JOURNAL OF THE EUROPEAN SOCIETY OF SURGERY

04/01/2026

CLINICAL AND IMMUNOLOGICAL ASPECTS OF TREATMENT OF STRANGULATED INGUINAL HERNIAS USING THE TAPP METHOD

V.P. Kryshen[1], I.V. Korpusenko[1], N.N. Nor[1], N.V. Trofimov[1], A.V. Kudryavtsev[2]

[1] Dnipro State Medical University, Dnipro, Ukraine
[2] Separate Structural Unit "University Clinic" of Dnipro State Medical University, Dnipro, Ukraine

RESEARCH ARTICLE

Volume
1

Issue
1

Corresponding author
V.P. Kryshen

Submitted *05 March 2026*

Accepted *24 March 2026*

Published *01 April 2026*

Citation
V.P. Kryshen. Et.al *Clinical and Immunological Aspects of Treatment of Strangulated Inguinal Hernias Using the Tapp Method, Vol 1: Iss 1, 2026.*

Abstract

The aim of the study was to analyze the results of surgical treatment for strangulated inguinal hernia by comparing open and laparoscopic TAPP hernia repair techniques and to evaluate the immune system in the postoperative period.

Clinical And Immunological Aspects of Treatment of Strangulated Inguinal Hernias Using the Tapp Method

Materials and Methods:

The study included 182 patients diagnosed with strangulated inguinal hernia. They were divided into two groups: a main group (MG) of 87 patients who underwent laparoscopic TAPP hernia repair and a comparison group (CG) of 95 patients who underwent traditional Lichtenstein allograft hernia repair. Total T- and B-lymphocyte counts and T-lymphocyte subpopulations (CD3, CD19, CD4, CD8, and CD16) were analyzed using flow cytometry. Humoral immunity was assessed by measuring changes in immunoglobulin levels of IgA, IgM, and IgG in the late postoperative period.

Results:

In the early postoperative period, patients in MG were active within a few hours after surgery, and wound pain was moderate. Patients in the CG were active on the next day after surgery and required analgesia. The length of stay in the surgical department for patients in the MG was 1-3 days (2,8±0,2), while in the CG it was 3-7 days (5,1±1,2), $p<0,05$. Analysis of the development of complications in the early postoperative period showed significant differences between patients in groups 1 and 2 (4,6% in the MG versus 18,9% in the CG, $p<0,05$). Patients in both groups were given recommendations on physical exercises to strengthen muscles and diet after surgery. Six months after surgery, 51,3% of patients in the CG and 97,6% of patients in the MG adhered to the recommendations. In patients in the CG group, CD3+ levels were lower than in the normal group (41,16±1,9% versus 50,88±0,68% in the control group) and were also significantly lower than in the TAPP group (51,07±1,8). The Tx/Tc ratio was significantly lower in the CG group compared to the control and MG groups (1,28±0,07 versus 1,97±0,07 and 1,98±0,08, respectively), ($p<0,05$).

Conclusions:

Laparoscopic hernia repair produces more encouraging clinical and functional results compared to the Lichtenstein technique due to rapid social adaptation of the patient's body in the early and late postoperative periods.

Keywords:
Strangulated inguinal hernia, hernia repair, TAPP, Lichtenstein, immunity, postoperative period.

1. Introduction

Treatment of inguinal hernias is one of the most frequently performed surgical procedures in operating rooms worldwide. In Italy, more than 113,000 inguinal and femoral hernia repairs were reported in 2019, approximately 40,000 inguinal hernia operations are performed annually in Ukraine, 80,000 in England, and 700,000 in the USA [1,2,3,4]. Over the past 20 years, elective surgical treatment of inguinal hernia has changed and developed significantly, and currently the laparoscopic approach, both using the TAPP (transabdominal preperitoneal) and TEP (totally extraperitoneal) technique, is considered equivalent and even superior to the classic open approach [5]. There are significantly fewer publications devoted to the study of the consequences of laparoscopic hernioplasty in emergency conditions such as strangulated inguinal hernia. This suggests a cautious approach to this technique due to concerns about iatrogenic injury [6]. Strangulated inguinal hernia is the second most common cause of intestinal obstruction. Negative treatment outcomes in these cases are observed in elderly patients, patients with serious comorbidities, and those who were admitted to the hospital late [7]. The use of minimally invasive techniques in emergency cases remains controversial, and even existing guidelines do not provide a definitive answer to this question [8,9]. Therefore, the aim of this study is to evaluate the safety and efficacy of the laparoscopic transabdominal preperitoneal (TAPP) technique in the treatment of inguinal hernias in emergency cases, comparing minimally invasive treatment with the open technique.

