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THE EFFECTIVENESS OF USING CHEMICAL PLEURODESIS WITH IODPOVIDONE IN THE TREATMENT OF PATIENTS WITH PNEUMOTHORAX OF VARIOUS ETIOLOGIES

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ЭФФЕКТИВНОСТЬ ПРИМЕНЕНИЯ ХИМИЧЕСКОГО ПЛЕВРОДЕЗА ЙОДПОВИДОНОМ В ЛЕЧЕНИИ ПАЦИЕНТОВ С ПНЕВМОТОРАКСОМ РАЗЛИЧНОЙ ЭТИОЛОГИИ

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Abstract. Pneumothorax is a pathological condition characterized by the accumulation of air in the pleural cavity, which leads to loss of negative pressure and collapse of the lung. Traditionally, pneumothorax is divided into traumatic and spontaneous, if in the first case the cause is clear, then in the second case, the diagnosis is sometimes difficult. Particular interest to thoracic physicians is spontaneous pneumothorax (SP), which often develops as a result of rupture of a bulla or bleb. Drainage of the pleural cavity is an effective method of treatment, it allows to stop respiratory failure and straighten the lung in the shortest possible time. The problem remains the high recurrence rate, which, according to the literature, ranges from 20 to 40% after the first episode of pneumothorax. Describe the main causes of pneumothorax. Describe the possibility of using chemical pleurodesis (CP) to prevent relapse. Evaluation the efficacy and safety of CP with iodopovidone. The study was made on the basis of the clinic named after I.K. Akhunbaev National Hospital of the Ministry of Health of the Kyrgyz Republic in the Department of Thoracic Surgery. The study included 115 patients with pneumothorax of various etiologies who were treated in the department from September 2015 to February 2023. The control group included 62 patients, here traditional treatment was carried out by drainage of the pleural cavity. The number of people in the test group was 53, here, after complete expansion of the lung, a CP procedure was performed in order to prevent recurrence. If the patient underwent only drainage of the pleural cavity, then the recurrence rate was compared. If the patient underwent thoracotomy with bullectomy, then the frequency of postoperative air leaking was assessed. The safety of the technique was assessed by the main indicators of hemodynamics, temperature and pain response. CP with iodopovidone after drainage of the pleural cavity, as well as as the final stage of open thoracotomy, turned out to be 100% effective in preventing recurrences, as well as postoperative air leaking. Statistical processing showed the safety of CP with iodopovidone. CP with iodopovidone can be successfully used as a prevention of relapse, as well as the prevention of postoperative air leakage. The positive effect was in 100% of cases with minimal side effects.

Аннотация. Пневмоторакс — это патологическое состояние, характеризующееся скоплением воздуха в плевральной полости, что ведет к потере отрицательного давления и

коллапсу легкого. Традиционно, пневмоторакс разделяют на травматический и спонтанный, если в первом случае причина понятна, то во втором постановка диагноза порой бывает затруднительной. Особый интерес для врачей торакального профиля представляет спонтанный пневмоторакс (СП), который зачастую развивается в результате разрыва буллы или блебы. Дренирование плевральной полости является эффективным методом лечения, позволяет в кратчайшее время купировать дыхательную недостаточность и расправить легкое. Проблемой остается высокая частота рецидивов, которая, по литературным данным, составляет от 20 до 40% после первого эпизода пневмоторакса. Цель — описать основные причины возникновения пневмоторакса. Обозначить возможность применения химического плевродеза (ХП) с целью предупреждения рецидива. Оценить эффективность и безопасность ХП йодповидоном. Исследование проводилось на базе клиники имени И. К. Ахунбаева Национального госпиталя Министерства здравоохранения Кыргызской Республики в отделении торакальной хирургии. В исследование попало 115 пациентов с пневмотораксом различной этиологии, находившихся на лечении в отделении в период с сентября 2015 года по февраль 2023 года. В контрольную группу было включено 62 пациента, здесь проводилось традиционное лечение дренированием плевральной полости. Количество человек в испытываемой группе составило 53, здесь после полного расправления легкого проводилась процедура ХП с целью предупреждения рецидива. Если пациенту было проведено только дренирование плевральной полости, то сравнивалась частота рецидивов. Если пациенту проводилась торакотомия с буллэктомией, то оценивалась частота послеоперационного барботажа. Безопасность методики оценивалась по основным показателям гемодинамики, температурной и болевой реакции. ХП йодповидоном после дренирования плевральной полости, а также в качестве завершающего этапа открытой торакотомии оказался в 100% эффективным методом борьбы с рецидивами, а также с послеоперационным барботажем. Статистическая обработка показала безопасность ХП йодповидоном. ХП йодповидоном может быть с успехом применен в качестве предупреждения рецидива, а также профилактики послеоперационного барботажа. Положительный эффект оказался в 100% случаев при минимальных побочных явлениях.

