botulinum Toxin A Facilitated Laparoscopic Repair of Complex Ventral Hernia. Front Surg. 2022 Jan 10;8:803023. doi: 10.3389/fsurg.2021.803023.