

Spontaneous pneumothorax in women. Team approach of thoracic surgeons and gynecologists

V. V. Tkalich¹, Yu. V. Nedilia¹, V. I. Borysova¹, O. V. Galiiev¹, S. I. Savoliuk²

¹Kyiv City Hospital № 17

²Shupyk National Healthcare University of Ukraine, Kyiv

The objective: to implement the non-intubated treatment of pneumothorax in women and its inclusion in the protocol of Enhanced Recovery After Surgery (ERAS).

Materials and methods. Surgical treatment using non-intubated video-assisted thoracic surgery (NIVATS) in 30 women with an average age of 38.56 ± 11.32 years (18–69 years) with spontaneous pneumothorax was analyzed. Most of the patients had a first episode of pneumothorax (90%), 3 people had a recurrent episode.

All patients were operated by the method of non-intubated uniportal video-assisted thoracic surgery (NI-UVATS) with thoracic epidural anesthesia (TEA) as the main method of analgesia in the postoperative period. The average time to surgery was 1.5 days (0–5 days).

Pathohistological studies confirmed the etiology of pneumothorax: bullous disease, thoracic endometriosis. Patients with confirmed thoracic endometriosis were referred to a gynecologist for consultation. The observation period was 48 months.

Results. All patients underwent operative treatment and were satisfied with the NIVATS operation. The level of pain intensity according to the visual analogue scale was 1–2 points. The recurrence rate after NI-VATS surgery was 6.7% (2 patients) with confirmed thoracic endometriosis during the use of combined estrogen and progesterone hormone pills, the recurrences occurred after stop of hormonal treatment.

Conclusions. Non-intubated video-assisted thoracic surgery for spontaneous pneumothorax in women can be considered a safe and effective treatment and as part of enhanced recovery after surgery (ERAS). Long-term follow-up and further clinical studies are needed to confirm the benefits of the proposed approach.

Keywords: catamenial pneumothorax, diaphragmatic endometriosis, spontaneous pneumothorax, non-intubated video-assisted thoracic surgery, video-assisted thoracoscopic surgery, enhanced recovery after surgery.

Спонтанний пневмоторакс у жінок. Командний підхід торакальних хірургів та гінекологів В. В. Ткалич, Ю. В. Неділя, В. І. Борисова, О. В. Галієв, С. І. Саволіук

Мета дослідження: впровадження неінтубованого лікування пневмотораксу у жінок і включення його до протоколу прискореного відновлення після операції (Enhanced Recovery After Surgery – ERAS).

Матеріали та методи. Проаналізовано хірургічне лікування за допомогою неінтубованої відеоасистованої торакальної хірургії (non-intubated video-assisted thoracic surgery – NIVATS) у 30 жінок середнього віку $38,56 \pm 11,32$ року (18–69 років) зі спонтанним пневмотораксом. У більшості з них був перший епізод пневмотораксу (90%), у 3 осіб – рецидивний.

Усі пацієнтки були прооперовані методом неінтубованої однопортової відеоасистованої торакальної хірургії (non-intubated uniportal video-assisted thoracic surgery – NI-UVATS) з торакальною епідуральною анестезією (TEA) як основним методом знеболювання у післяопераційний період. Середній час до операції становив 1,5 доби (0–5 днів).

Патогістологічними дослідженнями підтверджена етіологія пневмотораксу: бульозна хвороба, торакальний ендометріоз. Пацієнтки з підтвердженим торакальним ендометріозом направлені на консультацію до гінеколога. Термін спостереження становив 48 міс.

Результати. Усі пацієнтки пройшли оперативне лікування та залишилися задоволені операцією NIVATS. Інтенсивність болю за візуальною аналоговою шкалою становила 1–2 бали. Частота рецидивів після операції NIVATS становила 6,7% (2 пацієнтки) з підтвердженим торакальним ендометріозом під час використання комбінованих естроген- та прогестеронгормональних таблеток, після припинення вживання яких у них виник рецидив.

Висновки. Неінтубовану відеоасистовану торакальну хірургію спонтанного пневмотораксу у жінок можна вважати безпечним та ефективним методом лікування та як частину прискореного відновлення після операції (ERAS). Для підтвердження переваг запропонованого підходу необхідні тривале спостереження та подальші клінічні дослідження.