Keywords: pneumothorax, bullous disease, recurrent pneumothorax, pleurodesis, iodovidone.

Ключевые слова: пневмоторакс, буллезная болезнь, рецидивный пневмоторакс, плевродез, йодповидон.

The pleural cavity is a virtual space between two sheets of the pleura, containing only a small amount of liquid, which allows lung to easily slide during breathing. If air enters this cavity, then this condition is called pneumothorax.

One of the first documented cases of pneumothorax falls on the 15th century, when the Turkish surgeon Ottoman described pneumothorax as a complication of the traumatic fracture of the ribs [1]. Later, already in the 19th century, Laennec described the case of pneumothorax in a patient with tuberculosis infection. He also noted the emergence of spontaneous pneumothorax (SP) without tuberculosis, calling it “simple pneumothorax” [2].

Pneumothorax, due to occurrence, is divided into traumatic and spontaneous. This article will consider cases of SP, a pathological state did not precede any trauma and iatrogenic injury. Consequently, the air present in the pleural cavity arose as a result of an abnormal connection

between the air-containing alveolar space and pleura. SP, in turn, is divided into primary spontaneous pneumothorax (PSP), when the cause of the occurrence is unknown and secondary spontaneous pneumothorax (SSP), when this condition occurs against the background of a pulmonary disease, such as chronic obstructive disease of the lung (COPD).

Pneumothorax has a different clinical manifestation from the asymptomatic course to a life — threatening condition [3]. According to the pathophysiological mechanism, pneumothorax is divided into three types: 1. Simple — air in the pleural cavity does not communicate with the atmospheric, there is no displacement of the mediastinum, flattening of the diaphragm dome, this pathological condition more often occurs with a fracture of the ribs or rupture of the bull; 2. Communicating — air enters the pleural cavity through a defect in the chest wall; 3. Tension — this is the growing flow of air into the pleural cavity, leading to a displacement of the mediastinum, squeezing the vena cava and other large vessels, a decrease in diastolic filling of the heart and, in the end, a violation of cardiac output [4].

The clinical picture of pneumothorax is very specific, although the left-sided localization of the process can be disguised as a heart attack. The classic symptoms of pneumothorax are shortness of breath of various intensities, dry cough, pain in the chest. With tension pneumothorax, the patient's condition worsens significantly, symptoms of unstable hemodynamics appear up to the collapse. Given the possibility of a sudden onset and sharp development of tension, an objective examination has great importance. The asymmetry of the chest, the swelling of the cervical veins, the absence of active respiratory movements on the side of the lesion, the tympanic sound during percussion and the absence of breathing during auscultation are the key signs of pneumothorax. If the patient's condition allows, then a radiological study is carried out, the routine conduct of computed tomography (CT) is not carried out under the first episode of CP. CT is recommended in the case of positive family history and specific features of the constitution [5]. Among patients with PSP, 10–12% have a family history, the risk of relapse in which is much higher, also in 5–10% of patients with PSP detect Bert-Hogg-Dube syndrome [6].

For many years to this day, chest tube insertion (CTI) is the main way to treat pneumothorax aimed at evacuating air from the pleural cavity. In the case of signs of respiratory failure and hemodynamic instability of the CTI, it is the only way of emergency care. Signs of instability of patients with pneumothorax are the respiratory rate more than 24 times per minute, the heart rate of less than 60 or more than 120 beats per minute, oxygen saturation is less than 90%, systolic blood pressure less than 90 mm Hg. and diastolic blood pressure less than 60 mm Hg [7]. With a relatively stable condition of the patient with the treatment and diagnostic purpose, thoracoscopy or pleuroscopy will be used. The latter is performed under local anesthesia, while a rigid thoracoscope is introduced into the pleural cavity and a visual inspection of the available sections of the visceral pleura for the presence of bulls is carried out. In the presence of a videothoracoscope, both operational and diagnostic capabilities expand.

