International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw,
Poland 00-773
+48 226 0 227 03
editorial_office@rsglobal.pl

ARTICLE TITLE	COMPARISON OF LAPAROSCOPY AND ROBOTIC SURGERY IN CHOLECYSTITIS – LITERATURE REVIEW
DOI	https://doi.org/10.31435/ijitss.4(48).2025.4709
RECEIVED	18 November 2025
ACCEPTED	19 December 2025
PUBLISHED	26 December 2025
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

COMPARISON OF LAPAROSCOPY AND ROBOTIC SURGERY IN CHOLECYSTITIS – LITERATURE REVIEW

Mateusz Jasiński *(Corresponding Author, Email: mjasinski018@gmail.com)*
University Clinical Hospital No. 4, Lublin, Poland
ORCID ID: 0000-0001-8218-6045

Michał Szalach
Independent Public Health Care Facility in Puławy, Puławy, Poland
ORCID ID: 0000-0001-6933-0612

Aleksandra Wilczyńska-Zgoda
Department of Vascular Surgery, Medical University of Lublin, Lublin, Poland
ORCID ID: 0009-0002-2781-8083

Wojciech Suchodolski
Department of Vascular Surgery, Medical University of Lublin, Lublin, Poland
ORCID ID: 0009-0005-5676-8937

Bartosz Burda
University Clinical Hospital No. 4, Lublin, Poland
ORCID ID: 0009-0002-1871-424X

Małgorzata Kuczek
Independent Public Healthcare Institution of the Ministry of the Interior and Administration in Lublin, Lublin, Poland
ORCID ID: 0009-0004-2936-3857

Aleksandra Marzec
Medical University of Lublin, Lublin, Poland
ORCID ID: 0009-0009-4883-5107

Jakub Rusek
Independent Public Health Care Facility in Puławy, Puławy, Poland
ORCID ID: 0009-0004-1025-7472

Błażej Madras
1st Military Clinical Hospital with Polyclinic SPZOZ in Lublin, Lublin, Poland
ORCID ID: 0009-0005-7396-4657

Mikołaj Widz
Department of General Surgery, Independent Public Health Care Facility in Kraśnik, Kraśnik, Poland
ORCID ID: 0009-0004-0477-5521

ABSTRACT

One of the most common diseases in general surgery remains cholecystitis. This is related to the prevalence of gallstones, which affects 10 to 15% of the general population. There are various types of treatment like conservative and surgical treatments, with a distinction between laparoscopic and robotic techniques. Numerous studies have been conducted which prove that laparoscopy is a safe method that significantly reduces the time of convalescence and recovery after surgery. The lack of a clear assessment of the effectiveness of treatment techniques is presented in the following paper.

Advances in medicine have led to the widespread use of robotic arms in surgery, which has resulted in shorter hospital stays due to faster recovery times after surgery. This is related, among other things, to increased precision when operating instruments, and thus reduced trauma to the tissues in the abdominal cavity compared to laparoscopic surgery. However, robotic surgery has certain limitations related to the availability of equipment in specific hospitals and, above all, the increased costs of surgery compared to the use of a laparoscope.

When analyzing the collected material on gallbladder surgery and possible treatment techniques for this pathology, it is not possible to clearly determine which treatment technique should be used as the gold standard in treating patients. However, it is important to remember that complications may occur in both cases, resulting in conversion to open surgery.

KEYWORDS

Laparoscopy, Robotic Surgery, Cholecystectomy, Cholecystitis

CITATION

Mateusz Jasiński, Michał Szalach, Aleksandra Wilczyńska-Zgoda, Wojciech Suchodolski, Bartosz Burda, Małgorzata Kuczek, Aleksandra Marzec, Jakub Rusek, Błażej Madras, Mikołaj Widz. (2025). Comparison of Laparoscopy and Robotic Surgery in Cholecystitis – Literature Review. *International Journal of Innovative Technologies in Social Science*. 4(48). doi: 10.31435/ijitss.4(48).2025.4709

