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The authors declare that they have no conflicts of interest

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TROCAR SITE INCISIONAL HERNIAS

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Abstract

Objective: to analyse the incidence of trocar site hernias among patients admitted to the surgical clinic on an emergency basis with a diagnosis of an incarcerated hernia.

Materials and methods. The retrospective and prospective study; the follow-up period is 10 years. A statistical analysis of patients with incarcerated hernias had been performed. A total of 1,448 subjects was selected for the study. Of these, 825 (57.0%) patients were diagnosed with incarcerated hernias of various localizations. The diagnosis of incarceration among 623 (43.0%) subjects proved to be false, and the hernias of these patients were classified as "reducible" and "irreducible" hernias.

Results. An analysis of the operations revealed 34 patients with trocar site hernias, representing 2.34% of the total number of patients admitted to hospital with hernias and 4.93% of those operated on an emergency basis.

Conclusion. The rare, partial incarceration of the omentum and small intestine, the so-called Richter's hernia, after using 5-mm-diameter trocars was revealed in 4 people operated on previously (3 to 5 years). Moreover, the hernial orifice (abdominal wall defect) at the time of our operation turned out to be significantly larger than after puncture with a 5-mm trocar. A direct correlation was found between the incidence of trocar site hernia and the degree of obesity, body mass index.

Отадан кейінгі троакарлы жарықтар

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қысылған жарықтар, троакарлы жарықтар, Рихтер қысылуы, дене салмағының индексі

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Тұжырым

Мақсаты: троакарлы жарықтардың пайда болу жиілігіне хирургия бөлімшелеріне жедел түрде қысылған жарық диагнозымен жеткізілген науқастарға анализ жасау.

Материалдары мен әдістері. Ретроспективті және проспективті зерттеу. Бақылау уақыты 10 жыл. Қысылған жарық диагнозымен науқастарға статистикалық анализ жүргізілді. Науқастар 1448 адам арасынан іріктеп алынды. Олардың 825 (57,0%) қысылған жарықтар диагностикаланды, ал 623 (43,0%) науқаста қысылған жарық диагнозы дәлелденбеді. Бұл науқастарда жарықтар қайтадан кіретін және қайтадан кірмейтін жарықтар деп анықталды.

Нәтижелер. Троакарлы жарықпен 34 науқасқа ота жасалды. Стационарға түскен жалпы науқастар санының 2,34% және де жедел түрде ота жасаған науқастардың 4,93% құрайды.

Қорытынды. 4 адамда диаметрі 5 мм троакарларды қолданумен операция жасалған (3 жылдан 5 жылға дейін), сирек шарбы майының және жіңішке ішектің жартылай қысылуы (қабырғалық қысылу) - Рихтер жарығы анықталды. Операция барысында жарық қақпасы (іш қабырғасының ақауы) 5 мм троакармен тескеннен кейінгіге қарағанда айтарлықтай үлкен болып шықты. Троакар жарығының пайда болу жиілігі мен семіздік дәрежесі мен дене салмағының индексі арасында тікелей корреляция анықталды.

Послеоперационные троакарные грыжи

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Аннотация

Цель исследования - провести анализ частоты образования троакарных грыж среди больных доставленных в хирургическую клинику в экстренном порядке с диагнозом ущемленной грыжи.

Материалы и методы. Исследование ретроспективное и проспективное, период наблюдения 10 лет. Проведен статистический анализ больных с ущемленными грыжами. Отбор пациентов проведен среди 1448 человек. Из них у 825 (57,0%) больных диагностированы ущемленные грыжи различной локализации. У 623 (43,0) - диагноз ущемления не подтвердился, грыжи у таких лиц были квалифицированы как «вправимые» и «невправимые» грыжи.

Результаты. Анализ операций показал, что с троакарными грыжами было 34 человека, что составило 2,34% от общего количества доставленных пациентов с грыжами в стационар и 4,93% от количества прооперированных в экстренном порядке.

Выводы. У 4 человек оперированных ранее (от 3 до 5 лет) с после применения троакаров диаметром 5 мм выявлены редкие, частичные ущемления сальника и тонкого кишечника – так называемые ущемления Рихтера. При чем грыжевые ворота (дефект брюшной стенки) на момент нашей операции оказались значительно большими чем после прокола троакаром 5 мм. Выявлена прямая корреляция частоты образования троакарных грыж от степени ожирения, индекса массы тела.

