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MEASURES TO PREVENT COMPLICATIONS IN THORACIC SURGERY. REVIEW.

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Abstract

Introduction. There are now many efforts, particularly in the perioperative period, to improve the quality of surgical care based on scientific findings, medical error reviews, and surgical outcome tracking measures. Experience in reducing the risk of complications is essential to improve surgical outcomes. Today, WHO's priority is preventive medicine, and it is necessary to identify and implement factors that can be influenced.

Aim: to study preventive measures used in thoracic surgery in the perioperative period to reduce the risk of complications.

Materials and methods. Search strategy. Open access articles were searched using the following databases of scientific publications and specialized search engines in depth over the past 5 years: PubMed, Mendeley, Scopus, Web of Science, Google Scholar. *Inclusion criteria:* Publications of level of evidence A, B: meta-analyses, systematic reviews, cohort and cross-sectional studies. *Exclusion criteria:* expert opinion in the form of short messages, advertising articles. The search yielded 91 publications, of which 64 met the inclusion criteria.

Results. Quite a few studies of treatment outcomes in abdominal surgery have focused on nutrition in terms of prognostic treatment outcomes; more research in this area is needed for thoracic surgery, both preoperative nutrition and dietary therapy after surgery. It is necessary to develop preoperative training regimens for elective chest surgery.

Successful post-operative rehabilitation is developed individually for the patient. This way you can reduce the risk of possible complications, the length of hospital stay and speed up the recovery period.

Conclusion. At the moment, there are no high-level evidence-based studies on preoperative preparation strategies or optimal rehabilitation measures after operations on the chest organs. There is also no scientific basis for some physiotherapeutic interventions and diet therapy before and after surgery. Research in this area is extremely important due to the fact that in this branch of surgery complications of the postoperative period occur much more often than intraoperative complications, which have pathophysiological reasons specific to the chest organs and complicate the rehabilitation process.

Keywords: thoracic surgery, prevention of complications, perioperative preparation, pulmonary rehabilitation, breathing exercises.

Резюме

МЕРЫ ПРОФИЛАКТИКИ ОСЛОЖНЕНИЙ В ТОРАКАЛЬНОЙ ХИРУРГИИ. ОБЗОР ЛИТЕРАТУРЫ.

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Введение. На сегодняшний день принимается множество усилий, в частности, в периоперационном периоде, направленных на улучшение качества хирургической помощи, основанные на научных результатах, разборах медицинских ошибок, а также мерах отслеживания результатов хирургической помощи. Опыт снижения риска осложнений крайне необходим для улучшения результатов операции. На сегодняшний день приоритетом ВОЗ является профилактическая медицина и необходимо выявлять и внедрять факторы, на которые возможно воздействовать.

Цель: изучить меры профилактики, используемые в торакальной хирургии в периоперационном периоде для снижения риска осложнений.

Стратегия поиска. Были изучены статьи, находящиеся в открытом доступе, с использованием следующих баз данных научных публикаций и специализированных поисковых систем глубиной за последние 5 лет: PubMed, Mendeleu, Scopus, Web of Science, Google Scholar. *Критерии включения:* публикации уровня доказательности А, В: мета-анализы, систематические обзоры, когортные и поперечные исследования. *Критерии исключения:* мнение экспертов в виде коротких сообщений, рекламные статьи. По запросу было найдено 91 публикация, из них 64 соответствовали критериям включения.

Результаты. Достаточно немало исследований исходов лечения в абдоминальной хирургии сосредоточены на питании с точки зрения прогностических исходов лечения, необходимо больше исследований в этой области для торакальной хирургии, как предоперационного питания, так и диетотерапия после операции. Необходимы разработки режимов предоперационных тренировок для плановой хирургии на грудной клетке.

Успешная послеоперационная реабилитационная диетотерапия разрабатывается индивидуально для пациента. Так можно снизить риск возможных осложнений, срок пребывания в стационаре и ускорить период восстановления.