Ключові слова: катаменіальний пневмоторакс, ендометріоз діафрагми, спонтанний пневмоторакс, неінтубована відеоасистована торакальна хірургія, відеоасистована торакаоскопічна хірургія, прискорене відновлення після операції.

Spontaneous pneumothorax in women is a rare condition and accounts 1,2–6/100 000 per year [1]. The history of treatment of pneumothorax started from conservative treatment (observation), needle aspiration and thoracic drain. After failure of these methods surgery in the way of thoracotomy was established. The era of modern technology switched open thoracic procedures to less invasive

Video Assisted Thoracic Surgery (VATS) and progress and deep understanding of anesthesia gave the possibility to do VATS procedures in non-intubated manner (NIVATS).

The objective: of our study was to implement non-intubated treatment of pneumothorax in women and to make it a part of Enhanced Recovery After Surgery (ERAS) protocol.

MATERIALS AND METHODS

This is a retrospective study which was done in Kyiv City Hospital № 17, polytrauma department from a period of 2017–2023 years. 30 women with spontaneous pneumothorax were included in this study.

The inclusion criteria were: age > 18 years, incidence of spontaneous pneumothorax (1st episode or recurrence).

The study was performed according to all bioethical norms and written consent was obtained from patient.

There is no conflict of interest and financial support in our study.

The diagnosis of pneumothorax was confirmed on chest X-ray (CXR) after admission or computer tomography (CT) if it was done in another hospital. Un patients with the urgent need for chest decompression thoracoscopy was performed under local anesthesia with the aim to examine the lung and diaphragm surfaces. Before the operation chest and abdomen CT and only necessary blood tests (Hb, blood type and Rh-factor, coagulation tests) were performed.

Thoracoscopy was performed under local anesthesia in medial axillary line in th 4–5th intercostal. Thoracoscopic findings: the degree of lung collapse of the initial volume was investigated and was 1/3 to 1/2, in 15 cases small apical blebs and in 10 cases brown spots on tendinous part of the diaphragm suspicious for endometriosis, in 2 cases pleural adhesions were found.

All patients were examined by an anesthesiologist before surgery. Anesthetic risk of surgery (ASA status of patients was I–II), Mallampati score was I, body mass index (BMI) less than 20 kg/m² and physical status were checked. Anesthetic protocol was explained to the participants before surgical procedure and the informed consent was obtained.

Demographic and clinical patient characteristics: age 38.56 ± 11.32 years, weight 56.2 ± 9.3 kg, BMI

20.01 ± 2.39 kg/m², Mallampati score I – 93,4%, II – 6.6%, ASA anesthetic risk for surgery I – 90%, II – 10% (Table).

The indications for surgery were 1st episode of spontaneous pneumothorax in 27 patients (90%), the recurrence of pneumothorax in 3 patients (10%).

Surgical technique

All patients were operated on the lateral decubitus position, with gel positioners and use of forced air warming system (3M, Bair Hugger) during the whole perioperative period using a combination of intravenous anesthesia with spontaneous ventilation and thoracic epidural anesthesia (TEA). A uniportal approach in the 4–5th intercostal space was applied, wound protector SurgiSleeve XS (Covidien, USA) was inserted. After that a Hopkins II 10 mm 30 degree (Storz) thoracoscope was put in the wound and chest cavity was examined: thoracic wall, diaphragm, mediastinum and lung.

Wedge resection of small apical blebs or bullectomy was done with Endo GIA universal stapler (Covidien, USA) with Tri-Staple purple loading units. Resection of fenestrations or pores on the surface of diaphragm, its the tendinous part was done, and sewn with 2–0 Prolene and central tendinous part of the diaphragm was augmented with Prolene mesh. Mechanical pleurodesis was performed with tip cleaner from the apex to the diaphragm. Hemostasis and air leak were checked at the end of operation, wound protector was removed and 18 Fr chest tube (Balton, Poland) was introduced under direct visual control through the same incision under direct camera visualization. We didn't observe any surgical complications.

Administration of anesthesia

Non-intubated thoracoscopic surgeries anesthetic protocol was performed with TEA and intravenous addition of drugs (dexmedetomidine, propofol and fentanyl).