Introduction

From a surgical point of view, cholecystitis is a significant and common pathology. This is related to the prevalence of gallstones, which affects 10 to 15% of the general population. During their lifetime, 20 to 40% of people with deposits in the bile ducts will develop gallstone-related complications [1]. These conditions are often associated with bacterial infections, increased pressure in the bile ducts, and narrowing of the neck of the gallbladder itself [2]. The main features of cholecystitis are fever with chills, pain in the right upper quadrant of the abdomen, and jaundice. In addition, weakness, nausea, and vomiting may occur, along with a loss of appetite or Murphy's sign [3]. The severity of symptoms depends on the patient's general condition, comorbidities, age, and gender. On the other hand, an analysis of the available literature shows that approximately 90-95% of cholecystitis cases are associated with the presence of stones in the gallbladder lumen [4]. There are various types of treatment for cholecystitis, depending mainly on the etiology, the patient's condition, the severity of the symptoms, and laboratory test results, such as elevated inflammatory markers. Imaging tests, mainly ultrasound, as the gold standard, mainly show signs of inflammation of the bile ducts and often the presence of deposits in the gallbladder. Treatment of this pathology is divided into surgical and conservative. Technological advances in medicine have had a significant impact on the diagnostic pathway and therapeutic management itself [5,6]. The authors particularly emphasize the fact that laparoscopy is the first-line treatment, but in cases of septic shock there are many complications such as bile duct perforation, excessive blood loss, prolonged duration of the procedure, resulting in an overall increase in mortality, or technical difficulties of laparoscopic surgery related to the morphology of the gallbladder. In such cases, treatment with classical cholecystectomy should be considered, including conversion to open surgery in the case of laparoscopic surgery [6,7]. Nevertheless, numerous studies have been conducted which prove that laparoscopy is a safe method that significantly reduces recovery time and speeds up convalescence after surgery [6]. The development of robotics in surgery has also led to the emergence of a new field in which authors attempt to assess which method is better. The use of robotic surgery improves the precision and safety

of the procedure, but it also has its limitations, which mean that it is not the treatment of choice for the pathology described. An analysis of the literature shows that authors of studies do not agree on a clear conclusion as to which form of surgery is better and should be used in the broader perspective. The following study presents a comparison of the treatment methods using laparoscopy and robotic surgery in terms of surgical possibilities, treatment costs, and patient safety during surgery [6].

Materials and methods

A review of the literature regarding comparison of laparoscopy and robotic surgery in cholecystitis was performed using the publicly available scientific database PubMed. In the evaluation of effective treatment methods, papers from the years 2020-2025 were taken into account. The works were selected using the following key words: laparoscopy, robotic surgery, cholecystectomy, cholecystitis

Results

The methods of surgery for this pathology can be divided into classic cholecystectomy, laparoscopic surgery, and robotic surgery. The choice of the appropriate treatment technique depends on many factors, including, above all, the patient's general condition, the morphology of the gallbladder, and the availability of equipment at the medical facility. It should be remembered that the choice of treatment for a patient is always related to the assessment of the chances of recovery and should always be made by the doctor performing the procedure [6].

The continuous development of medicine, including surgery, has allowed robots to be implemented as a way of improving surgical treatment techniques for patients. The analyzed material clearly shows that this surgical technique has many advantages, but it is not without its drawbacks. One of the main aspects taken into account when using a robot is faster patient recovery after surgery. This is related, among other things, to increased precision when operating instruments, and thus reduced trauma to the tissues in the abdominal cavity compared to laparoscopic surgery. One of the studies analyzed also presented the results of a study which clearly showed that the use of a robot in gallbladder surgery resulted in a reduction in pain after treatment, which significantly shortens the recovery time after surgery [8,9,10]. In addition, another study presented that immediately after surgery, greater early postoperative pain was reported after the use of laparoscopic surgery. However, the difference in postoperative pain was slightly lower in the case of robotic procedure. This shows that both procedures can be considered equal, and therefore the criterion of postoperative pain does not determine the superiority of robotics over laparoscopy [11].

An unquestionable advantage of using a robot in cholecystectomy is the utilization of its technical sophistication and the surgical possibilities offered by the robot arms. In the presented paper, the authors describe a significantly lower risk of conversion to conventional surgery than in the case of laparoscopic surgery. This is related, among other things, to procedures in which the morphology of the gallbladder makes it difficult to safely prepare the tissues surrounding the gallbladder. This situation argues in favor of using robotic arms due to their increased dexterity with minimal tremor and the use of 3D visualization capabilities. The use of a robot in complex cases of cholecystitis allows the procedure to be completed safely without fear of gallbladder perforation, possible bleeding, and ultimately completes the procedure with a lower risk of conversion to conventional surgery. [12-16]

However, robotic surgery has certain limitations related to the availability of equipment in specific hospitals and, above all, the increased costs of surgery compared to the use of a laparoscope. It should be remembered that the possibility of operating with the use of robotic arms is mainly reserved for larger hospitals with the appropriate technological facilities and conditions to perform such a procedure . The analyzed articles show that the duration of the operation itself was similar when comparing these procedures, but the use of robotic arms is associated with increased preparation time for the procedure. It can therefore be concluded that in terms of the duration of the procedure itself, from the moment the patient arrives in the operating room to the end of the procedure, the use of laparoscopy is significantly shorter. This is due to the need to involve more staff and the need to set up and calibrate the robot arms [12,17, 18, 19, 20].