Конфликт интересов:

Авторы заявляют об отсутствии конфликта интересов

Ключевые слова:

ущемленные грыжи,
троакарные грыжи, ущемление
Рихтера, индекс массы тела

Relevance

Hernias attributed to laparoscopic surgery have recently become more common [1]. In the early days of the development of laparoscopic surgery, these complications were scarcely focused on. An analysis of literary sources during the period of widespread introduction of endoscopic operations indicates that the main emphasis was placed on the search and testing of new operational techniques associated with the implementation of new technologies, tools and equipment followed by pooling of experience and the publication of scientific materials that proved out the successful results of treatment. In this respect, the significant advantages of minimally invasive endoscopic techniques and the lack of postoperative complications inherent in the traditional surgical techniques were evidenced [1, 2].

Therefore, for a long time it was thought that postoperative hernias were secondary and that they could only occur after open laparotomies. Because the cause of hernial defects of the anterior abdominal wall after abdominal surgery was considered to be: a) large incisions; b) extensive tissue trauma; c) tissue infection; d) insufficient anatomical comparability of the edges when suturing the abdominal cavity; e) inadequate (inaccurate) comparability of different tissue structures; f) cutting or loosening of surgical sutures, etc.

However, the lack of the above risk factors in those operated on with laparoscopic instruments did not save patients from surgical complications [3, 4].

The accumulated global experience testifies to cases of new, strictly endoscopic surgery-specific complications (trocar injuries of internal organs, vessels, burns due to high frequency currents, subcutaneous emphysema, pneumomediastinum, etc.) [5-10].

Among the complications, the incarcerated hernias after laparoscopic surgery or so-called trocar site hernias

are quite common.

It could not be denied that the introduction of laparoscopic technologies has led to a decrease in the number of so-called "traditional" surgical complications after abdominal surgery, which primarily included incisional hernias. However, as time has passed, it has become clear that postoperative defects of the anterior abdominal wall often occur in laparoscopically operated patients as well. The increasing incidence of such complications is now a growing concern among practicing surgeons.

Incisional hernias in such cases have been associated with insufficient closure and healing of the so-called trocar wound (puncture site and instrument placement). Moreover, many surgeons do not close the remaining defects of the anterior abdominal wall after removal of laparoscopic ports from the abdominal cavity, if these defects are minor. This excludes the use of laparoscopic ports with a diameter of 10 mm or more.

In the international literature, such postoperative defects are referred to as TSIH (Trocar site incisional hernia) [1]. Moreover, few studies describe the incidence or risk factors contributing to hernias at present.

There are insufficient data on studies results in the medical literature examining the mechanism or causes of so-called trocar site hernias in patients admitted to the emergency department with surgical complications, including those with a high body mass index (BMI) and obesity.

Objective: to determine the prevalence of TSIH in patients admitted to the surgical department on an emergency and elective basis and to identify risk factors for hernia after laparoscopic surgery.

Materials and methods

Retrospective and prospective methods of analysis were used in the study. Patients who underwent laparoscopic surgery for various abdominal pathologies

over a ten-year period (2011 - 2020) were studied and the case-records were reviewed in the study.

All patients were assessed using the criteria and parameters as below: history of laparoscopic access during surgery, diagnosis of anterior abdominal wall hernia, overweight, obesity, diabetes, concomitant cardiac and pulmonary pathology, age, gender, etc. Clinical examination, radiography (-scopy), computed tomography (CT), and ultrasound of the abdomen and anterior abdominal wall were analysed to confirm the existence of a trocar site hernia.

Statistical analysis, tabulation and plotting were carried out using the software Statistica 10.0. Statistical analysis took into account that the main variable studied was the incidence of TSIH. Other results of clinical and instrumental examinations represented the additional criteria. A multivariate analysis was aimed at the identification of risk factors. The terms after the operation were taken into account for the above ten-year period starting from the second day after the surgery. Particular attention is paid to the observation of patients with overweight, obesity (body mass index over $>25 \text{ kg/m}^2$) of varying severity (stages I-IV).

Results

In total, the cohort with trocar site hernias included 34 subjects who were selected from 1448 patients admitted to the surgical clinic with a diagnosis of incarcerated hernia. All patients (1448) were admitted to the hospital on an emergency basis; the diagnoses were verified after examining by the surgeons. Of these, 825 (57.0%) patients were diagnosed with incarcerated hernias of

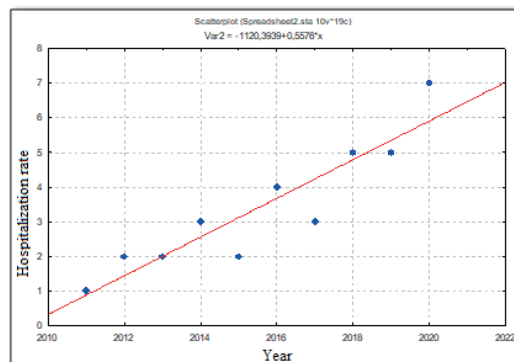
anterior abdominal wall of various localizations. The diagnosis of incarceration among 623 (43.0%) patients proved to be false, and the hernias of these subjects were classified as “reducible” and “irreducible” hernias.