In the operating room after intravenous rehydration with Sterofundin (B-Braun) TEA was performed in the sitting position at the level of T5 – T6 interspace. Spontaneous breathing was preserving with the speed (6–8 ml/h) of bupivacaine hydrochloride 0,25% continuous infusion. T2–T10 level of anesthesia was achieved. Lateral decubitus positioning of the patient for surgery was the next step.

Anesthesia monitoring included non-invasive blood pressure measurement, pulse oximetry, measurement of respiratory rate, electrocardiogram, BIS (bispectral index), and capnography (the detector was attached to the oxygen mask) During the surgery, oxygen supply (FiO₂ 0,4–0,5 and oxygen flow 7–10 L/min) was maintained through a non-rebreathing mask.

The patients didn't have a premedication before the operation. But, in 1 case intravenous injection of Midazolam 5 mg was used to eliminate anxiety and discomfort of the patient. Sterile prepping and draping of the site of surgery were done. Additional local anesthesia with 0,25% bupivacaine hydrochloride 20 ml of the sites of surgical incisions was performed.

The induction dose of dexmedetomidine 1 µg/kg was started for 20 minutes after lateral decubitus positioning of the patient, with further infusion 0,7 µg/kg/h and stopped at the end of pleural abrasion. The depth of anesthesia was under BIS monitor control at the range 40–60 and was

Surgical and anesthetic results: are presented (n = 30)

Variable	Data
Surgical duration (min)	79.7 ± 32.3
Peak EtCO ₂ during operation (mmHg)	49.85 ± 3.69
Peak EtCO ₂ after operation (mmHg)	35.94 ± 1.35
Lowest SpO ₂ during operation (%)	94.1 ± 1.20
Lowest SpO ₂ after operation (%)	98.1 ± 1.7
Conversion to thoracotomy (%)	0 (0%)
Total blood loss (ml)	13.0 ± 12.3
Intraoperative mean arterial pressure (mm Hg)	83.7 ± 21.3
Volume of fluid administration (ml/kg/h)	17.6 ± 7.3
Postoperative pain, visual analogue scale (VAS) scale (0–10 points)	1.8 ± 0.7
Time to the 1st meal after surgery (hours)	0,5–1
Admission time of patients to normal activity (hours)	2–3
Chest drainage (days)	3.56 ± 0.27
Complications	
Air leak > 5 days	2/30 (6.7%)
Recurrence rate of pneumothorax	2 (6.7%)
Mortality	0 (0%)
Follow-up period (months)	48.2 ± 3.9

maintained with fentanyl and propofol continuously infusion at the rate $2 \pm 0,8 \mu\text{g}/\text{kg}/\text{h}$ and $3,5 \pm 1,1 \text{ mg}/\text{kg}/\text{h}$ respectively. The systolic blood pressure and mean arterial pressure were and $108,8 \pm 28,9 \text{ mm Hg}$ and $79,7 \pm 21,4 \text{ mm Hg}$ respectively. Normal capnography parameters and adequate oxygen saturation were observed.

Intraoperatively to reduce coughing area of phrenic and vagus nerves, surface of the lung was sprayed with 20 ml of 0,25% bupivacaine hydrochloride.

After surgery, the patients didn't require stay in ICU (intensive care unit) and with adequate breathing, in conscious and fully awake and were returned directly to the initial department. The pain intensity in postoperative period was assessed according to VAS (1–10 points) and was 0–1 score. Postoperative pain management was obtained with Dexketoprofen 50 mg on demand of day and continuous TEA. We didn't observe any anesthesia complications.

Postoperative period

$3.4 \pm 1,85$ days was the median time of chest drain stay. Lung expansion was confirmed on CXR and chest drain was removed. After chest drain removal the epidural catheter was took off.

1 patient have a prolonged air leak for a period of 6 days.

The patients were discharged on the next day for ambulatory treatment.

After discharge we restrict patients for physical activity and flight for a period of 1 month. In the future their childbirth could be in physiological delivery. C-section is done only for obstetric reasons.