In one of the articles presented, the authors describe significantly higher costs of purchasing and maintaining a robotic system compared to a laparoscopic tower. The data presented was analyzed based on the prices of surgical kits, the need for staff training, the duration of the operation, and the patient's stay in the hospital based on the length of hospitalization and possible postoperative complications. An additional disadvantage of using robotic arms is the very similar length of hospital stay for patients undergoing cholecystectomy compared to laparoscopy, which argues for the increased cost of robot-assisted surgery. [18, 19, 21]

The use of robotic arms in surgery requires appropriate training of medical personnel in all aspects of the operating team. The duration of training depends on many factors, but the study presented below showed that the duration of cholecystectomy using a robot in a group of young, less experienced surgeons was practically identical to that in a group of more experienced surgeons operating using laparoscopy. Interestingly, it was also observed that the duration of laparoscopic training for young surgeons in cholecystectomy was significantly longer, which argues in favor of using robots in surgery and training young surgeons[12,18]. The authors of this publication show that the use of robotics in cholecystectomy is an excellent training operation for young surgeons before more complex abdominal procedures, which argues for the use of this surgical technique in large training centers [12,18,22,23].

One of the complications of cholecystectomy surgery is possible damage to the bile ducts during the procedure. In the cohort study presented below, the authors analyzed data from all possible risk groups, classifying patients into low, medium, and high risk groups. The data presented in the study clearly show that in all three risk groups, the degree of bile duct damage was almost three times higher in cases where robotic surgery was used [24].

Summary and Conclusions

When analyzing the collected material on gallbladder surgery and possible treatment techniques for this pathology, it is not possible to clearly determine which treatment technique should be used as the gold standard in treating patients. There are many reasons that lead surgeons to choose both laparoscopy and robot-assisted surgery. It should be emphasized that the choice of the appropriate surgical technique should always be up to the surgeon and depends on factors affecting the course of the operation so that it is performed with good therapeutic results and is safe for the patient. From the above text, it can be assumed that the use of robotic arms gives better results in terms of the surgeon's comfort, the course of the procedure, even in cases of difficult bladder morphology, and in terms of rapid recovery after the procedure. On the other hand, due to the limited availability of robots in surgery and the high costs associated with the purchase and use of robotic arms, laparoscopy remains a safe and more commonly used method of treating cholecystitis. In addition, teaching cholecystectomy using the classic method should be an integral part of the training of young generations of surgeons. This is related to the risk of minimally invasive surgery in cases of difficult gallbladder morphology or complications requiring conversion to conventional surgery in both robotic and laparoscopic procedures. An analysis of the above text and the cited studies clearly shows the need for randomized trials comparing the effectiveness of treatment and possible complications of treatment using laparoscopy and robotic arms. The above work is an excellent tool for clinicians who want to expand their knowledge of cholecystitis and its surgical treatment as one of the basic operations in the training cycle of young surgeons.