Заключение. На настоящий момент пока нет исследований высокого доказательного уровня о стратегиях предоперационной подготовки, об оптимальных реабилитационных мероприятиях после операций на органах грудной клетки. Также нет научного обоснования для некоторых физиотерапевтических вмешательств, диетотерапии до и после операции. Исследования в этой области крайне важны, в связи с тем, что в этой отрасли хирургии осложнения послеоперационного периода случаются гораздо чаще интраоперационных, что имеет патофизиологические причины специфичные для органов грудной клетки и затрудняет процесс реабилитации.

Ключевые слова: торакальная хирургия, профилактика осложнений, периоперационная подготовка, легочная реабилитация, дыхательная гимнастика.

Түйіндеме

ТОРАКАЛДЫ ХИРУРГИЯДАҒЫ АСҚЫНУЛАРДЫҢ АЛДЫН АЛУ ШАРАЛАРЫ. ӘДЕБИЕТТЕРГЕ ШОЛУ

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Кіріспе. Бүгінгі күні ғылыми нәтижелерге, медициналық қателіктерді талдауға, сондай-ақ хирургиялық көмектің нәтижелерін бақылау шараларына негізделген хирургиялық көмектің сапасын жақсартуға бағытталған көптеген күш-жігер, атап айтқанда, периоперациялық кезеңде қабылдануда. Операция нәтижелерін жақсарту үшін асқыну қаупін азайту тәжірибесі өте қажет. Бүгінгі таңда ДДҰ-ның басымдығы профилактикалық медицина болып табылады және әсер етуі мүмкін факторларды анықтау және енгізу қажет.

Зерттеудің мақсаты: асқыну қаупін азайту үшін периоперативті кезеңде кеуде клеткасының хирургиясында қолданылатын алдын алу шараларын зерттеу.

Материалдар мен әдістер. Іздеу стратегиясы. Соңғы 5 жылдағы келесі ғылыми жарияланымдар мен мамандандырылған іздеу жүйелерінің мәліметтер базасын қолдана отырып, көпшілікке қол жетімді мақалалар зерттелді: PubMed, Mendeley, Scopus, Web of Science, Google Scholar. *Қосу критерийлері:* А, В дәлелдеу деңгейінің жарияланымдары: мета-талдаулар, жүйелі шолулар, когорттық және көлденең зерттеулер. *Алын тастау критерийлері:* қысқа хабарламалар түріндегі сарапшылардың пікірі, жарнамалық мақалалар. Сұраныс бойынша 91 басылым табылды, оның 64-і қосу критерийлеріне сәйкес келді.

Нәтижелер. Абдоминалды хирургиядағы емдеу нәтижелері туралы көптеген зерттеулер емдеудің болжамды нәтижелері бойынша тамақтануға бағытталған, операцияға дейінгі тамақтану және операциядан кейінгі диеталық терапия үшін осы салада көбірек зерттеулер қажет. Кеуде қуысына жоспарланған хирургия үшін операция алдындағы жаттығу режимдерін әзірлеу қажет.

Операциядан кейінгі сәтті оңалту науқас үшін жеке әзірленеді. Осылайша сіз ықтимал асқынулардың қаупін, ауруханада болу мерзімін азайтып, қалпына келтіру кезеңін жеделдете аласыз

Қорытынды. Бүгінгі күнде операцияға дейінгі дайындық стратегиялары, кеуде қуысы мүшелеріне операциядан кейінгі оңтайлы оңалту шаралары туралы жоғары дәлелді деңгейдегі зерттеулер әлі жоқ. Сондай-ақ, кейбір физиотерапиялық араласулар, операцияға дейін және операциядан кейінгі диеталық терапия үшін ғылыми негіз жоқ. Бұл саладағы зерттеулер өте маңызды, өйткені хирургияның осы саласында операциядан кейінгі кезеңнің асқынулары интраоперацияға қарағанда әлдеқайда жиі кездеседі, бұл кеуде қуысы мүшелеріне тән патофизиологиялық себептерге ие және оңалту процесін қиындатады.

Түйінді сөздер: кеуде хирургиясы, асқынулардың алдын алу, периоперациялық дайындық, өкпелік оңалту, тыныс алу жаттығулары.

