Commentary

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The Role of Robotic Surgery in the Management of Hiatal Hernias

Hiatal Herni Ameliyatlarında Robotik Cerrahinin Yeri

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ABSTRACT

Robotic surgery (RS) has recently become an increasingly preferred minimally invasive approach for hiatal hernia repair. This commentary discusses the efficacy of RS compared to laparoscopic surgery (LS) in light of current meta-analyses and retrospective studies. RS offers technical advantages such as three-dimensional visualization, enhanced dexterity, and improved ergonomics, potentially providing superior precision for surgeons. Several studies have reported lower postoperative complication rates and, in some cases, shorter hospital stays in the RS group. However, operative times did not show a statistically significant difference between the two techniques. Large-scale meta-analyses indicated no clear clinical superiority of RS over LS, while costs associated with RS were significantly higher. Additionally, the retrospective nature of most studies and the heterogeneity in patient characteristics limit the generalizability of the findings. Despite its promising technical capabilities and increasing surgeon experience, further randomized controlled trials are necessary to establish the clinical benefits of RS. Nevertheless, RS represents a promising approach that may become more widely adopted in hiatal hernia surgery in the near future.

Keywords: Robotic surgery, hiatal hernia repair, laparoscopic surgery, minimally invasive techniques, postoperative outcomes

ÖZ

Robotik cerrahi (RC), son yıllarda hiatal herni onarımında giderek daha fazla tercih edilen minimal invaziv bir yöntem haline gelmiştir. Bu yorum yazısı, mevcut meta-analizler ve retrospektif çalışmalar ışığında RC'nin laparoskopik cerrahi (LC) ile karşılaştırmalı etkinliğini ele almaktadır. RC, cerrahlara daha üstün bir hassasiyet sunma potansiyeline sahip üç boyutlu görüntüleme, artırılmış el becerisi ve geliştirilmiş ergonomi gibi teknik avantajlar sağlamaktadır. Birçok çalışmada RC uygulanan hastalarda daha düşük postoperatif komplikasyon oranları ve bazı durumlarda daha kısa hastanede kalış süreleri bildirilmiştir. Ancak, her iki cerrahi teknik arasında operasyon süreleri açısından istatistiksel olarak anlamlı bir fark saptanmamıştır. Geniş ölçekli meta-analizler, RC'nin LC'ye karşı belirgin bir klinik üstünlüğünü göstermemekle birlikte, RC ile ilişkili maliyetlerin belirgin şekilde daha yüksek olduğunu ortaya koymuştur. Ayrıca, çalışmaların çoğunun retrospektif olması ve hasta özelliklerindeki heterojenlik, elde edilen bulguların genellenebilirliğini sınırlamaktadır. RC'nin umut vaat eden teknik yetkinlikleri ve cerrahların artan deneyimine rağmen, RC'nin klinik yararlarının net olarak ortaya konulabilmesi için daha fazla randomize kontrollü çalışmaya ihtiyaç duyulmaktadır. Bununla birlikte, RC hiatal herni cerrahisinde gelecekte daha yaygın olarak kullanılabilecek umut verici bir yaklaşım olarak değerlendirilmektedir.

Anahtar Kelimeler: Robotik cerrahi, hiatal herni onarımı, laparoskopik cerrahi, minimal invaziv teknikler, postoperatif sonuçlar

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Dear Readers,

In this issue, I will draw attention to robotic surgery (RS), which has become increasingly preferred in hiatal hernia surgeries with the effect of advancing technology and which we have recently started to apply in our own clinic. I will present an overview of the results of this minimally invasive approach, whose superiority is still controversial, compared to laparoscopic surgery (LS) in adult patients, taking into account the available literature.

A hiatal hernia is defined as the migration of the stomach or other abdominal organs through the esophageal hiatus into the thoracic cavity. An anatomical classification developed by Dr. Norman Barrett in 1954 categorized hiatal hernias into four types: sliding type I, paraesophageal type II, mixed type III, and herniation of organs other than the stomach type IV. Among these, sliding or type I hernias, in which the gastroesophageal junction migrates into the thorax, are the most common (95%) (1). Typical symptoms include reflux, regurgitation, pressure, and distension. Compression or volvulus can also create an unusual situation that can lead to ischemia. Surgical treatment is recommended for symptomatic hiatal hernias or those that have become ischemic. Traditionally, repair was performed via an open transabdominal or transthoracic approach, but with the advent of minimally invasive surgery, laparoscopic repair is now the standard. LS has been reported to offer fewer overall complications and a faster recovery compared to the open approach. However, LS has limitations, including less ergonomics due to the use of rigid instruments with limited range of motion, limitations in depth perception in two-dimensional imaging, the need for a trained camera assistant, and surgeon fatigue, leading researchers to explore alternative technologies. In the 2000s, the introduction of computer-assisted RS represented a significant advance in minimally invasive surgery by providing additional tools for performing minimally invasive surgery. RS appears to potentially overcome some of the limitations of traditional laparoscopy. Compared to the laparoscopic approach, RS offers improved three-dimensional imaging, motion scaling, vibration filtering, and improved ergonomics and rotation (2-5). These features are beneficial for the precise dissection and suturing required for procedures such as hiatal hernia repair. Despite its advantages, RS also presents its own challenges. While RS has been shown to result in longer operative times, higher costs, and less tactile feedback, the level of evidence definitively demonstrating its superiority in terms of clinical outcomes has not yet been reached. In this article, I will discuss three meta-analyses comparing RS and LS, and two retrospective studies that demonstrate the types of studies included in these analyses.