1.1 The aim of the study

The aim of the study was to analyze the results of surgical treatment of strangulated inguinal hernia by comparing open and laparoscopic TAPP hernioplasty methods and to assess the state of the immune system in the postoperative period.

2. Materials and Methods

The study included 182 patients diagnosed with strangulated inguinal hernia. They underwent surgery between January 2021 and June 2025 at the General Surgery Clinic of the Dnipro State Hospital and were divided into two groups. The first, a study group of 87 patients (MG), underwent laparoscopic hernioplasty (TAPP), and the second, a comparison group of 95 (CG), underwent traditional Lichtenstein hernioplasty.

Laparoscopic surgeries were performed on Smith & Nephew HD laparoscopic stands (USA), 2013, with a 1080 camera (1920 x 1080 Full HD), a 32-inch monitor, contrast up to 1400:2, a 3-block CO2 insufflator 30 l/min with heating, and a KARL STORZ AUTOCON II 400 SCB high-frequency ultrasound system. The mesh prostheses used in hernioplasty were Duzeymesh (Turkey), Ultrapro J&J (USA), Promesh® T Surgical IOS (France), and others, without preference for a particular manufacturer.

Patients were retrospectively analyzed by age, gender, length of hospital stay, hernia location, hernia type, strangulation, hospitalization, and surgical time. Patient status and early postoperative complications were prospectively assessed.

Various components of the immune system were studied, including cellular immunity (total T- and B-lymphocyte counts, T-lymphocyte subpopulations: CD3, CD19, CD4, CD8, CD16) using flow cytometry. Humoral immunity (changes in serum immunoglobulin levels of IgA, IgM, and IgG classes) was determined using radial immunodiffusion assay using the Mancini method in the late postoperative period.

Statistical processing of the obtained data was performed using generally accepted methods of analysis using nonparametric and parametric criteria. Determination of the reliability of differences in the comparison groups with a normal distribution was carried out using the student's t-test; with an abnormal distribution for unrelated samples, using the Pearson χ^2 (Xi square) compliance criterion, for related samples, using the Whitney-Wilcoxon test (W). The minimum statistical probability was determined at $P<0,05$. Primary processing of the research data was carried out in the shells of the original Microsoft Office 2016 programs, version 18.2008.12711.0., STATISTICA 6.1 Stat Soft Inc No. AGAR909E41588.

3. Results and Tables

Statistical processing of the obtained data was performed using generally accepted methods of analysis using nonparametric and parametric criteria. Determination of the reliability of differences in the comparison groups with a normal distribution was carried out using the Student's t-test; with an abnormal distribution for unrelated samples, using the Pearson χ^2 (Xi square) compliance criterion, for related samples, using the Whitney-Wilcoxon test (W). The minimum statistical probability was determined at $P<0,05$. Primary processing of the research data was carried out in the shells of the original Microsoft Office 2016 programs, version 18.2008.12711.0., STATISTICA 6.1 Stat Soft Inc No. AGAR909E41588.

Statistical processing of the obtained data was performed using generally accepted methods of analysis using nonparametric and parametric criteria. Determination of the reliability of differences in the comparison groups with a normal distribution was carried out using the Student's t-test; with an abnormal distribution for unrelated samples,

using the Pearson χ^2 (Xi square) compliance criterion, for related samples, using the Whitney-Wilcoxon test (W). The minimum statistical probability was determined at P<0,05. Primary processing of the research data was carried out in the shells of the original Microsoft Office 2016 programs, version 18.2008.12711.0., STATISTICA 6.1 Stat Soft Inc No. AGAR909E41588.

