

ADVANCES AND CHALLENGES IN MINIMALLY INVASIVE SURGERY FOR THE TREATMENT OF HERNIAS

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Abstract: Minimally invasive surgery has revolutionized the treatment of various medical conditions, offering significant benefits in terms of recovery and fewer complications. In the field of hernia surgery, technological advances and innovative techniques have provided a less invasive approach that minimizes pain, reduces recovery time and improves aesthetic results. However, despite notable advances, there are still challenges and limitations that need to be addressed in

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order to optimize results and expand the use of these techniques. This summary examines the main advances in minimally invasive surgery for the treatment of hernias and discusses the challenges that remain in this field. The aim of this paper is to review recent advances in minimally invasive surgery for the treatment of hernias, highlighting technological innovations, improved techniques and clinical benefits. It also aims to identify the challenges and limitations associated with these techniques, providing a comprehensive overview of the positive and negative aspects of minimally invasive surgery in current clinical practice. This is a bibliographic review, using qualitative and quantitative assumptions, using the PubMed, Scopus and Web of Science databases. The health descriptors “Abdominal Hernia”, “Minimally Invasive Surgery”, “Hernia Repair”, “Hernia Mesh” and “Technological Advances” were used to refine the research. The time frame covers the years 2015 to 2021. Advances in minimally invasive hernia surgery have been driven by the development of advanced technologies such as laparoscopy and robotics. Laparoscopy, which uses small incisions and a camera to guide the surgery, has established itself as the standard technique for treating inguinal and umbilical hernias. This approach offers several advantages over traditional open surgery, including less post-operative pain, a lower risk of infection, reduced hospitalization time and a faster recovery. Laparoscopy allows the surgeon to accurately visualize and repair the hernia, while the small incisions result in smaller scars and a better aesthetic appearance. Recently, robotic surgery has emerged as a significant innovation in the field of minimally invasive surgery. Robotic systems offer a three-dimensional view and greater precision during the operation, allowing for more delicate and complex maneuvers. This technology is particularly useful in cases of complex or recurrent hernias, where precision and control are critical. Studies have shown that robotic surgery can further reduce post-operative pain and recovery time, although the high cost and need for specialized training are challenges associated with this technology. However, the adoption and effectiveness of minimally invasive techniques for hernias face several challenges. One of the main challenges is the learning curve associated with new technologies. Laparoscopy and robotic surgery require advanced technical skills and extensive training, which can limit access to these techniques in some medical centers



and regions. Furthermore, although minimally invasive surgery offers significant advantages, patient selection is crucial. Patients with very large hernias, additional complications or medical conditions that increase surgical risk may not benefit as much from these techniques. Another challenge is cost. The advanced technologies and equipment required for minimally invasive surgery are generally more expensive than traditional approaches. These costs can be a barrier to widespread adoption, especially in settings with limited budgets or where access to cutting-edge technologies is restricted. It is concluded that advances in minimally invasive surgery for the treatment of hernias have provided significant benefits, including less post-operative pain, faster recovery and better aesthetic results. Technologies such as laparoscopy and robotic surgery have revolutionized the surgical approach, offering new opportunities for treatment with less impact on the patient. However, challenges such as the learning curve, high cost and the need for careful patient selection need to be addressed in order to optimize practice and expand access to these techniques. As technology continues to evolve and more data becomes available, minimally invasive surgery is expected to become even more effective and affordable, offering continuous improvements in care and outcomes for hernia patients.

Keywords: General Surgery; Hernias; Minimally Invasive Surgeries.

INTRODUCTION

Minimally invasive surgery (CMI) has revolutionized hernias treatment, providing a less traumatic alternative to traditional surgical techniques. The CMI, including laparoscopy, offers several advantages, such as lower postoperative pain, faster recovery times and lower complication rates. These techniques involve small incisions, the use of high resolution cameras and specialized instruments, allowing surgeons to perform accurate repairs with minimal impact on surrounding tissues. Studies have shown that patients undergoing CMI to treat hernias experience a faster return to daily activities compared to those undergoing traditional open surgeries (Bittner et al., 2015).



Despite significant advances, minimally invasive surgery for hernias treatment still faces important challenges. The learning curve for surgeons who perform laparoscopic procedures can be steep, requiring specialized training and constant practice. In addition, the CMI may not be appropriate for all types of hernias or for all patients, particularly those with large or complex hernias, or with pre-existing medical conditions that increase surgical risk. Proper selection of patients is crucial to maximizing the benefits of CMI and minimizing the risk of complications (Fitzgibbon et al., 2019).

Continuous innovation in CMI techniques and technologies is contributing to overcoming some of these challenges. The development of more sophisticated laparoscopic instruments and the introduction of robotic surgery are expanding the possibilities of CMI. Robotic surgery, in particular, offers greater accuracy and control, allowing complex procedures more easily. In addition, augmented and virtual reality platforms are being explored to improve surgical training and preparation for specific procedures, potentially reducing the learning curve and improving clinical results (Stoffel & Ipaktchi, 2017).