In this context, to the best of our knowledge, the first meta-analysis comparing the results of robotic and laparoscopic surgeries for hiatal hernia surgery (1) compared the operative time, intraoperative complications, 30-day re-admission, length of stay, and postoperative complications for hiatal hernia in published articles. In the study, which included a total of seven articles, 8166 patients underwent LS and 1945 patients underwent RS. In the postoperative complication analysis, which included five studies among the included studies, the rate was 4.25% (302/7111) in the LC group, while this rate was 3.49% (38/1088) in the RS group, indicating that the complication rate was significantly lower in the RS group (p=0.000). In three studies including 2096 patients, no significant difference was observed between the LS and RS groups when reporting operative time, and it was not found to be statistically significant (p=0.06). In three studies evaluating intraoperative complications; complications were observed in 10.67% of patients in the RS group and 9.09% of patients in the LS group, but the difference between the two groups was not found to be significant (p=0.89). In the results of the analysis where three studies including 2,176 patients were selected, hospital stay was reported and the mean hospital stay in these three studies was reported as 3.2 days in the RS group and 4.2 days in the LS group. The hospital stay was found to be significantly shorter in the RS group compared to the LS group (p=0.04). However, the analysis performed after excluding the study that increased statistical heterogeneity found no difference between the remaining two studies (p=0.97) in terms of length of hospital stay. In addition, in the analysis including two studies including 421 patients, 30-day re-admission was evaluated and no significant difference was noted between the RS and LS groups (p=0.53). This study has some limitations; the study lacked prospective randomized controlled trials directly comparing laparoscopic and robotic approaches. It contained significant heterogeneity in hospital stay and operative time, which could weaken the reliability of the results. It also lacked information on preoperative patient characteristics and intraoperative data, such as hernia size, comorbidities, posterior cruroplasty method, postoperative complications classified according to the Clavien-Dindo classification, etc. Despite these limitations, RS has been shown to be a better option, primarily due to decreased postoperative complications and length of stay.

A 2024 meta-analysis (6) aimed to compare the operative time, intraoperative complications, hospital stay, re-admission rates, overall complications, mortality, and costs associated with RS and LS for anti-reflux and hiatal hernia surgery. A total of fourteen articles and 555,368 patients were included. Of these patients, 66,725 underwent RS and 488,643 underwent LS. Eight studies, including 11,936 patients, evaluated operative time, and no statistically significant difference was found between the RS and LS groups (p=0.10). Intraoperative complications were excluded from the meta-analysis because they were documented only in a small subset of studies, comprising 0.02% of patients undergoing RS and 2% of patients undergoing RS. Length of hospital stay was reported in twelve studies and the mean was 3.7 days in the RS group and 3.5 days in the LS group, with no statistically significant difference observed (p=0.11). The results of the analysis of re-admission rates including a total of 539,673 patients from nine studies showed that there was no significant difference between the RS and LS groups (p=0.53). The results of the analysis of general postoperative complications including eleven studies also did not detect a significant difference between the RS and LS groups (p=0.62). In the analysis including twelve studies, mortality was compared for both groups and was determined as 0.4% (244/66,638) for the RS group and 0.3%

(1531/488,429) for the LS group. The analyses of seven studies that included cost reports also showed that the LS group had statistically significantly lower costs (p<0.00001). The limitations of this analysis are; while some of the included studies reported hiatal hernia types based on patient preoperative characteristics, no stratification was performed based on hiatal hernia type for various outcomes such as intraoperative and postoperative complications, operative time, length of stay, etc.