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Introduction

There are currently many efforts, particularly in the perioperative period, to improve the quality of surgical care based on scientific findings, medical error reviews, and surgical outcome tracking measures [3, 9]. The presence of complications and their degree, the quality of life of patients, and an assessment of economic efficiency are taken into account. Constant optimization of surgical care does not lose its relevance, since the number of patients with a complicated surgical situation is only increasing in the world. Due to this trend, strict regulation of the perioperative period is necessary. Despite scientific and technological progress in surgery itself, thoracic surgical patients have concomitant pulmonary diseases. [7, 12].

Most research in this area focuses on management of existing complications. Experience in reducing the risk of complications is essential to improve surgical outcomes, but such practices are very difficult to standardize.

The postoperative period in thoracic surgery is unique in its complexity, due to the fact that patients usually have a number of severe lung diseases that complicate the course of the postoperative period [13, 16]. Basically, all

complications in thoracic surgery usually occur in the postoperative period, which is especially dangerous for emergency surgery, where it is not possible to carry out any preventive measures at the prehospital stage. The main problems of postoperative patients undergoing thoracic surgery include pain after incision and/or drainage; cough; decrease in lung volume; postoperative pulmonary complications, which may be non-infectious (eg, atelectasis and respiratory failure) or infectious (eg, pneumonia); violation of airway clearance; frozen shoulder on the side of the thoracotomy; postural disorders; and a persistent feeling of tightness in the chest [15, 21]. These complications can lead to delayed patient recovery, prolonged hospitalization, and increased morbidity and mortality.

Today, WHO's priority is preventive medicine and it is necessary to identify and implement factors that can be influenced, which will become the basis of perioperative management algorithms to prevent these complications and conduct more research in this area. Therefore, it is imperative that medical personnel are trained to manage any situation following surgery. As well as carrying out effective prevention [4].

Aim: to study preventive measures used in thoracic surgery in the perioperative period to reduce the risk of complications.

Search strategy. Open access articles were searched using the following databases of scientific publications and specialized search engines in depth over the past 5 years: PubMed, Mendeley, Scopus, Web of Science, Google Scholar. Information search was carried out using keywords: thoracic surgery, minimally invasive surgery, thoracoscopy, robotic technology in thoracic surgery. *Inclusion criteria:* Evidence level A, B publications; systematic reviews and cross-sectional studies. *Exclusion criteria:* expert opinion in the form of short messages, advertising articles.

Research methods: To search the literature, the following search engines were used: Pubmed, Google Academy, elibrary.ru, as well as manually. We chose the following search strategy in PubMed regarding measures to prevent complications in thoracic surgery (MeSH Terms: epidemiology of complications in thoracic surgery). The search depth in Pubmed was not limited. The following filters were used: full text, humans. 91 publications were found for the given request, of which 64 publications met the purpose of our study.

Results

The first important aspect is pain control, as thoracic surgery incisions are some of the most painful. Severe pain occurs due to the proximity and abundance of intercostal somatic nerve fibers, irritation of the pleura because of surgical manipulations, as well as the need to fracture the ribs during the operation. All these factors lead to immobility, shallow breathing, atelectasis and pathological complications such as pneumonia and dependence on a ventilator. [19, 20]. Therefore, in thoracic surgery, it is especially important to evaluate patients for potential susceptibility to significant pain or those with chronic pain. One of the methods of analgesia is preventive anesthesia. The approach was effective in reducing postoperative pain and opioid requirements.

A meta-analysis of different pain treatment strategies, including 66 studies involving 3261 participants, found that the addition of epidural analgesia, local infiltrating analgesia, or nonsteroidal anti-inflammatory drugs (NSAIDs) had good efficacy in reducing the amount of additional analgesia after surgery, as well as reducing the time until the first dose is required. Non-opioid analgesics, the use of multimodal analgesic regimens with peripheral nerve blockade aimed at reducing sensitization, and preoperative administration of dextromethorphan into the intercostal space influenced reducing the need for opioids after surgery [25, 28, 36].