An analysis of the development of complications in the early postoperative period revealed significant differences between patients in Groups 1 and 2 in the following indicators: hematomas, infiltrates, funiculitis, orchitis, epididymitis, dysuric disorders, damage to the epigastric vessels, cutaneous neuralgia, bladder injury, etc. (Table 1)

Table 1: Early complications of hernioplasty

Complications	Main group (MG) (n=87)	Comparison group (CG) (n=95)
Funiculitis	1 (1,1%)	2 (2,1%)*
Injury to the epigastric vessels	0(0%)	1 (1,0 %)*
Orchitis, epididymitis	2 (2,2%)	4 (4,2%)*
Dysuria	0 (0%)	3(3,2%)*
Infiltrate	0(0%)	2 (2,1%)*
Hematoma	0(0%)	2 (2,1%)*
Seroma	1 (1,1%)	3 (3,2%)*
Neuralgia of the superficial nerves	0(0%)	1 (2,1%)*
Overall complication rate	4(4,6%)	18(18,9%)*

*(p<0.05 compared with MG)

As the table shows, the use of laparoscopic TAPP hernioplasty resulted in a more than fourfold reduction in the incidence of early postoperative complications, due to less trauma to the spermatic cord and the absence of the risk of misalignment of the external inguinal ring. Patients in the primary care setting experienced no complications, such as infiltrates or hematomas. The incidence of neuralgia also decreased due to the absence of large skin incisions and more "clear" manipulations around the hernia orifice. Thus, the use of laparoscopic hernioplasty for strangulated inguinal hernias reduced the incidence of early postoperative complications by 4,7 times ($p < 0,05$) compared to the Lichtenstein hernioalloplasty technique, indicating a more physiological postoperative course. Post-surgical patients were given recommendations tailored to their individual immunodiagnostics. These included instructions on physical exercise to strengthen muscles, support the cardiovascular system, stimulate metabolism, and boost the immune system. Secondly, a recommended diet included fresh fruits, vegetables, whole grains, legumes, and protein. Patients with a tendency toward decreased T-cell immunity were recommended immunomodulatory foods rich in vitamin C (citrus fruits, kiwi, broccoli, and bell peppers), vitamin E (nuts, seeds, and green leafy vegetables), and vitamin D (fish, eggs, and mushrooms). Survey results showed that 80,2% of patients in the comparison group (MG) followed the exercise recommendations in the first two months after surgery. At the time of the survey, 6 months after surgery, 47,4% of patients adhered to recommendations. According to the dietary regimen for improving immunity, 51,3% of patients in this group at the time of the survey adhered to our recommendations, 14,5% did not comply with our recommendations and gained excess weight. These patients had reduced indicators of T-cell immunity (CD3+, CD4+, B-cell activation (CD19+), circulating immune complexes (CIC), and NBT). In the study group (SG) of patients, 97,6% of patients followed the recommendations for physical exercise in the first 2 months after surgery. This is due to the less traumatic surgical technique, so they quickly resumed their physical activity. Six months after surgery, 81,2% of patients adhered to our recommendations for physical exercise and diet. The survey data obtained consistent with the better indicators of immune status in the group of patients who underwent surgery using the TAPP technique. All indicators of T-cell immunity, B-cells and the immunoregulatory index CD4+/CD8+ were within normal limits (Table 2).

Table 2: **Results of studies of the immune status of patients with strangulated inguinal hernia in the late postoperative period**

Indicators	Methodology Lichtenstein (n=95)	Methodology TAPP (n=87)	Control values (n=30)
Leukocytes x10^9 / L	5,83±0,42	5,48±0,31	5,35±0,21
Lymphocytes %	30,35±1,9	25,71±1,76	28,71±0,81
a.n.	1,54±0,18	1,5±0,08	1,61±0,07
T- lymphocytes %	41,16±1, 9*	51,07±1,8**	50,88±0,68
CD3+ a.n. x10^9/L	0, 53±0,07	0,79±0,04	0,76±0,04
T-helpers %	30,38±1,48*	37,45±1,03**	38,71±0,52
CD4+ a.n. x10^9/L	0,39±0,04	0,48±0,03	0,53±0,03
T-suppressors %	24,56±1,13	18,45±1,4	18,39±0,57
CD8+ a.n. x10^9/L	0,31±0,02	0,29±0,03	0,30±0,02
B-lymphocytes %	18,73±2,14	15,11±1,26*	14,78±0,48
CD19+a.n. x10^9/L	0,39±0,04*	0,26±0,03**	0,25±0,01
NST %	20,9±1,68*	14,16±1,67**	12,03±0,74
Th/Ts CD4+/ CD8+	1,28±0,07*	1,98±0,08**	1,97±0,07
CIC unit.opt.sh.	8,04±1,59*	4,24±0,05 **	3,42±0,23

Notes:

1. *p<0,05 compared to the control.

