Section A -Research paper

Laparoscopic Endoscopic Co-Operative Surgery For Gastric Gastroentistinal Stromal Tumors

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ABSTRACT

Gastrointestinal stromal tumor (GISTs) is the most common mesenchymal neoplasms of the GI tract. Surgical resection is the main treatment modality. Laparoscopic and endoscopic cooperative surgery (LECS) for gastric (GIST) was established as a type of minimal invasive resection and is now widely used worldwide

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1. History of LECS

Laparoscopic endoscopic cooperative surgery (LECS) has emerged as a groundbreaking advancement in the realm of surgical procedures for gastric tumor resection, particularly gastrointestinal stromal tumors (GISTs). The idea of LECS stemmed from classical LECS for resecting gastric submucosal tumors and has gained widespread recognition as a safe and feasible technique, resulting in approval for insurance coverage by Japan's National Health Insurance plan. This approval has led to its extensive use for gastric submucosal tumor resection[4].

The development of modified LECS procedures, such as inverted-LECS, non-exposed endoscopic wall-inversion surgery, and closed-LECS, has effectively addressed the limitations of classical LECS. These modifications have significantly reduced the risk of abdominal infection, scattering of tumor cells in the abdominal cavity, and tumor cell seeding in the peritoneum. Consequently, there has been an expanded indication for modified LECS to encompass patients with gastric epithelial neoplasms[5].LECS has also displayed promise in its application to tumor excision in other organs such as the duodenum, colon, and rectum. Moreover, future directions in LECS procedures are anticipated to include sentinel lymph node mapping combined with LECS, potentially

broadening the application of this approach to a portion of early gastric cancers[6].

The evolution of LECS procedures has led to its inclusion on the national insurance list in Japan and subsequent rapid dissemination throughout the surgical community[4]. The procedure's capacity to minimize the resected region and preserve stomach function after surgery further enhances its appeal. Additionally, applications of LECS have continued to expand beyond the classical version, resulting in further enhancements such as inverted LECS for gastric GIST and CLEAN-NET or closed LECS for GIST with delle.

Overall, while classical LECS is considered a safe and useful procedure for gastric submucosal tumors without mucosal defects independent of tumor location or proximity to critical structures like the esophagogastric junction or pyloric ring. There are still areas that need improvement for future applications of LECS-related procedures for other malignant diseases with mucosal lesions such as GIST with mucosal defects and gastric cancer[3].

LECS has evolved significantly since its inception as a technique for local resection of gastric tumors. With its proven safety and feasibility for various applications beyond GISTs, including potential implications for early gastric cancers treated by sentinel node mapping, this approach is expected to continue evolving into more specialized techniques tailored to specific patient needs.

2. Comparison with laparoscopic surgery and endoscopic surgery

The treatment of gastric GISTs commonly involves laparoscopic surgery and endoscopic surgery, each with its own set of limitations. While laparoscopic surgery provides a clearer field of vision and a wider resection range compared to endoscopic surgery, it struggles with accurate tumor localization and boundary judgment, often leading to tumor rupture and gastric deformation[6]. On the other hand, endoscopic surgery has difficulties with accurate tumor localization, boundary judgment, and wound closure, making it unsuitable for GIST treatment[2].

In response to these limitations, LECS was developed as an innovative technique that combines the strengths of both approaches while minimizing their drawbacks. This cooperative approach has significantly reduced procedural complications and improved complete resection rates for larger tumors.

As part of this cooperative approach, laparoscopy-assisted endoscopic surgery (LAES)[7] and integrated LECS have been introduced to incorporate the roles of both procedures in the operation process. LAES provides basic assistance from the other technique, while LECS involves full cooperation between laparoscopy and endoscopy teams for resection of lesions with essential significance.

Furthermore, advancements in laparoscopy-endoscopy cooperative techniques such as non-exposure simple suturing endoscopic full-thickness resection and simple non-exposure EFTR have been developed to preserve residual gastric motility while

ensuring complete resection[8].

It is important to recognize that each approach has its own strengths and limitations. A hybrid approach has been developed to combine the strong points of intraluminal and intraperitoneal procedures while mitigating their technical limitations, aiming to improve patient outcomes effectively.

LECS offers a promising alternative by leveraging the strengths of both laparoscopic and endoscopic surgeries while minimizing their individual limitations. Its development has significantly improved the treatment approach for gastric GISTs and holds potential for further advancements in surgical procedures.

3. Advantages of LECS for gastric GISTs (GISTs)

The emergence of LECS has brought a promising new technique to the table for the treatment of gastric GISTs. This innovative approach combines the strengths of both laparoscopic and endoscopic surgeries, offering optimal surgical margins, oncological benefits, and functional preservation of the residual stomach. LECS was primarily developed as a treatment for gastric submucosal tumors without epithelial lesions, including GISTs.