Epidural block is associated with effective reduction of postoperative pain and is widely used in surgery, but has a few possible complications, such as hypotension, high block, injection of anesthetic into the spinal space, non-functional catheter, hematoma, or abscess [27, 30, 38].

Another method is to inject an anesthetic into the paravertebral space. There was no significant difference in pain control across studies, but slightly fewer side effects were reported compared with epidural block [18].

Intercostal liposomal blockade with bupivacaine is another method of pain relief, which has demonstrated itself as an alternative to those previously described, and even helps to improve postoperative results, but this method is more expensive [29, 46].

Local analgesia for surgical wounds is another alternative method of pain control, where a catheter is inserted intercostally to continuously administer local anesthetic. However, there is no convincing data for its effectiveness; not many studies have been conducted and often very good results are demonstrated [17, 44].

Chronic pain occurs in up to 50% after chest surgery, which may be due to insufficient pain control in the acute period; there is no evidence in favor of other factors, such as psychosocial support, mental disorders [47, 59]. About this complication, the introduction of minimally invasive methods can probably be preventive.

Nutrition. There is evidence that a low-calorie diet and low protein intake are associated with poor postoperative outcomes. Thus, adequate dietary therapy is of great importance in optimizing the perioperative period [49, 61].

Principles of successful surgical nutrition:

1. early feeding (within 24 hours after surgery);
2. enteral nutrition is preferable to parenteral nutrition;
3. preoperative nutritional risk assessment;
4. consideration of additional immunonutrition in high-risk surgical patients [42, 58].

Assessing preoperative status is challenging and there are many scoring scales as well as assessment of laboratory parameters. Although several nutritional risk scales have been described in the literature, there is no data on their use in thoracic surgery; research in this area is needed. For example, the Nutritional Risk Index (NRI)—endorsed by the Veterans Affairs Parenteral Nutrition Cooperative Research Group—uses serum albumin, serum prealbumin, and patient weight to calculate a risk score. Patients at high nutritional risk can be divided into three categories [50, 53]:

- Underweight (BMI ≤ 18.5 kg/m²);
- Weight loss $>10\%$ or $>5\%$ in 3 months of total body weight before surgery.
- Obesity (BMI ≥ 30 kg/m²).

Obesity is associated with metabolic disorders and relates to poor nutritional status.

Preoperative assessment of albumin levels is a prognostic factor. An association in thoracic surgery has been demonstrated in several studies. Poor overall survival and disease-free survival in patients with non-small cell lung cancer were observed when serum albumin levels were less than 4.2 g/dL. Hypoalbuminemia has also been associated with bronchopleural fistula and prolonged air leakage [33, 39]. The patient's weight is usually taken as a marker of normal nutrition. However, the relationship between body mass index (BMI) and outcomes is not clear enough; in some studies, low BMI was associated with high mortality after surgery, but a longer survival period; in other studies, no connection was found between low BMI and mortality. *Takamori S. et al* showed that loss of skeletal muscle was associated with poor postoperative outcomes. Thus, BMI can be used as a factor to consider [54].

Preoperative nutrition. Recent European guidelines do not advocate preoperative fasting, only limiting solid foods to 6 hours and liquids to 2 hours before surgery. However, there are not many studies evaluating dietary patterns before thoracic surgery. One randomized trial showed an association between reduced complications and a shorter period of needing a chest tube after surgery and an immunomodulatory diet (enriched with arginine, omega-3 fatty acids, and nucleotides) for 10 days before surgery [23]. However, in thoracic surgery there is not

much research in favor of immunonutrition; most studies have been conducted in the field of abdominal surgery on the gastrointestinal tract, where immunonutrition 10-14 days before surgery is associated with a faster recovery period, fewer complications and a shorter period of hospital stay. hospital [6, 35].

Postoperative nutrition. There is quite a lot of data today in favor of early nutrition, in the first 24 hours after surgery. There is controversy regarding early oral nutrition, especially in esophageal interventions. Some studies show better results with oral nutrition, but the pooled meta-analysis evidence is weak [41].