2. **p<0,05 in comparison with the indicators of groups I and II.

As the studies have shown, 6 months after the surgery there was a tendency towards restoration of the immune status indicators, namely T-cell immunity CD3+, CD4+ and CD8+ in patients of the main group. In patients of the comparison group, the CD3+ indicators were reduced compared to the norm (41,16±1,9% versus 50,88±0,68% in the control) and were also significantly lower than in the group of patients operated on using the TAPP technique (51,07±1,8). The ratio of the helper subpopulation to the suppressor Tx/Tc was significantly reduced in the CG in relation to the control group and MG (1,28±0,07 versus 1,97±0,07 and 1,98±0,08, respectively). In the CG, the NBT test, which indicates immune resistance, was significantly elevated (p<0,05). The CIC, which indicates the presence of inflammatory processes, including the accumulation of toxic products in tissues and a high probability of allergic reactions, was also significantly elevated (p<0,05).

Thus, in many respects (clinical presentation, immune status characteristics), the TAPP technique has clear advantages over other hernia repair techniques, as evidenced by a reduced incidence of postoperative complications and normalization of immune status.

4. Discussion

Over the years, the laparoscopic approach has become the gold standard for emergency care for many conditions, including acute appendicitis and acute cholecystitis. However, laparoscopic treatment of strangulated inguinal hernias, one of the most common reasons for emergency department visits worldwide, is still a subject of debate [10]. The advantages of minimally invasive hernia treatment methods are well known and are mainly associated with a lower rate of wound infection and better cosmetic results. Despite the cautious attitude of surgeons towards the use of laparoscopic hernioplasty for strangulated inguinal hernia, it has the following advantages over the open Lichtenstein procedure: less intense postoperative pain, earlier patient mobilization, a shorter overall treatment and rehabilitation period, and a lower incidence of complications requiring additional treatment [11]. In the field of emergency surgery, although the first laparoscopic operation for strangulated inguinal hernia was performed in 1993 [12], there is still no consensus regarding the use of minimally invasive techniques [13]. In our series of studies, we associate a shorter hospital stay, reduced postoperative pain, and fewer complications with a more rapid return to work, which is reflected in socioeconomic benefits [14]. In our study, complications with a closed approach were significantly lower than with an open approach (4,6% versus 18.9%, p < 0,05).

An extremely important issue in the postoperative period is the development of methods that allow for the optimal use of functional reserves and the truly unique capabilities of the human body to achieve positive surgical results

[15]. In this case, special attention should be paid to the correction of the T-cell component, since the depletion of the adaptive and reserve capabilities of the immune system is associated largely with a decrease in the body's bioenergetic capabilities at the cellular level. This can be achieved by increasing a person's physical endurance and directly correcting their immune system [16]. Our studies have led us to conclude that, after using the TAPP method, the clinical and functional results are more encouraging compared to the Lichtenstein method due to the rapid clinical and social adaptation of patients in the early and late periods following surgery.

5. Citations

1. The use of laparoscopic TAPP hernioplasty resulted in a more than fourfold reduction in the incidence rate of early postoperative complications (4,6% vs. 18,9%, $p < 0,05$).

2. Complete immune status restoration (T-cell immunity of CD3+, CD4+, and CD8+) was observed in 81.2% of patients operated on using the TAPP technique 6 months after surgery.

3. Laparoscopic hernioplasty has more encouraging clinical and functional late-term results compared to the Lichtenstein technique due to faster social adaptation of the patient's body at different times of postoperative period.

Author Contributions

Conceptualization, methodology, analysis, and writing were performed by the authors. All authors approved the final manuscript.

Funding

No external funding.

Informed Consent

This research was Obtained from all participants.

Conflicts of interest

The authors declare no conflicts of interest.

6. References

1.Sbacco V., Lauteri G., Cossa A. et al. Management of groin hernias in emergency setting: differences in indications and outcomes between laparoscopic and open approach. A single center retrospective experience. Langenbeck's Archives of Surgery. 2024; Vol.409(48): https://doi.org/10.1007/s00423-024-03238-7.