In comparison to the traditional simple wedge resection with a linear stapler, LECS presents several advantages. It allows for precise dissection of the local gastric wall without the need for lymphadenectomy, which is well-suited for treating gastric GISTs. The technique enables accurate and minimal resection while preserving the physiological function of the remaining stomach. Additionally, LECS offers minimally invasive treatment and enables oncologically precise resection[9].

The utilization of LECS in treating gastric GISTs has been linked to reduced operating time, hospital stay, and intraoperative blood loss. The success rate is high, with no compromise in outcomes or increased complications as reported in the literature. Furthermore, LECS provides the benefit of simultaneous intraluminal approach with endoscopy, allowing surgeons to optimize the resection area[9].

An important advantage of classical LECS is its independence from tumor location, such as proximity to the esophagogastric junction or pyloric ring. This makes it a safe and useful procedure for gastric submucosal tumors without mucosal defects.

Although classic LECS involves intentionally opening the gastric wall and carries a risk of tumor dissemination with contamination by gastric juice, various modified LECS techniques have been developed to avoid this risk. These modifications have expanded the potential applications of LECS to include early gastric cancer and other malignant diseases with mucosal lesions[3].

In conclusion, LECS presents several advantages for treating gastric GISTs. It ensures accurate resection with minimal invasiveness, optimal surgical margins, and functional preservation of the remaining stomach. The technique has shown positive

outcomes in reducing operating time, hospital stay, and intraoperative blood loss while maintaining a high success rate. See references.

4. Disadvantages of LECS

Despite the numerous advantages it offers, LECS is not without its drawbacks and limitations. One of the primary concerns associated with LECS is the potential risk of tumor exposure within the abdominal cavity and the possibility of leakage of gastric contents during the surgical procedure. The classic LECS technique has been the subject of criticism due to these issues, as it may result in contamination and seeding of tumor cells in the peritoneal cavity, especially when dealing with tumors associated with an ulcer or epithelial lesion[10]. This raises significant concerns about the potential for peritoneal spread and dissemination of cancer cells.

Another drawback of LECS is its limitations in addressing epithelial lesions. The procedure may not be suitable for certain types of tumors, especially those located near the gastric inlet or outlet that require resection of relatively large sections of healthy stomach. Additionally, there is a risk associated with opening the gastric wall during classic LECS, as this could potentially lead to tumor dissemination through gastric juice[11].

Moreover, there are concerns surrounding the feasibility and safety of laparoscopic resection for large tumors. While some experts believe that laparoscopic surgery can be equally applicable to large gastric GISTs, others argue that there is a higher risk of intraoperative tumor rupture, particularly when dealing with larger tumors. This raises questions about the suitability of laparoscopic surgery for GISTs larger than 5 cm in diameter.

Additionally, despite its ability to minimize the resected region and preserve stomach function post-surgery, there are still risks associated with intraoperative tumor rupture, especially when dealing with larger tumors. The potential for complications such as intraoperative bleeding and perforation must be carefully considered when evaluating the feasibility and safety of laparoscopic resection for gastric GISTs[3].

It is important to note that while LECS offers numerous advantages in terms of reduced surgical margins and better anatomical preservation compared to traditional techniques, there are still areas that require further improvement in terms of safety and certainty.

5. Limitations of LECS

While LECS has been proven to be a secure and viable method for removing gastric GISTs , it is crucial to acknowledge some constraints of this technique. One of the main concerns regarding LECS is the potential risk of scattering and seeding of bacterial contamination or tumor cells into the abdominal cavity due to the perforation of the gastric wall[13]. This has raised concerns about intraoperative bacterial infection and dissemination of tumor cells, especially in LECS with exposure technique. The classical LECS procedure, while effective in achieving precise resection, still

poses these inherent risks.

To address these limitations, several modified LECS procedures with non-exposure techniques have been developed, such as combination of laparoscopic and endoscopic approaches for neoplasia with non-exposure technique (CLEAN-NET) and non-exposed endoscopic wall-inversion surgery (NEWS)[6]. These modified procedures aim to prevent the concerns related to bacterial infection and tumor cell dissemination by utilizing non-exposure techniques. CLEAN-NET, for example, involves inversion of the tumor into or outer the lumen, retrieval of tumor per oral or through the abdominal cavity, and dominance in the role of the endoscopist or the laparoscopic surgeon[3].

It is important to recognize that even though these modified LECS procedures address some limitations of classical LECS, they also have their own set of characteristic procedures and potential drawbacks. Familiarization with these procedure details is crucial for understanding their specific indications, advantages, and limitations. While these modified techniques offer potential solutions to certain limitations of classical LECS, they require careful consideration and expertise for successful implementation.

Another limitation worth noting is that not all patients may be suitable candidates for LECS. Some contraindications for LECS include large tumors located at specific sites such as near the esophagogastric junction or pylorus, as well as tumors with an extrinsic growth pattern. In addition, large tumors may pose challenges in ensuring negative margins with current techniques[6].