Of the group of patients (825 people) with signs of incarceration, an emergency surgery was performed for 689 (83.5% of 825) patients. The remaining 136 (16.5% of 825) patients had a hernia removal at the time of examination in the diagnostic department. Therefore, one part of the patients refused hospitalization for surgery, the other part was transferred to other clinics for surgical treatment.

The analysis of the operations revealed 34 patients with trocar site hernias, representing 2.34% of the total number of patients admitted to hospital with hernias and 4.93% of those operated on with hernias. This observation group included 11 men and 23 women who met the prerequisite selection criteria. From the anamnesis it was found that all of them had been operated on previously between 2 and 15 years ago. But in 75% of the cases, laparoscopic surgery was performed in the period of 3-5 years ago.

The mean annual hospitalization rate with strangulated TSIH was as follows $M(3.4)$; $MD(3)$; $(SD)\pm 1.8$. Where, M is the mean of the number of patients hospitalized and treated, MD is the median, SD is the standard deviation. It has been revealed a definite upward trend in the number of persons hospitalised in the surgical department with postoperative trocar site hernias. The calculations are shown graphically in the Figure 1.

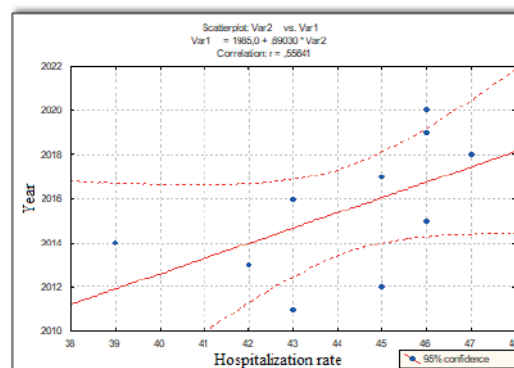
Figure 1.
Hospitalization rates for trocar site hernias
Where, (●) – values of the average rate $M\pm$; (/) - trend line indicating an increase in the hospitalization of patients with TSIH



In addition, it should be noted that the correlation indices by years of observation have a rather moderate than strong correlation (Pirson, $r = 0.55$). However, according to our calculations, the probability of this trend

to be maintained in subsequent years is positive. The probability of this correlation persisting in subsequent years after our study is well evidenced in the graph in the Figure 2.

Figure 2.
Probability of increasing correlation between hospitalisation rate and follow-up years. Where, (●) are the values of the average $M\pm$; (/) - trend line indicating an increase in the hospitalization of patients with TSIH



In addition, based on the analysis we have done for the previous ten-year period, we can assume an intensification of the correlation for the coming years. This includes the so-called cumulative effect. This is not unrealistic given the principle – the more patients

operated on with the use of trocars, the more trocar complications expected. The probability increase plot with the empirical and theoretical cumulative distribution is shown in the Figure 3.

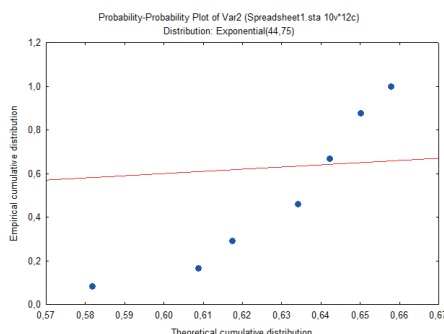


Figure 3. Probability of cumulative and empirical distribution of cases. Where, distribution: exponential (=44,75)

The analysis of the location of trocar site hernias revealed that paraumbilical hernias were more common (19 cases) than the other localizations (15 cases). This amounted to 1.3% and 1.0%, respectively, of all hernias hospitalised on an emergency basis. If we consider the percentage of the number of patients operated on, then these figures will be higher - 2.3% and 1.8%. It should be noted 4 cases of lateral localization of a trocar site hernia, all of which occurred after puncture with a 5-mm trocar. When clarifying the anamnesis, two patients had drainage tubes in these places. It turned out that these cases are the incarceration of the omentum and intestines. In the remaining 2 cases, incomplete

or partial incarceration of the intestine (the so-called "Richter's hernia") was observed. These strangulated hernias were reported in obese individuals with a high body mass index (BMI over 26.5). Moreover, the diameter of the hernial opening was significantly larger than the diameter of the 5-mm trocar, which was used during the first surgery. Among those with trocar site hernias, the vast majority of patients were overweight and had a high body mass index. A graphical picture (3D graphics) of the intercorrelation between the quantitative growth of trocar site hernias over time and a large body weight of patients with excess fatty tissue on the anterior abdominal wall is shown in the Figure 4.