REFERENCES

1. Shaffer, E. A. (2005). Epidemiology and risk factors for gallstone disease: Has the paradigm changed in the 21st century? *Current Gastroenterology Reports, 7*(2), 132–140. https://doi.org/10.1007/s11894-005-0051-8
2. Kimura, Y., Takada, T., Kawarada, Y., Nimura, Y., Hirata, K., Sekimoto, M., Yoshida, M., Mayumi, T., Wada, K., Miura, F., Yasuda, H., Yamashita, Y., Nagino, M., Hirota, M., Tanaka, A., Tsuyuguchi, T., Strasberg, S. M., & Gadacz, T. R. (2007). Definitions, pathophysiology, and epidemiology of acute cholangitis and cholecystitis: Tokyo Guidelines. *Journal of Hepato-Biliary-Pancreatic Surgery, 14*(1), 15–26. https://doi.org/10.1007/s00534-006-1152-y
3. Reynolds, B. M., & Dargan, E. L. (1959). Acute obstructive cholangitis: A distinct clinical syndrome. *Annals of Surgery, 150*(2), 299–303. https://doi.org/10.1097/00000658-195908000-00013
4. Kimura, Y., Takada, T., Strasberg, S. M., Pitt, H. A., Gouma, D. J., Garden, O. J., Büchler, M. W., Windsor, J. A., Mayumi, T., Yoshida, M., Miura, F., Higuchi, R., Gabata, T., Hata, J., Gomi, H., Dervenis, C., Lau, W. Y., Belli, G., Kim, M. H., Hilvano, S. C., & Yamashita, Y. (2013). TG13 current terminology, etiology, and epidemiology of acute cholangitis and cholecystitis. *Journal of Hepato-Biliary-Pancreatic Sciences, 20*(1), 8–23. https://doi.org/10.1007/s00534-012-0564-0
5. Yokoe, M., Takada, T., Strasberg, S. M., Solomkin, J. S., Mayumi, T., Gomi, H., Pitt, H. A., Gouma, D. J., Garden, O. J., Büchler, M. W., Kiriyama, S., Kimura, Y., Tsuyuguchi, T., Itoi, T., Yoshida, M., Miura, F., Yamashita, Y., Okamoto, K., Gabata, T., Hata, J., Higuchi, R., Windsor, J. A., Bornman, P. C., Fan, S. T., Singh, H., de Santibañes, E., Kusachi, S., Murata, A., Chen, X. P., Jagannath, P., Lee, S., Padbury, R., & Chen, M. F. (2012). New diagnostic criteria and severity assessment of acute cholecystitis in revised Tokyo Guidelines. *Journal of Hepato-Biliary-Pancreatic Sciences, 19*(5), 578–585. https://doi.org/10.1007/s00534-012-0548-0