An important point in the maintenance of patients from CP is the prevention of recurrence. The highest frequency of relapses falls on the first year after the episode of pneumothorax and is 29% with PSP [8]. The risk factors for the development of relapse are smoking, young age, male gender, low body weight and high growth [8]. One way to prevent relapses is the conduct of pleurodesis. Pleurodesis is a chemical or mechanical effect on the sheets of the pleura, aimed at the induction of the inflammatory process and the subsequent obliteration of the pleural cavity [9].

The aim of the present review

Describe the main causes of pneumothorax, as well as the frequency of recurrence. To

outline the possibility of pleurodesis. To evaluate the effectiveness and safety of iodopovidone as an agent for chemical pleurodesis (CP) in order to prevent recurrence and improve treatment outcomes.

Material and methods

Patients of the Department of Thoracic Surgery of the National Hospital under the Ministry of Health of the Kyrgyz Republic were included in this study. The time interval was taken from September 2015 to February 2023. During this period there were 115 patients with pneumothorax of various etiologies in the department, and the number of hospitalizations was 136. The age range of patients was from 16 to 77 years. According to the literature data, as well as in practice, the number of male patients prevailed and amounted to 97 patients (84.4%), female patients were 18 (15.6%).

Patients who were under conservative treatment and were under outpatient observation were not included in the study. None of the patients had undergone pleurodesis before. The department on the basis of which the study was carried out is the leading in the republic concerning pulmonary surgery, in the algorithm of treatment of patients with pneumothorax CP was absent, hence, the informed consent was taken from all patients who received this type of treatment.

Administration of pleuroscerosant was performed in patients through a drainage tube or during open surgery. In 30 patients (26.1%) the condition allowed for thoracoscopy for diagnostic purposes. The chemical agent and test substance was a 10% iodopovidone solution, with which the pleural leaflets were treated with an exposure of 2 hours. An obligatory condition for CP with iodopavidone was absence of allergic reactions to iodine preparations, as well as complete lung spreading after pleural cavity drainage or absence of conditions for incomplete spreading.

The CP technique itself included preliminary anesthesia of the pleural leaflets with Lidocaine 1% solution in the volume of 50 ml, which was injected through the pleural drainage, for 20 minutes. To achieve the best anesthetic effect, patients were advised to change their body position every 5 minutes, as well as to perform deep breathing movements. Then, the anesthetic solution was removed and a pre-prepared 10% iodopovidone solution with 50 ml 1% solution of Lidocaine was injected through the tube, the tube was blocked, and the exposure was 2 hours. The patient changed the body position every 30 minutes: on the right and left sides, on the back, and on the belly. Then the drainage was opened and pleuroscerosant was removed from the pleural cavity.

Safety of CP with iodopovidone was assessed by the following indicators: pain syndrome according to visual analogue scale (VAS), pulse, blood pressure, temperature response. Non-steroidal anti-inflammatory drugs were used for pain, and pyrolytic effect was achieved by taking 500 mg of paracetamol. The effectiveness of CP was assessed immediately after the surgical intervention, as well as on the basis of the patients' follow-up. Control examinations were performed 1 month after discharge, then after 3 and 6 months, with follow-up every year. In addition to CP, patients received drug therapy. Control was performed radiologically and clinically.

Results

Statistical data processing was performed using IBM SPSS Statistics 28.0 program.

According to the above classification of pneumothorax, out of 115 patients, 91 cases (79.1%) had CP, 21 cases (18.3%) had traumatic pneumothorax, and 3 cases (2.6%) had iatrogenic pneumothorax. Of 91 patients with SP, 79 (86.8%) had PSP, 12 patients (13.2%) had SSP. The total number of hospital admissions was 136, as 21 of 115 patients (25.2%) had recurrence, with 18 cases (85.7%) of recurrent pneumothoraxes being from CP, and 3 cases (14.3%) from traumatic pneumothorax. The cases of recurrent pneumothorax with traumatic cause are most likely related to the initial presence of bullous lung disease.