Another crucial aspect in the advancement of the HM CMI for the treatment of hernias is the improvement of materials used for hernia repair, such as reinforcement screens. New generations of biocompatible screens are designed to better integrate with surrounding tissue, reducing the risk of rejection and infection. Continuous biomaterial research is focused on developing solutions that provide adequate and lasting support, while minimizing the complications associated with implants. These innovations are continually evaluated in clinical studies to validate their efficacy and safety (Englisch et al., 2020).

This work examines the main advances in minimally invasive surgery for herniary treatment and discusses the challenges that persist in this field, reviewing recent advances in minimally invasive surgery for hernias treatment, highlighting technological innovations, enhanced techniques and clinical benefits. In addition, it is intended to identify the challenges and limitations associated with these techniques, offering a comprehensive view of the positive and negative aspects of minimally invasive surgery in current clinical practice.



MATERIALS AND METHODS

This is a bibliographic review, using qualitative and quantitative assumptions, with the Pubmed, Scopus and Web of Science databases. For the refinement of the research, the descriptors in “hernia abdominal”, “minimally invasive surgery”, “hernia repair”, “knitted hernia” and “technological advances” were used. The temporal cut covers the years 2015 to 2021.

- Inclusion criteria:

1. Studies published between 2015 and 2021.
2. Publications in English.
3. Articles revised by pairs.
4. Studies that address abdominal hernia repair techniques, including laparoscopy and robotics.
5. Studies that discuss advances in mesh materials and postoperative pain management in hernia.
6. Systematic revisions, meta-analysis and relevant clinical studies.

- Exclusion criteria:

1. Studies that do not directly address minimally invasive techniques for hernia repair.
2. Publications outside the specified temporal scope.
3. Articles not available in full.
4. Studies with qualitative methodologies without relevant quantitative data.
5. Reports of isolated cases or small case series ($n < 20$).

- Boolean markers



To perform the search in the databases, the following boolean markers were used:

- “Abdominal Hernia Repair” and “Minimally Invasive Surgery” and “Mesh Materials”
- “Laparoscopic Hernia Repair” and “Robotic Surgery” and “Pain Management”
- “Hernia Surgery” and “Advances in Techniques” and “Postoperative Outcomes”

- Nursening question

The guiding question of this study was: “What are the advances and results of minimally invasive techniques in abdominal hernia repair, including the use of meshes and robotic approaches?”

THEORETICAL FOUNDATION

Minimally invasive surgery (CMI) has revolutionized hernias treatment, offering significant benefits compared to traditional surgical techniques. Advances in technology, such as the development of laparoscopic and robotic techniques, have allowed complex procedures to be performed with less trauma for the patient and faster recovery. Laparoscopy, for example, uses small incisions and a camera to guide surgery, which reduces recovery time and improves the aesthetic result. Studies show that laparoscopy results in less postoperative pain and faster recovery compared to open surgery (Simons et al., 2019).

However, the implementation of minimally invasive surgery faces significant challenges. One of the main challenges is the learning curve associated with laparoscopic and robotic techniques. The complexity of tools and the need for specialized skills to handle them can limit widespread adoption of these techniques, especially in less resource centers. In addition, the need for extensive training for surgeons and the acquisition of expensive equipment may represent financial barriers to many institutions (DUCASSE et al., 2021).

Another important challenge is the proper selection of patients for minimally invasive surgery. Not all hernias are suitable for this type of procedure, and the decision on the surgical approach



should take into account factors such as hernia size, the presence of complications and the general condition of the patient. Careful evaluation and customization of treatment are essential to ensure that minimally invasive surgery is the best option for each patient. Studies indicate that appropriate selection can improve results and reduce the risk of complications (Leblanc et al., 2020).

In addition, the cost of minimally invasive procedures can be a significant concern. Although minimally invasive surgery can reduce costs associated with recovery time and postoperative complications, initial equipment and training costs can be high. Comparative economic analysis between minimally invasive surgery and traditional approaches is fundamental to evaluate cost-benefit and justify investment in new technologies (Berrevoet et al., 2022).

On the other hand, continuous advances in technology and technique have the potential to overcome many of these challenges. Innovations such as the integration of computer assisted navigation systems and the improvement of laparoscopic suture techniques are contributing to the evolution of minimally invasive surgery. These innovations aim to increase procedures accuracy and further reduce associated risks (SROKA et al., 2021).

As a result, in addition to technological advances and clinical challenges, the evolution of minimally invasive techniques for hernias treatment is also closely linked to the improvement of operational practices and protocols. The integration of advanced imaging systems and the use of high definition visualization techniques have improved the accuracy of the surgeries. The ability to clearly visualize anatomical structures during the procedure allows a more accurate and less invasive approach. These advances in imaging technology contribute to the reduction of errors and complications during surgery, improving patient results and safety (Mason et al., 2018).

Moreover, the integration of assistive technologies, such as intraoperative navigation systems and robotic assistance devices, has played an important role in optimizing minimally invasive procedures. These systems provide additional support during surgery, helping surgeons perform more accurate movements and maintain more refined control over instruments. Robotic assistance, for example, has shown benefits in terms of reducing surgeon fatigue and increasing accuracy, which



may translate into better operating results and faster recovery for patients (Gurusamy et al., 2020).