Furthermore, while LECS offers advantages in minimizing resected stomach tissue compared to traditional surgical approaches, there are still limitations in terms of ensuring negative margins for large tumors or those located at specific sites. Additionally, there is a need for further research and development to enhance the reliability and feasibility of this technique.

In conclusion, while LECS has demonstrated its potential benefits for gastric GISTs resection, it is essential to recognize its limitations in terms of inherent risks related to exposure techniques, contraindications based on tumor size and location, as well as challenges in ensuring negative margins for certain cases. Future directions in research and development should focus on addressing these limitations while maximizing the advantages offered by this minimally invasive surgical approach.

6. Future directions in LECS for GISTs

The future of LECS for gastric GISTs holds promise for continued advancements and innovations. As this surgical technique continues to evolve, it is essential to consider the potential areas of growth and development.

One potential area for future development in LECS for GISTs is the refinement of modified LECS procedures. These advanced techniques, such as inverted LECS with crown method, nonexposed endoscopic wall-inversion surgery (NEWS), and a combination of laparoscopic

endoscopic approaches to neoplasia with a nonexposure technique (CLEAN-NET), have shown promise in expanding the indications for LECS to include cases with epithelial lesions. Further research and clinical application of these advanced techniques can contribute to the broader utilization of LECS in treating GISTs, potentially enhancing patient outcomes and minimizing postoperative complications[14].

Moreover, future directions in LECS may involve advancements in technology and equipment used during the procedure. The integration of new tools and technologies can enhance the precision and safety of LECS, ultimately improving surgical outcomes for patients with GISTs. For example, the development of advanced imaging modalities or robotic-assisted surgical systems tailored specifically for LECS could offer significant advantages in terms of intraoperative visualization and procedural accuracy[15].

In addition, ongoing research efforts should focus on refining patient selection criteria for LECS. By identifying specific clinical and pathological factors that correlate with optimal outcomes following LECS for GISTs, surgeons can better tailor this approach to individual patient needs. This personalized approach may involve genetic profiling of GIST tumors to identify molecular markers associated with treatment response, which could inform decision-making regarding the appropriateness of LECS as a therapeutic option[3].

In the realm of surgical education and training, future directions in LECS should prioritize the dissemination of best practices and standardized guidelines. Comprehensive training programs focused on teaching the principles and technical skills required for successful LECS can ensure that more surgeons are proficient in this specialized approach. Additionally, fostering interdisciplinary collaboration between laparoscopic surgeons and endoscopists will be essential in advancing the field of LECS by promoting knowledge sharing and skill development.

Looking ahead, it is clear that LECS holds great potential as a minimally invasive treatment modality for gastric GISTs. Continued research, technological innovation, refined patient selection criteria, and comprehensive training initiatives will be instrumental in shaping the future landscape of LECS, ultimately improving patient care and outcomes.

Conclusion

In conclusion, the future of LECS for gastric GISTs is filled with potential for advancements and innovations. As this surgical technique continues to evolve, it is essential to consider the potential areas of growth and development, much like the refinement of modified LECS procedures. One potential area for future development in LECS for GISTs is the advancement of innovative techniques such as third space robotic and endoscopic cooperative surgery (TS-RECS), which are being developed to dissect tumors entirely while preserving the intact mucosal layer. These advancements hold promise as alternative methods for resecting gastric GISTs > 2 cm[16].

Moreover, technological advancements in laparoscopic and endoscopic instruments, including those for robotic LECS surgery, will be essential to address challenges associated with LECS. The integration of new tools and technologies can enhance precision and safety, ultimately improving surgical outcomes for patients with GISTs[17].

Furthermore, it is important to acknowledge some limitations and contraindications associated with LECS. The technique has been limited by potential tumor cell seeding and bacterial contamination of the abdominal cavity. Additionally, there are concerns regarding technical difficulty, specifically in modified procedures such as new innovative techniques developed from classical LECS.

Looking toward future directions in LECS for GISTs, ongoing research into innovative techniques and advancements in laparoscopic and endoscopic instruments will play a pivotal role in shaping the future of LECS for GISTs. This personalized approach may involve genetic profiling of GIST tumors to identify molecular markers associated with treatment response, which could inform decision-making regarding the appropriateness of LECS as a therapeutic option.

In summary, LECS represents a novel approach that aligns with the principles of minimally invasive surgery while offering favorable short-term outcomes for appropriately selected patients with gastric GISTs. Continued research efforts should focus on refining patient selection criteria for LECS to ensure optimal outcomes following surgery. Additionally, fostering interdisciplinary collaboration between laparoscopic surgeons and endoscopists will be essential in advancing the field of LECS by promoting knowledge sharing and skill development.

Overall, the future landscape of LECS holds great promise as a minimally invasive treatment modality for gastric GISTs. Continued research, technological innovation, refined patient selection criteria, and comprehensive training initiatives will be instrumental in shaping the future landscape of LECS, ultimately improving patient care and outcomes.

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