RESULTS AND DISCUSSION

Among 30 patients 27 had a 1st episode of pneumothorax, 3 patients had a recurrence episode: 2 patients had 2nd episode, 1 patient – 4th episode. 3 patients with recurrence had their episodes of pneumothorax treated not in our department and all were. All patients undergone surgical treatment and were satisfied NI-uVATS surgery. According to the time frames of catamenial pneumothorax (CP) (7 days before and after menses) 15 patients had a CP. After pathohistological and immunohistochemical examination 8 patients had catamenial not endometriosis-related pneumothorax (bullous lung disease pathologically confirmed), 7 patients had catamenial endometriosis-related. All patients with confirmed diagnosis of thoracic endometriosis had a consultation of gynecologist. Before thoracic surgery any woman doesn't have a diagnosis or treatment of endometriosis. Abdominal ultrasound was done and revealed foci of suspicious for endometriosis in 2 patients in pelvis. In 3 patients systemic oral progestogen pills Dienogest (Visanne®) were prescribed, another 4 had an observation without any pills. No patients were prescribed the 2nd line hormonal therapy of Gonadotropin Releasing Hormone (GnRH) analogues. MRI of the thoracic abdominal cavity and pelvis was done in 2 patients. MRI showed endometrial cysts in 2 patients with confirmed thoracic endometriosis.

Another 15 patients had a pathohistological confirmation of bullous lung disease.

The observation period was 48 months. The recurrence rate after NI-UVATS surgery was 6.7% – 2 patients with confirmed thoracic endometriosis on Dienogest pills, after

stopping of them 6 months after treatment, had a recurrence.

For a long time it was only British Thoracic Society guidelines for treatment of spontaneous pneumothorax (2010, 2018, 2023 years) [2]. According to these guidelines the indications for surgery were tension pneumothorax, second ipsilateral pneumothorax, first contralateral pneumothorax, synchronous bilateral pneumothorax, persistent air leak, professions at risk, pregnancy.

In the whole world each hospital try to establish protocols/program to minimize LOS (length of stay), ICU time, and to give patients more satisfaction from his surgical journey.

In 1994 R.M. Engelman proposed a concept of fast-track surgery, which was later followed by H. Kehlet (1995, 1999) and Enhanced Recovery After Surgery (ERAS) project was initiated in 2000 [3]. Nowadays almost every surgical specialty is working on establishing ERAS protocols in their field (Thoracic 2019, Obstetrics and Gynecology 2018, 2019, 2023) [4, 5].

Fast track concept in time of treatment of spontaneous pneumothorax was proposed in 2003 year in articles of Chou, S. H. [6] and Margolis, M. [7], who performed surgery for spontaneous pneumothorax within 12 h after admission and on the next day.

ERAS guidelines propose evidence-based medical knowledge and combine multimodal approach with the aim of giving high quality medical care.

According to ERAS guidelines most of the recommendations were accepted and adopted. In preoperative period patients had all information about their surgery, anesthesia technique, goals of surgery and estimated LOS. All this information increase patient satisfaction, decrease anxiety and misunderstanding, friends and relatives were included in recovery process.

Patients, who's condition was not critical for performing tube thoracostomy/thoracoscopy just now, where informed about the possibility to do a radical surgical intervention without thoracoscopy before this day or on the next.

Anesthesiology check: ASA -status, explain to patient the anesthesia protocol of non intubated technique (BIS monitor control), TEA its role and necessity. The last meal was allowed 6h and drink 2h before the time of surgery.

In females the causes of spontaneous pneumothorax are thoracic endometriosis, bullous lung disease and lymphangiomyomatosis. The combination of thoracic endometriosis with bullous lung disease was revealed in 5 cases in our study.

The prevalence of the endometriosis in the world population reaches 11 %, extragenital forms accounts for 12% of them have. Thoracic endometriosis is one of the extragenital form of endometriosis and it can be an independent disease in thoracic cavity. Thoracic endometriosis syndrome (TES) is a clinical manifestation of endometrial tissue growth inside or near the lung [8]. TES includes: catamenial pneumothorax, catamenial haemothorax, catamenial haemoptysis, catamenial chest pain, pulmonary nodules.