Exercises before surgery. Some studies have demonstrated better outcomes, shorter hospital stay, and the need for an intercostal catheter and susceptibility to infection in patients undergoing exercise training before elective thoracic surgery [48]. Data from a recent meta-analysis confirm that patients who undergo training before surgery have fewer postoperative complications [60]. Exercise training is generally divided into three areas: aerobic exercise, resistance training, and respiratory muscle training. There are no recommendations regarding the optimal training regimen. There is also the problem of assessing the required load since a highly qualified physiotherapist may not be available. More research is needed in this area. Of course, these measures are applicable for elective surgery, however, at the primary health care level, a functional assessment of the lungs in people at risk for chest diseases with recommendations for physical exercises and breathing exercises is possible.

Quitting smoking. There are many studies that smoking has a negative effect on surgical outcomes in thoracic surgery, and smoking cessation has had both short-term and long-term positive effects on postoperative outcomes. The pathophysiology of the harmful effects of smoking is multifactorial [10]. Smoking is associated with a variety of chronic diseases, such as cancer, atherosclerosis, stroke and chronic obstructive pulmonary disease. For thoracic surgeons, smokers are at particularly high risk, increasing the risk of the surgical procedure itself and a higher risk of complications and mortality [56]. A systematic review and meta-analysis conducted in 2012 found that smokers tend to have a higher incidence of postoperative healing complications compared with nonsmokers, and that a history of smoking carries a lifetime risk of these complications. There is considerable debate about how long smoking should be stopped before surgery, but it has been emphasized that abstinence for at least 4 weeks reduces the likelihood of surgical site infections but does not affect other healing complications. However, according to recent studies, it is impossible to make clear recommendations about the smoking cessation interval [24,51, 63, 64].

A 2014y Cochrane review recommended starting smoking cessation efforts 4-8 weeks before surgery.

Physical therapy has recently become an integral part of the recovery period after thoracic surgery. Evidence-based physical therapy postoperative management is essential for effective recovery. However, not many studies have discussed the rationale for physical therapy interventions that are commonly used after thoracic surgery. Physical therapy has been recommended by the European Society of Thoracic Surgeons, the European Respiratory Society, and the American College of Chest Physicians and is now considered

an important element of enhanced recovery protocols (ERP) or "fast track" protocols after thoracic surgery, promoting rapid functional recovery of postoperative patients and minimizing hospital stays. [34, 55]. Thus, the role of physical therapy in these "fast track" protocols after thoracic surgery requires further clarification.

To date, there are no sufficiently scientifically based algorithms for physiotherapeutic management after operations on the chest organs. More research is needed in this area.

An accurate initial assessment of patients is necessary to develop a physical therapy plan. After the initial postoperative assessment, a list of problems can be compiled, which most often includes pain, respiratory distress, decreased lung capacity, cough, and limited shoulder movement [45]. Re-evaluation is also recommended to evaluate the effectiveness of treatment, change the treatment plan, and identify new problems.

Chest physical therapy can effectively reduce the overall incidence of pulmonary complications after lung resection. Physiotherapeutic treatment should begin in the postoperative period, 4-12 hours after recovery from general anesthesia. The estimated session time is 30 minutes, 2-3 sessions per day [32, 43].

Physiotherapeutic treatment of pain. Thoracic procedures are considered to be one of the most painful surgical procedures and are accompanied by severe postoperative pain. The pain prevents patients from breathing deeply or coughing effectively, which can lead to decreased lung capacity and sputum retention. Pain can also affect hemodynamic stability and limit the mobility of the shoulder and scapula, which leads to freezing of the shoulder [14, 37]

The goal of physical therapy is not to replace analgesics, but to reduce the total dose of analgesics, which will reduce the likelihood of side effects.

The following methods of pain reduction are used: transcutaneous electrical nerve stimulation, cryotherapy (cold therapy), wound support (pressure applied to the wound by the patient or a physical therapist).

Positioning. Early and correct positioning helps prevent atelectasis and increase functional residual capacity for several reasons: gravity improves ventilation and helps clear excess bronchial secretions [62].