Diagnostic thoracoscopy was performed when the patients' condition was relatively satisfactory; the number of these patients was 30 (26,1%), in 16 (53,3%) of them the presence of bullas was revealed, in 14 (46,7%) the cause of pneumothorax was unknown. The indications for thoracotomy were: the presence of bullas, bronchopleural fistula and absence of tendency to its independent closure, turbid discharge from the drain against the background of continuous air leakage. Thoracotomy was performed in 51 cases (44.3%) out of 115 patients, the volume of the operation was dissection and suturing of bullas, suturing of bronchopleural fistulas as well as treatment of pleural cavity with 10% iodopovidone solution in 23 patients (53.5%). Thus, out of the total number of patients (115) CP was performed in 53 cases (46.1%). The main results of CP with iodopovidone are presented in Table 1.

Table 1
 MAIN RESULTS OF IODOPOVIDONE AS A PLEUROSCLEROSANT IN PNEUMOTHORAX

<i>Name of group</i>	<i>Total number of patients</i>	<i>Number of recurrent pneumothorax</i>	<i>Thoracotomy with excision and suturing of bullas</i>	<i>Postoperative air leakage</i>
Control group	62 (53,9%)	21 (33,9%)	28 (45,2%)	3 (10,7%)
Test group	53 (46,1%)	0	23 (43,4%)	0
Total number	115	21 (18,3%)	51 (44,3%)	3 (2,6%)

The test group included patients who underwent CP with iodopovidone, in 30 (56,6%) the procedure was performed through a drainage tube, and in 23 (43,4%) as a final step during thoracotomy. In the control group the number of pneumothorax recurrences was 21 (33,9%) after pleural cavity drainage, in the test group no recurrences were registered ($p < 0,05$), air leakage via drainage after thoracotomy was noted in 3 cases (10,7%), no such complications were noted in patients after leaflet treatment with iodopovidone ($p < 0,05$).

The safety of CP with iodopovidone was assessed by hemodynamic, temperature, and VAS pain scores, and the results are shown in Table 2.

Table 2
 HEMODYNAMIC, BODY TEMPERATURE AND PAIN SCORES
 IN PATIENTS WHO UNDERWENT CP

<i>Indicator</i>	<i>Baseline value</i>	<i>Indicators after (first 24 hours)</i>	<i>Indicators after (24-48 hours)</i>
Pulse rate	75,1±8,9	76,2±7,4	74,8±4,3
Systolic blood pressure, mm Hg	117,1±8,3	117,2±7	115,4±7,2
Body temperature	36,6±0,1	36,8±0,3	36,6±0,1
Pain by VAS	0,3±0,1	2,1±1	0,4±0,5

Analysis of statistical data shows that CP with iodopovidone statistically reliably ($p < 0,05$) does not cause changes in hemodynamic parameters (pulse, BP), body temperature significantly increased within 24 hours after the injection of pleurosclerosant ($p > 0,05$), but comes to the initial value during the next day ($p < 0,05$). Pain reaction after the procedure was considered to be mild, also the pain syndrome leveled off within 24-48 hours ($p < 0,05$).

Conclusions

1. The recurrence rate, after the first episode of pneumothorax, is 33.9%, which corresponds to the literature data. Also recurrence can occur after the traumatic nature of pneumothorax, which

is the result of bulla rupture as a result of trauma;

2. CP with iodopovidone can be used as a prevention of recurrence by its administration through a drainage tube, and as a final step during thoracotomy. In the first case, the number of recurrences, statistically significantly ($p < 0.05$) decreased to 0, and in the second case, pleural leaflet treatment eliminated postoperative air leakage ($p < 0.05$);

3. Application of CP with iodopovidone was an effective method to achieve postoperative tightness;

4. Pleurodesis with iodopovidone is a safe method, as it does not cause statistically significant changes in hemodynamic parameters (pulse, BP) $p > 0,05$. Considering that the main mechanism of pleural obliteration is an inflammatory process, after the injection of the chemical agent there was a temperature reaction and pain syndrome, which statistically reliably came back to normal within 48 hours.

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