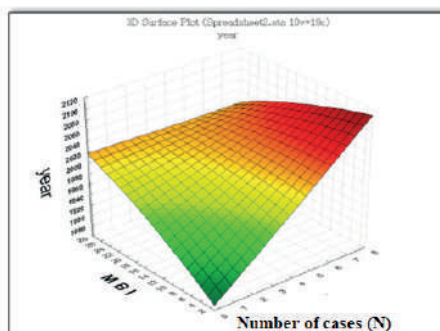


Figure 4. Interdependence between the increase in cases of trocar site hernias and length of follow-up (years) and body mass index (BMI)

Discussion

It is believed that Dr. Fear R.E. (USA) first reported a hernia TSH (Trocar Site Hernia) after a puncture of the anterior abdominal wall with a trocar. He published his observations in the Journal "Obstetrics & Gynaecology" in March 1968. The article studied the historical and contemporary views at that time on the role of laparoscopy in gynaecological diagnostics [11]. Subsequently, many authors recognized this as the first report of trocar site hernias [12-15].

Then in 1991 Maio Angela and Ruchman Richard B. reported a trocar site hernia with small intestinal obstruction occurring immediately after cholecystectomy [16]; this was the first report of trocar site hernias in digestive surgery. Since then, many similar reports have been published after cholecystectomy and, more recently, after many gastrointestinal surgeries. Published reports show extremely wide variation in the clinical aspects of trocar site hernias. They are so significant that many authors began to delve into the terminology, classification, and the meaning of the medical term "hernia of the trocar section" or "trocar

site hernia", which is not clearly defined today [12-16].

However, the main point is that trocar site hernias after laparoscopic surgery are, according to international authors, rare complications in laparoscopic surgery [17]. Hernias are more common after the use of trocars with a diameter ≥ 10 mm. However, there are rare cases of such hernias where a laparoscopic instrument with a 5 mm diameter has been inserted into the abdominal cavity. Such cases can lead to serious postoperative complications. In 2016, Pereira N, Hutchinson AP, Irani M and co-authors conducted a systematic review of publications, which analysed 295 cases of the formation of defects in the anterior abdominal wall after laparoscopic surgery. Of these, in 5.76%, the hernia was associated with a defect in the area of 5 mm. Moreover, the incidence of umbilical and non-umbilical (lateral) localization is slightly different (56% and 44%) [17].

Considering the results of our study, it can be noted that they are mostly consistent with the data presented by the above authors in their publications and articles. It should be said that in our case, the main localization of postoperative trocar site hernias coincides with the

incidence indicated by many authors. However, there are some differences between our results and those published in international papers. Thus, the majority of incarcerations in the lateral localisation are associated with appendectomy, laparoscopic diagnosis and gynaecological surgery rather than cholecystectomy. There are almost no reports of trocar site hernias after the use of a 5-mm trocar in the global literature. In our opinion, it is very difficult to make any comparison and obtain reliable statistics. This also applies to descriptions of the strangulated gut according to the Richter type, which are very scarce in the literature. This requires significant large-scale multicentre studies, not just at the level of one region or a single clinic.

Many surgeons, when determining the kind of the incarceration, adhere to the previously proposed classification of trocar site hernias, which divides them into 3 types:

- Early-onset type: An early type that occurs immediately after surgery, with frequent small intestinal obstruction, especially Richter's hernia.

- The late-onset type: A type of late onset that occurred a few months after surgery, mainly with local protrusion of the abdomen without development of small intestinal obstruction.

- The special type: The special type indicated protrusion of the bowel and/or omentum. Trocar -site hernias with fascial defects of 10 mm or more should be closed, including of the peritoneum [18].

According to Abe Fukumitsu and his co-authors, the so-called Richter's hernias are characteristic only in the early postoperative period. However, in our case, we trace the result of the trocar incarceration at a much later stage.

The submitted study result on the diameter of the hernial orifice (orifice after trocar puncture), which we observed, is a contribution to this scientific field. Moreover, we find a significant increase in the defect of the anterior abdominal wall after a trocar hole of 5 mm, made 3-5 years or more ago. The escalation of trocar site hernias rate is associated with rise in the number of operations, including an increase in the number of overweight and obese patients operated on, which is accompanied by the effect of stretching the anterior abdominal wall and weakness of the muscle aponeurosis.

Conclusion

In the last decade, there has been an increase in the incisional hernias after laparoscopic surgery. A statistical trend line indicates a projected increase in this pathology. One of the most dangerous complications for the patient is a trocar site hernia. The share of trocar site hernia among all incarcerated hernias operated on an emergency basis is 2.34%. There is a correlation between the incidence of incarcerated hernia and the age of surgery, trocar diameter, overweight and obesity. The rarest complication of a trocar site hernia is Richter-type intestinal incarceration (Richter's hernia).

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