The diagnosis of TES in 2/3 of patients is based on clinic and pathohistological examination. The diagnosis of CP is based on the anamnesis of menses, while endometrial or not – on pathohistological examination [9].

The time frames of CP vary from 24 hours before menstruations until 72 hours after their beginning, and up to 7 days before and after menses according to the literature.

The peak of pelvic endometriosis is found at period of 24-29 years, thoracic endometriosis – 5 years later [10]. CP can occur in right, left and both sides [11].

Recurrence following spontaneous pneumothorax is a frequent concern and overall occurs in 32% of patients after a single episode.

18.9±27.0 months is the mean interval time for diagnosis of thoracic endometriosis after the 1st episode of pneumothorax. The 1st episode of pneumothorax according to the British Thoracic Surgery Guideline for pleural disease (2023) the 1st episode of pneumothorax is treated conservatively observation or chest drain. In our practice thoracoscopy under local anaesthesia was established and performed in the 1st episode of pneumothorax with the aim to investigate possible changes in pleural cavity (chest wall, diaphragm, lung). There is no definitive way of CP treatment: surgical, hormonal or combined treatment.

The recurrence rate after surgical treatment of CP is 8–40% in 4 years, after hormonal treatment – 60% in 1 year. Some authors suppose that combination of surgical and hormonal treatment may have better results [12].

Nowadays the approaches and time of surgical intervention of diaphragm endometriosis treatment remains controversial?

The approaches are becoming less invasive: uniportal VATS has changed open thoracotomy approach in majority of cases. The debates about the time of surgery supposed that surgical treatment during menses is feasible and of enhance visualization of endometriotic lesions [13].

During surgery of CP diaphragmatic lesions could be found in 38,6%, visceral pleura endometriosis – in 29,6%, bullae – in 23,1% and no pathology – in 8,5% of cases [14].

One lung ventilation (OLV) is a gold standard for almost all thoracic surgeries but the interest to alternative methods of anaesthesia is constantly growing.

A minimally invasive surgical approach was demonstrated to be superior in shortening the length of stay in hospital, less postoperative pain, improving postoperative lung function and reducing overall morbidities and mortalities after surgery [2].

In the early 2000s, the Awake Thoracic Surgery Research Group at the University of Tor Vergata in Rome started the investigation and implementation of thoracic surgery under spontaneous ventilation without general anaesthesia. Since that date over 5,000 operations have been successfully carried out around the world [15]. Strict surgical and anaesthesiological non-intubated VATS indications and contraindications were developed during investigation period.

Over the last 20 years a lot of thoracic surgeries were performed in the non-intubated VATS technique and showed safety in comparison to standard intubated VATS. Non intubated anesthesia eliminated adverse effects of intubated anesthesia: intubation-associated respiratory trauma, ventilation-induced lung injury, residual neuromuscular blockade, and postoperative nausea and vomiting [16–18]. H. Knoll et al. found that 44% of patients after using double lumen tubes has complained on hoarseness after

surgery [19].

Spontaneous breathing, sedation and adequate analgesia can be maintained with the combination of TEA and intravenous anesthesia. The prevention of respiratory depression and ventilation disorders can be reduced with the add of dexmedetomidine to the propofol and fentanyl anesthesia strategy.

All pathological specimens should undergo immunohistochemical examination; CD 10 markers, progesterone and estrogen receptors for endometriosis confirmation and HMB 45 or lymphangiomyomatosis [20].

Computer tomography and MRI are useful diagnostic tools for many surgical and therapeutic pathologies. CT is the first diagnostic modality in the investigation of pneumothorax in women. It's poorly specific but it can rule out other diagnoses and map the indications for surgery if necessary. CT findings can be haemothorax, haemopneumothorax, diaphragm herniation, nodules (endometrial) on the diaphragm, pneumoperitoneum [21]. In combination with history of disease CT findings could be suspicious for thoracic endometriosis syndrome diagnosis. MRI for diaphragm endometriosis diagnosis has a sensitivity 78–83% among 23 women who were studied and has no value if there are only pores (fenestres) in the diaphragm [22].

Hormonal treatment varies and is controversial till nowadays among gynecologists [23].