Provision for improved ventilation and gas exchange.

1. Sitting position upright.
2. High position on the side (lying on your side) with the operated lung at the top.

Provisions that promote the removal of bronchial secretions.

A modified (horizontal) postural drainage position is recommended over the classic (head down) position in postoperative patients, as the classic position may result in decreased arterial oxygenation and increase the risk of aspiration.

Early mobilization - changing the patient's position from lying or slouching in bed to an upright sitting position in or out of bed, standing or walking. According to some data, early mobilization while sitting in bed 3.5 hours after surgery, maintaining a sitting position for 30 minutes and then moving around in the fourth hour after surgery led to better recovery of pulmonary function than traditional mobilization (walking in place) on the first postoperative day) in patients who underwent lobectomy [22, 31].

After chest surgery, lung volume and functional residual capacity are reduced due to anesthesia, chest pain, and/or recumbency. This can lead to pulmonary atelectasis, which is considered one of the most significant non-infectious postoperative complications. Deep breathing exercises, incentive spirometry, and inspiratory muscle training are aimed at improving lung expansion and increasing lung volume and capacity. An approach that combines all these measures may be more effective [36].

Typically, postoperative pain prevents the patient from coughing and expectorating effectively, leading to the risk of postoperative pneumonia. Both manual and mechanical methods of clearing the respiratory tract are used. Any of the methods may be applicable; the literature does not describe the advantages of one method over the other. Methods for clearing the airways: coughing with wound support, puffing, forced expiratory technique, active cycle, positive expiratory pressure technique, modified postural drainage positions, manual chest physiotherapy methods [1,5].

80% of patients experience shoulder pain after thoracotomy. Raising the arm within the limits of pain should be started as early as possible to avoid the complication of frozen shoulder. The scapula can be gently mobilized through its full range of motion in the lateral decubitus position. It is only necessary to exclude shoulder abduction and external rotation in the first days so as not to overload the incision. Exercises should be performed 3–4 times a day [26, 57].

Exercises for the legs and arms can be started on the first postoperative day to avoid deep vein thrombosis. Chest mobilization exercises should also be performed up to 5 times daily with adequate pain relief and/or wound support [2].

Patients should be provided with a detailed home program upon discharge. They are encouraged to continue regular breathing exercises, gradually increase their mobility and daily activities, and practice airway clearance techniques when necessary. Step-by-step walking technique: after discharge, you need to walk at least 3 times a day for 5 minutes (15 minutes a day), increase the walking time by 5 minutes every week, by the first month you need to reach 30 minutes with breaks or continuously [8, 11].

Supervised aerobic training on a treadmill or stationary bike may be recommended and has been shown to improve quality of life, but the study by *Stigt J.A. et al* recommended starting training 3–4 months after surgery [40, 52].

Conclusions

Quite a few studies of treatment outcomes in abdominal surgery have focused on nutrition in terms of prognostic treatment outcomes; more research in this area is needed for thoracic surgery, both preoperative nutrition and postoperative diet therapy. Development of preoperative training regimens for elective chest surgery is needed, however, to reduce the number of complications during potentially emergency operations, functional assessment of the lungs in people at risk with chest diseases with recommendations for physical exercises, gymnastics and breathing is possible at the primary health care level.

Successful postoperative rehabilitation tactics must begin with a thorough initial examination of the patient, identify clinical problems, and are developed individually for the patient. This way you can reduce the risk of possible complications, the length of hospital stays and speed up the recovery period. It is also very important to select a rehabilitation program for the

patient after discharge. The effectiveness of rehabilitation measures, of course, depends on the patient's commitment to their implementation.

Now, there are no high-level evidence-based studies on preoperative preparation strategies or optimal rehabilitation measures after operations on the chest organs. There is also no scientific basis for some physiotherapeutic interventions and diet therapy before and after surgery. Therefore, research in this area is extremely important, since in this branch of surgery complications of the postoperative period occur much more often than intraoperative ones, which has pathophysiological reasons specific to the chest organs and complicates the rehabilitation process.

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