2. Шапринський В.О, Горовий В.І. Історичні аспекти хірургічного лікування пахвинних гриж. Здоров'я України. 2023; 4-5: 20-26 /Hirurg_4_5_2023_st20-26.pdf.

3.Mancini R, Pattaro G, Spaziani E. Laparoscopic trans-abdominal preperitoneal (TAPP) surgery for incarcerated inguinal hernia repair. Hernia. 2019;23(2):261–6. / doi: 10.1007/s10029-018-1828-7.

4. Kryshen V.P., Nor N.N., Kudriavtsev A.V, Komshuk T.S. Laparoscopic hernioplasty as a possible choice for treatment of strangulated inguinal hernia. ATJ.2024; 4: 61-65. DOI: https//doi.org/10.34921/amj.2024.4.001.

5. Leibl B.J., Däubler P, Schmedt C.G., Kraft K., Bittner R. Long-term results of a randomized clinical trial between laparoscopic hernioplasty and Shouldice repair. Br. J. Surg.2000; 87(6):780– 783. https://doi.org/10.1046/j.1365-2168.2000.01426.x

6. Jing Liu, Yingmo Shen, Yusheng Nie, Xuefei Zhao, Fan Wang, Jie Chen. If laparoscopic technique can be used for treatment of acutely incarcerated/ strangulated inguinal hernia? World Journal of Emergency Surgery. 2021. 16(5) /https://doi.org/10.1186/s13017-021-00348-1.

7. Tamer Akay, Murat Akici. Should a laparoscopic repair be the first choice in incarcerated inguinal hernia. International Surgery Journal. 2020;7(4):961-965. DOI: http://dx.doi.org/10.18203/2349-2902.isj20201014

8. Sartori A, Balla A, Botteri E, Scolari F. et al. Laparoscopic approach in emergency for the treatment of acute incarcerated groin hernia: a systematic review and meta-analysis. Hernia.2023; 27(3):458–501. https://doi.org/10.1007/ s10029-022-02631-9

9. Liu J, Shen Y, Nie Y, Zhao X, Wang F, Chen J If laparoscopic technique can be used for treatment of acutely incarcerated/strangulated inguinal hernia? World J Emerg Surg.2021; 16(1):1–6. https://doi.org/10.1186/s13017-021-00348-1

10. Ortenzi M, Botteri E, Balla A.. et al. Nationwide analysis of laparoscopic groin hernia repair in Italy from 2015 to 2020. Updates Surg.2022; 75(1):77–84. https://doi. org/10.1007/s13304-022-01374-7

11. Scheuermann U., Niebisch S., Lyros O., Jansen-Winkeln B., Gockel I. Transabdominal Preperitoneal (TAPP) versus Lichtenstein operation for primary inguinal hernia repair — a systematic review and meta-analysis of randomized controlled trials. BMC Surg. 2017; 17(1):1–10. https://doi.org/10.1186/s12893-017-0253-7

12. Watson S.D., Saye W., Hollier P.A. Combined laparoscopic incarcerate herniorrhaphy and small bowel resection. Surg Laparosc Endosc. 1993;3(2):106–108 Available: https://pubmed-ncbi-nlmnih-gov.ezproxy.uniroma1.it/8269227/

13. Yang G.P. Laparoscopy in emergency hernia repair Ann Laparosc Endosc Surg.2017; 2:107–107. https://doi.org/10.21037/ales.2017.05.05

14. Schmedt C.G., Sauerland S., Bittner R.Comparison of endoscopic procedures vs Lichtenstein and other open mesh techniques for inguinal hernia repair: a meta-analysis of randomized controlled trials. Surg Endosc Other Interv Tech.2005; 19(2):188–199. https://doi.org/10.1007/s00464-004-9126-0

15. Луковська О.Л., Петречук Л.М., Кудрявцева В.Є. Загальні питання адаптації людини. Методичні рекомендації. Дніпро: Вид-во «Поліграфцентр», 2021. 67 с.

16. Sandeep Sharma, Rakesh Shakya, Vishnu Gupta, Anand Rajput. Risk Factors of Postoperative Complications After Emergency Inguinal Hernia Surgery. International Journal of Life Sciences Biotechnology and Pharma Research.2023;12,(3). http://ijlbpr.com/uploadfiles/67vol12issue3pp352-357.20230724080654.pdf.