Evidence based studies of thoracic endometriosis surgical treatment are controversial. In the works of A. C. Leong et al. (2006) [23], S. Attaran et al. (2013) [24], S. M. Hwang et al. (2015) [25], after surgical treatment alone had a recurrence rate in 100% of cases. P. Ciriaco et al. (2009) [26], in surgical treatment + oestrogen–progesterone therapy had a recurrence rate 100%. S. Attaran et al. (2013) [24], S. M. Hwang et al. (2015) [25] in surgical treatment + GnRH therapy for 6 months had a 0% recurrence rate. D. Subotic et al. (2016) [27] after surgical treatment alone had a recurrence rate in 100% of cases. All series had a small amount of patients from 4 to 10 patients [24–28].

In one of the last review of M. Tang et al. which compare the efficacy of dienogest and GnRH-a after endometriosis surgery there were no differences, but dienogest is better in postoperative recurrence [29]. Some studies propose combined hormonal treatment of genital endometriosis with oral contraceptive pills and GnRH therapy [30].

Prolonged follow-up and further clinical investigations are required to choose the optimal hormonal treatment after thoracic surgery of catamenial pneumothorax.

CONCLUSIONS

1. NIVATS technique can be a part of ERAS (Enhanced Recovery After Surgery) in thoracic surgery in the treatment of primary spontaneous pneumothorax in women in addition to early mobilization (2 hours after surgery), less pain (TEA and multimodal analgesia, VAS 1.8 ± 0.7 points), lower recurrence rates of pneumothorax (6,7%).

2. Multidisciplinary approach: thoracic surgeons, gynecologist, radiologist, pathologist is more favorable for better results.

Conflicts of interest: authors have no conflict of interest to declare.

Information about the authors

Tkalich Vasyly V. – MD, PhD, Kyiv City Hospital № 17; tel.: (093) 346-33-06. *E-mail: airmj23@ukr.net*

ORCID: 0000-0001-7696-8403

Nedilia Yurii V. – MD, Kyiv City Hospital № 17. *E-mail: nedilyay@ukr.net*

ORCID: 0009-0005-5860-3204

Borysova Valentyna I. – MD, Kyiv City Hospital № 17. *E-mail: v-borisova@ukr.net*

ORCID: 0009-0009-2999-4196

Galiiev Oleksandr V. – MD, Kyiv City Hospital № 17. *E-mail: galiiev@ukr.net*

ORCID: 0009-0006-5634-5704

Savoliuk Sergii I. – MD, PhD, DSc, Professor, Shupyk National Healthcare University of Ukraine, Kyiv. *E-mail: savoluk@meta.ua*

ORCID: 0000-0002-8988-5866

Відомості про авторів

Ткаліч Василь Васильович – канд. мед. наук, Київська міська клінічна лікарня № 17; тел.: (093) 346-33-06. *E-mail: airmj23@ukr.net*

ORCID: 0000-0001-7696-8403

Неділя Юрій Вячеславович – Київська міська клінічна лікарня № 17. *E-mail: nedilyay@ukr.net*

ORCID: 0009-0005-5860-3204

Борисова Валентина Іванівна – Київська міська клінічна лікарня № 17. *E-mail: v-borisova@ukr.net*

ORCID: 0009-0009-2999-4196

Галієв Олександр Владиславович – Київська міська клінічна лікарня № 17. *E-mail: galiiev@ukr.net*

ORCID: 0009-0006-5634-5704

Саволук Сергій Іванович – д-р мед. наук, проф., Національний університет охорони здоров'я України імені П. Л. Шупика, м. Київ. *E-mail: savoluk@meta.ua*