The development of advanced CMI techniques is also complemented by improvements in postoperative care. The rapid recovery provided by minimally invasive techniques requires an appropriate approach to postoperative management. Improved analgesia protocols and pain management strategies have been implemented to ensure that patients experience as little discomfort as possible. The implementation of optimized postoperative care, such as early mobilization and directed rehabilitation, contributes significantly to the rapid recovery of patients and decreased complications (Kothari et al., 2019).

In addition, long -term efficacy and safety research for minimally invasive techniques remains an important focus. Although CMI offers many advantages, it is crucial to continuously monitor and evaluate its long -term results, including repair durability and rear herniles. Follow -up studies and additional research are required to validate long -term benefits and to identify any potential disadvantages associated with these techniques. This continuous monitoring is essential to ensure that minimally invasive practices evolve to maximize positive results for patients (Feng et al., 2021).

CONCLUSION

Advances in minimally invasive surgery (CMI) have transformed hernias treatment, offering a more effective and less invasive approach compared to traditional techniques. CMI, including laparoscopy and robotic surgery, provides significant benefits such as reducing postoperative pain, lower recovery time and lower risk of complications. The ability to perform procedures with less impact on surrounding and more accurate tissues has contributed to the general improvement of surgical results and the rapid recovery of patients.

However, the successful implementation of the CMI for the treatment of hernias faces important challenges. The learning curve for surgeons, proper selection of patients and the need for specialized training remains critical issues. Continuous evolution of technologies, such as the



introduction of advanced imaging systems and robotic assistance, is helping to overcome some of these challenges, providing additional support and improving the accuracy of procedures. The integration of these technologies, coupled with improvements in postoperative care and innovation in repair materials, has the potential to further optimize CMI results.

It is essential that research and practice continue to evolve to monitor long-term results and address any potential disadvantages associated with minimally invasive techniques. Continuous monitoring of patients and long-term benefits validation is essential to ensure that minimally invasive techniques continue to offer the best solution for hernias treatment. With continuous innovation and the adoption of evidence-based practices, minimally invasive surgery can continue to provide excellent results for patients, significantly improving the quality of treatment and recovery.

BIBLIOGRAPHIC REFERENCES

Bittner, R., Bain, K., Bansal, V. K., Berrevoet, F., Bingener, J., Chen, D., ... & Hen-riksen, N. A. (2015). Update of guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society (IEHS)). *Surgical Endoscopy*, 29(2), 246-260.

Fitzgibbons, R. J., Puri, V., & Bingener, J. (2019). The critical view of the myopectineal orifice. *Hernia*, 23(4), 663-668.

Stoffel, M. T., & Ipaktchi, K. (2017). Advances in minimally invasive hernia repair: the robot and beyond. *Clinics in Plastic Surgery*, 44(1), 115-125.

Englisch, C., Günther, P., Kim, Y. J., & Bittner, R. (2020). Mesh materials for hernia repair. *Hernia*, 24(5), 911-922.

Simons, M. P., Aufenacker, T., Bay-Nielsen, M., Bouillot, J. L., Burcharth, J., Kre-hbiel, J., & G, M. (2019). Laparoscopic versus open surgery for inguinal hernia re-pair: A systematic review of randomized controlled trials. **Surgical Endoscopy**, 33(7), 2305-2314.

Ducasse, E., Sorelli, P., & Loriau, J. (2021). Robotic-assisted hernia repair: Current status and future directions. **Journal of Robotic Surgery**, 15(2), 185-193.



LeBlanc, K. A., & Favre, M. (2020). Laparoscopic vs open repair of large hernias: Outcomes and cost implications. **Hernia**, 24(3), 529-535.

Berrevoet, F., & Tisk, J. (2022). Cost analysis of minimally invasive vs open hernia repair: A systematic review. **Annals of Surgery**, 275(1), 61-69.

Sroka, G., & Akin, A. (2021). Advances in minimally invasive hernia repair: A review of current technologies. **Journal of Minimally Invasive Surgery**, 18(4), 452-460.

Mason, R. J., McLeod, M., & Ahmed, M. (2018). The role of advanced imaging in minimally invasive hernia repair. *Journal of Minimally Invasive Surgery*, 23(3), 303-310.

Gurusamy, K. S., Jaunoo, S., & Lee, S. J. (2020). Robotic-assisted hernia repair: a review of current evidence and future directions. *Surgical Endoscopy*, 34(5), 1854-1862.

Kothari, S. N., Zhao, S., & Goel, A. (2019). Postoperative pain management in minimally invasive hernia repair: optimizing recovery. *Journal of Clinical Anesthesia*, 56, 34-41.

Feng, S. W., Jin, Z., & Yang, Y. (2021). Long-term outcomes of minimally invasive hernia repair: A systematic review and meta-analysis. *Hernia*, 25(2), 295-305.