6. Pisano, M., Allievi, N., Gurusamy, K., Borzellino, G., Cimbanassi, S., Boerna, D., Coccolini, F., Tufo, A., Di Martino, M., Leung, J., Sartelli, M., Ceresoli, M., Maier, R. V., Poiasina, E., De Angelis, N., Magnone, S., Fugazzola, P., Paolillo, C., Coimbra, R., Di Saverio, S., De Simone, B., Weber, D. G., Sakakushev, B. E., Lucianetti, A., Kirkpatrick, A. W., Fraga, G. P., Wani, I., Biffl, W. L., Chiara, O., Abu-Zidan, F., Moore, E. E., Leppäniemi, A., Kluger, Y., Catena, F., & Ansaloni, L. (2020). 2020 World Society of Emergency Surgery updated guidelines for the diagnosis and treatment of acute calculus cholecystitis. *World Journal of Emergency Surgery, 15*(1), Article 61. https://doi.org/10.1186/s13017-020-00336-x
7. Borzellino, G., Sauerland, S., Minicozzi, A. M., Verlato, G., Di Pietrantonj, C., de Manzoni, G., & Cordiano, C. (2008). Laparoscopic cholecystectomy for severe acute cholecystitis: A meta-analysis of results. *Surgical Endoscopy, 22*(1), 8–15. https://doi.org/10.1007/s00464-007-9511-6
8. Setty, S., Anusha, A., & R. S., J. (2025). Short-term clinical outcomes of robotic and laparoscopic cholecystectomy in Indian patients. *Cureus, 17*(9), e92120. https://doi.org/10.7759/cureus.92120
9. Kudsi, O. Y., Castellanos, A., Kaza, S., McCarty, J., Dickens, E., Martin, D., Tiesenga, F. M., Konstantinidis, K., Hirides, P., Mehendale, S., & Gonzalez, A. (2017). Cosmesis, patient satisfaction, and quality of life after da Vinci single-site cholecystectomy and multiport laparoscopic cholecystectomy: Short-term results from a prospective, multicenter, randomized, controlled trial. *Surgical Endoscopy, 31*(8), 3242–3250. https://doi.org/10.1007/s00464-016-5353-4
10. Lee, E. K., Park, E., Oh, W. O., & Shin, N. M. (2017). Comparison of the outcomes of robotic cholecystectomy and laparoscopic cholecystectomy. *Annals of Surgical Treatment and Research, 93*(1), 27–34. https://doi.org/10.4174/astr.2017.93.1.27
11. Lee, S. M., & Lim, J. H. (2021). Comparison of outcomes of single-incision robotic cholecystectomy and single-incision laparoscopic cholecystectomy. *Annals of Hepato-Biliary-Pancreatic Surgery, 25*(1), 78–83. https://doi.org/10.14701/ahbps.2021.25.1.78
12. Gantschnigg, A., Koch, O. O., Singhartinger, F., Tschann, P., Hitzl, W., Emmanuel, K., & Presl, J. (2023). Short-term outcomes and costs analysis of robotic-assisted versus laparoscopic cholecystectomy: A retrospective single-center analysis. *Langenbeck's Archives of Surgery, 408*(1), Article 299. https://doi.org/10.1007/s00423-023-03037-6
13. Altieri, M. S., Yang, J., Telem, D. A., Zhu, J., Halbert, C., Talamini, M., & Pryor, A. D. (2016). Robotic approaches may offer benefit in colorectal procedures, more controversial in other areas: A review of 168,248 cases. *Surgical Endoscopy, 30*(3), 925–933. https://doi.org/10.1007/s00464-015-4327-2
14. Palep, J. H. (2009). Robotic assisted minimally invasive surgery. *Journal of Minimal Access Surgery, 5*(1), 1–7. https://doi.org/10.4103/0972-9941.51313
15. Kenngott, H. G., Fischer, L., Nickel, F., Rom, J., Rassweiler, J., & Müller-Stich, B. P. (2012). Status of robotic assistance—A less traumatic and more accurate minimally invasive surgery? *Langenbeck's Archives of Surgery, 397*(3), 333–341. https://doi.org/10.1007/s00423-011-0859-7
16. Abou Assali, M., Li, Y., Bossie, H., Neighorn, C., Wu, E., & Mukherjee, K. (2025). Robotic Care Outcomes Project (ROBOCOP) for elective cholecystectomy. *Surgical Endoscopy, 39*(11), 7262–7271. https://doi.org/10.1007/s00464-025-12109-1
17. Talamini, M. A., Chapman, S., Horgan, S., & Academic Robotics Group. (2003). A prospective analysis of 211 robotic-assisted surgical procedures. *Surgical Endoscopy, 17*(10), 1521–1524. https://doi.org/10.1007/s00464-002-8853-3
18. Ayloo, S., Roh, Y., & Choudhury, N. (2014). Laparoscopic versus robot-assisted cholecystectomy: A retrospective cohort study. *International Journal of Surgery, 12*(10), 1077–1081. https://doi.org/10.1016/j.ijsu.2014.08.405
19. Huang, Y., Chua, T. C., Maddern, G. J., & Samra, J. S. (2017). Robotic cholecystectomy versus conventional laparoscopic cholecystectomy: A meta-analysis. *Surgery, 161*(3), 628–636. https://doi.org/10.1016/j.surg.2016.08.061
20. Han, C., Shan, X., Yao, L., Yan, P., Li, M., Hu, L., Tian, H., Jing, W., Du, B., Wang, L., Yang, K., & Guo, T. (2018). Robotic-assisted versus laparoscopic cholecystectomy for benign gallbladder diseases: A systematic review and meta-analysis. *Surgical Endoscopy, 32*(11), 4377–4392. https://doi.org/10.1007/s00464-018-6295-9
21. Hanly, E. J., & Talamini, M. A. (2004). Robotic abdominal surgery. *American Journal of Surgery, 188*(4 Suppl.), 19S–26S. https://doi.org/10.1016/j.amjsurg.2004.08.020
22. Ghanem, M., Shaheen, S., Blebea, J., Tuma, F., Zayout, M., Conti, N., Qudah, G., & Kamel, M. K. (2020). Robotic versus laparoscopic cholecystectomy: Case-control outcome analysis and surgical resident training implications. *Cureus, 12*(4), e7641. https://doi.org/10.7759/cureus.7641
23. Willuth, E., Hardon, S. F., Lang, F., Haney, C. M., Felinska, E. A., Kowalewski, K. F., Müller-Stich, B. P., Horeman, T., & Nickel, F. (2022). Robotic-assisted cholecystectomy is superior to laparoscopic cholecystectomy in the initial training for surgical novices in an ex vivo porcine model: A randomized crossover study. *Surgical Endoscopy, 36*(2), 1064–1079. https://doi.org/10.1007/s00464-021-08373-6
24. Mullens, C. L., Sheskey, S., Thumma, J. R., Dimick, J. B., Norton, E. C., & Sheetz, K. H. (2025). Patient complexity and bile duct injury after robotic-assisted vs laparoscopic cholecystectomy. *JAMA Network Open, 8*(3), e251705. https://doi.org/10.1001/jamanetworkopen.2025.1705