ORCID: 0000-0002-8988-5866

REFERENCES

- Hallifax RJ, Goldacre R, Landray MJ, Rahman NM, Goldacre MJ. Trends in the Incidence and Recurrence of Inpatient-Treated Spontaneous Pneumothorax, 1968-2016. *JAMA*. 2018;320(14):1471-80. doi: 10.1001/jama.2018.14299.
- Roberts ME, Rahman NM, Maskell NA, Bibby AC, Blyth KG, Corcoran JP, et al. British Thoracic Society Guideline for pleural disease. *Thorax*. 2022;78(3):1-42. doi: 10.1136/thorax-2022-219784.
- Ljungqvist O, Scott M, Fearon KC. Enhanced Recovery After Surgery: A Review. *JAMA Surg*. 2017;152(3):292-8. doi: 10.1001/jamasurg.2016.4952.
- Batchelor TJP, Rasburn NJ, Abdelnour-Berchtold E, Brunelli A, Cerfolio RJ, Gonzalez M, et al. Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS®) Society and the European Society of Thoracic Surgeons (ESTS). *Eur J Cardiothorac Surg*. 2019;55(1):91-115. doi: 10.1093/ejcts/ezy301.
- Nelson G, Bakkum-Gamez J, Kalogera E, Glaser G, Altman A, Meyer LA, et al. Guidelines for perioperative care in gynecologic/oncology: Enhanced Recovery After Surgery (ERAS) Society recommendations-2019 update. *Int J Gynecol Cancer*. 2019;29(4):651-68. doi: 10.1136/ijgc-2019-000356.
- Chiu HY, Ho YC, Yang PC, Chiang CM, Chung CC, Wu WC, et al. Recommendation for management of patients with their first episode of primary spontaneous pneumothorax, using video-assisted thoracoscopic surgery or conservative treatment. *Sci Rep*. 2021;11(1):10874. doi: 10.1038/s41598-021-90113-w.
- Tulay CM, Yaldiz S. Video-Assisted Thoracoscopic Surgery for the First Episode of Primary Spontaneous Pneumothorax. *Indian J Surg*. 2021;83:206-10. doi: 10.1007/s12262-020-02362-0.
- Fukuda S, Hirata T, Neriishi K, Nakazawa A, Takamura M, Izumi G, et al. Thoracic endometriosis syndrome: Comparison between catamenial pneumothorax or endometriosis-related pneumothorax and catamenial hemoptysis. *Eur J Obstet Gynecol Reprod Biol*. 2018;225:118-23. doi: 10.1016/j.ejogrb.2018.04.021.
- Visouli AN, Zarogoulidis K, Kougioumtzi I, Huang H, Li Q, Dryllis G, et al. Catamenial pneumothorax. *J Thorac Dis*. 2014;6(4):448-60. doi: 10.3978/j.issn.2072-1439.2014.08.49.
- Topbas Selcuki NF, Yilmaz S, Kaya C, Usta T, Kale A, Oral E. Thoracic Endometriosis: A Review Comparing 480 Patients Based on Catamenial and Noncatamenial Symptoms. *J Minim Invasive Gynecol*. 2022;29(1):41-55. doi: 10.1016/j.jmig.2021.08.005.
- Ciriaco P, Muriana P, Lembo R, Carretta A, Negri G. Treatment of Thoracic Endometriosis Syndrome: A Meta-Analysis and Review. *Ann Thorac Surg*. 2022;113(1):324-36. doi: 10.1016/j.athoracsur.2020.09.064.
- Campisi A, Ciarrocchi AP, Grani G, Sanna S, Congiu S, Mazzarra S, et al. The importance of diaphragmatic surgery, chemical pleurodesis and postoperative hormonal therapy in preventing recurrence in catamenial pneumothorax: a retrospective cohort study. *Gen Thorac Cardiovasc Surg*. 2022;70(9):818-24. doi: 10.1007/s11748-022-01802-w.
- Mineo TC, Tamburini A, Perroni G, Ambrogio V. 1000 cases of tubeless video-assisted thoracic surgery at the Rome Tor Vergata University. *Future Oncol*. 2016;12(23):13-8. doi: 10.2217/fon-2016-0348.
- Topbas Selcuki NF, Yilmaz S, Kaya C, Usta T, Kale A, Oral E. Thoracic Endometriosis: A Review Comparing 480 Patients Based on Catamenial and Noncatamenial Symptoms. *J Minim Invasive Gynecol*. 2022;29(1):41-55. doi: 10.1016/j.jmig.2021.08.005.