Awshah et al. (7), published in 2024, compared LS and RS for hiatal hernia and Heller myotomy in a meta-analysis of twenty-two studies involving 196,339 patients. The results of the analysis of seven of the thirteen hiatal hernia studies reporting perioperative complications revealed no significant difference between RS and LS in hiatal hernia repair; however, significant heterogeneity was highlighted. Similarly, in eleven hiatal hernia studies reporting morbidity, no significant difference was found between RS and LS, while significant heterogeneity was found. No significant difference was found in 10 studies comparing overall mortality in RS and LS. The results of studies comparing rates of reintervention/admission, recurrence, perioperative blood loss, operative time, and hospital stay were similar, with no significant differences found. A limitation of this meta-analysis is the paucity of randomized controlled trials and the retrospective nature of the included studies.

In the first of two retrospective studies, Benedix et al. (8) retrospectively examined 140 patients who underwent hiatal hernia and/or anti-reflux surgery in 2021. Of these patients, 85 (60.7%) underwent conventional LS, and 55 (39.3%) underwent RS. When the data obtained from this study were examined, it was observed that the mean operative time differed significantly between the LS and RS groups, with the mean operative time being longer in the RS group (p<0.01). However, it was noted that the procedure time decreased significantly over time in the RS group, with the mean operative time being 190.0 minutes for the first ten cases and 139.3 minutes for the last ten cases. The mean estimated intraoperative blood loss did not differ significantly between the LS and RS groups (p=0.25). Intraoperative complications occurred in 10 patients, 5 in each group (p=0.51). When postoperative outcomes and complications were examined, 15 patients (LS 8/9.4% vs. RS 7/12.7%; p=0.38) were transferred to the intermediate care unit due to pre-existing comorbidities. Furthermore, the mean length of hospital stay was not different between the two groups (p=0.2). Postoperative complications occurred in 11 (12.9%) and 6 (10.9%) patients in the LS and RS groups, respectively (p=0.8), and no mortality was observed. The current study has some limitations, including being a retrospective study examining the initial results from a single institution, the small number of patients in the RS group, and the study period coinciding with the initial introduction of the robotic system in the hospital. Similar parameters were examined in the analysis study by Tjeerdsma et al. (9) published in 2022, comparing the results of robotic-assisted and conventional laparoscopic hiatal hernia repair. In their three-year retrospective single-center study, in which they included a total of 58 patients, 42 of whom underwent LS and 16 who underwent RS, they determined the median hospital stay as 2.5 days for laparoscopic hiatal hernia repair and 3.0 days for robotic-assisted repair (p=0.301). Among the postoperative complications, five cases of pneumothorax, one patient with perforation, two patients with infection, and one patient with bleeding were reported in the conventional LS group. In the RS group, one case of pneumothorax and one patient with bleeding were observed. As a result of the analysis in which they also evaluated the parameter of admission to the intensive care unit; it was noted that the length of stay in the unit was longer in the conventional LS group, but the rate of admission to the unit tended to be higher in the RS group. Despite this, no mortality was reported in either group. Limitations of this study include its single-center nature and small sample size.

Conclusion

RS has become a powerful alternative for surgeons in hiatal hernia surgery, particularly in recent years, driven by increasing technological advancements. Significantly reducing the limitations of traditional LS, RS stands out with its technical advantages, including three-dimensional, high-resolution imaging, improved wrist mobility, tremor elimination, and motion scaling. These features facilitate more precise dissection and suturing in the anatomically complex diaphragmatic region, enabling a more effective translation of surgical skills into the field.

The low postoperative complication rates reported in studies and shorter hospital stays in some analyses suggest that RS may also have positive effects on patient comfort and recovery. As seen in the study by Benedix et al. (8), operative times were observed to be significantly shorter with experience in the RS group. However, it should be noted that these findings are not generalizable due to high heterogeneity rates and study quality limitations. In particular, the high levels of heterogeneity reported in Awshah et al. (7) meta-analysis clearly demonstrate the impact of differences in patient populations and surgical techniques on outcomes. This highlights the lack of standardization in studies evaluating the effectiveness of RS and the need for high-quality randomized controlled trials. Furthermore, while cost appears to be the current major limiting factor, it is also foreseeable that its technical appeal, surgeons' increasing experience, advances in robotic technology, and increased market competition will lead to a decrease in costs.

With the increasing prevalence of robotic systems and the increasing experience of surgeons, RS is likely to become a more frequently used standard for hiatal hernia repair in the near future. The technical advantages of RS, particularly in advanced hiatal hernias, reoperations, and anatomically challenging cases, will significantly influence surgeons' preferences.

Consequently, a significant portion of the existing literature is limited to single-center studies, making it difficult to draw a definitive conclusion about whether RS improves clinical outcomes. Although the clinical superiority of RS has not yet been clearly proven, its technical advantages and potential

healing benefits make RS a promising method for hiatal hernia surgery and a method that will be increasingly preferred in the future. While further prospective and randomized studies are needed in this area, it is clear that RS has solidified its place in the evolution of minimally invasive surgery.

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