- Szabo Z, Fabo C, Oszlanyi A, Hawchar F, Géczi T, Lantos J, et al. Anesthetic (r)evolution from the conventional concept to the minimally invasive techniques in thoracic surgery-narrative review. *J Thorac Dis*. 2022;14(8):3045-60. doi: 10.21037/jtd-22-80.
- Shah SB, Hariharan U, Chawla R. Choosing the correct-sized adult double-lumen tube: Quest for the holy grail. *Ann Card Anaesth*. 2023;26(2):124-32. doi: 10.4103/aca.aca.140.22.
- Palaczynski P, Misiolek H, Szarpak L, Smereka J, Pruc M, Rydel M, et al. Systematic Review and Meta-Analysis of Efficiency and Safety of Double-Lumen Tube and Bronchial Blocker for One-Lung Ventilation. *J Clin Med*. 2023;12(5):1877. doi: 10.3390/jcm12051877.
- Zhang X, Wang DX, Wei JQ, Liu H, Hu SP. Recent advances in double-lumen tube malposition in thoracic surgery: A bibliometric analysis and narrative literature review. *Front Med (Lausanne)*. 2022;9:1071254. doi: 10.3389/fmed.2022.1071254.
- Liang J, Liu J, Qiu Z, Sun G, Xiang P, Hei Z, et al. Effect of Esketamine Gargle on Postoperative Sore Throat in Patients Undergoing Double-Lumen Endobronchial Intubation: A Randomised Controlled Trial. *Drug Des Devel Ther*. 2023;17:3139-49. doi: 10.2147/DDDT.S430077.
- Cottin V, Blanchard E, Kerjouan M, Lazor R, Reynaud-Gaubert M, Taille C, et al. French recommendations for the diagnosis and management of lymphangioleiomyomatosis. *Respir Med Res*. 2023;83:101010. doi: 10.1016/j.resmer.2023.101010.
- Rousset P, Rousset-Jablonski C, Alifano M, Mansuet-Lupo A, Buy JN, Revel MP. Thoracic endometriosis syndrome: CT and MRI features. *Clin Radiol*. 2014;69(3):323-30. doi: 10.1016/j.crad.2013.10.014.
- Rousset P, Gregory J, Rousset-Jablonski C, Hugon-Rodin J, Regnard JF, Chapron C, et al. MR diagnosis of diaphragmatic endometriosis. *Eur Radiol*. 2016;26(11):3968-77. doi: 10.1007/s00330-016-4226-5.
- Rolla E. Endometriosis: advances and controversies in classification, pathogenesis, diagnosis, and treatment. *F1000Res*. 2019;8:F1000. doi: 10.126 88/f1000research.14817.1.
- Staring G, Monteiro F, Barracha I, Amorim R. Multi-Loculated Catamenial Pneumothorax: A Rare Complication of Thoracic Endometriosis. *Cureus*. 2021;13(8):e17583. doi: 10.7759/cureus.17583.
- Hwang SM, Lee CW, Lee BS, Park JH. Clinical features of thoracic endometriosis: A single center analysis. *Obstet Gynecol Sci*. 2015;58(3):223-31. doi: 10.5468/ogs.2015.58.3.223.
- Ciriaco P, Muriana P, Lembo R, Carretta A, Negri G. Treatment of Thoracic Endometriosis Syndrome: A Meta-Analysis and Review. *Ann Thorac Surg*. 2022;113(1):324-36. doi: 10.1016/j.athoracsur.2020.09.064.
- Subotic D, Mikovic Z, Atanasijadis N, Savic M, Moskovljevic D, Subotic D. Hormonal therapy after the operation for catamenial pneumothorax - is it always necessary? *J Cardiothorac Surg*. 2016;11(1):66. doi: 10.1186/s13019-016-0462-7.
- Garner M, Ahmed E, Gatiss S, West D. Hormonal manipulation after surgery for catamenial pneumothorax. *Interact Cardiovasc Thorac Surg*. 2018;26(2):319-22. doi: 10.1093/icvts/ivx319.
- Tang M, Yang W, Zhang H. Comparison of the efficacy of dienogest and GnRH-a after endometriosis surgery. *BMC Womens Health*. 2023;23(1):85. doi: 10.1186/s12905-022-02118-w.
- Tolstanova G, Lubkovska O, Gladenko S. Features of the course of genital endometriosis and its recurrence in women of reproductive age. *Reprod Health Women*. 2023;(2):38-42. doi: 10.30841/2708-8731.2.2023.278279.

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