Intercostal lung hernia as a complication of minithoracotomy for transapical valve implantation – a case report

Štefan Lukačin, Tomáš Toporcer, Anton Bereš, Marián Homola, Michal Trebišovský, Adrián Kolesár

Department of Heart Surgery, East Slovak Institute of Cardiovascular Diseases and Medical Faculty, University of Pavol Jozef Šafárik in Košice, Košice, Slovakia

ARTICLE INFO

Article history:
Submitted: 30. 9. 2024
Revised: 9. 10. 2024
Accepted: 14. 10. 2024
Available online: 2. 12. 2024

Kľúčové slová:
Medzirebrová hernia pľúc
Operácia srdca
Transapikálna implantácia chlopne

SÚHRN

Medzirebrová herniácia pľúc je definovaná ako protrúzia pľúcneho tkaniva za normálne hranice hrudnej steny. Prvý prípad pľúcnej hernie opísal v roku 1499 Roland. Pomer získaných a vrodených pľúcnych hernií je 4 : 1. Na základe anatomickej lokalizácie sú známe cervikálne, medzirebrové (interkostálne) a diafragmatické formy pľúcnej herniácie. Rizikovou zónou posttraumatickej a pooperačnej medzirebrovej pľúcnej hernie je v dôsledku slabého svalového krytu predná stena hrudníka. Kazuistika prezentuje 71-ročného muža, ktorý pred 9 rokmi podstúpil aortokoronárny bypass, náhradu mitrálnej chlopne, plastiku trikuspidálnej chlopne a zákrok MAZE. Pred pol rokom ďalej podstúpil transapikálnu implantáciu mitrálnej chlopne. Po implantácii chlopne pacient podstúpil opakovanú pleurálnu punkciu z dôvodu pleurálneho výpotku. Pacient prišiel do nemocnice pre bolestivú rezistenciu v mieste jazvy po torakotómii, ktorá sa zväčšila počas Valsalvovho manévru. Ultrasonografia a počítačová tomografia potvrdili diagnózu medzirebrovej pľúcnej hernie. Bola vykonaná resekcia herniálneho vaku a defekt bol uzavretý implantáciou polypropylénovej sieťky. Pacient bol prepustený v dobrom stave. Transapikálna implantácia chlopne predstavuje unikátnu kombináciu rizikových faktorov pre vznik medzirebrovej pľúcnej hernie ako zo strany pacienta, tak aj zo strany operačného prístupu. Dôsledné sledovanie pacientov za účelom včasnej identifikácie prítomnosti medzirebrovej pľúcnej hernie by malo byť bezpodmienečnou súčasťou pooperačného sledovania pacientov po transapikálnej implantácii chlopne.

Keywords:
Heart surgery
Intercostal lung hernia
Transapical valve implantation

ABSTRACT

Intercostal lung herniation is defined as a protrusion of lung tissue beyond the normal limits of the chest wall. The first case of pulmonary hernia was described in 1499 by Roland. The ratio of acquired to congenital lung hernias is 4 : 1. Based on anatomical localisation, cervical, intercostal, and diaphragmatic forms of lung herniation are known. The risk zone for posttraumatic and postoperative intercostal lung hernia is the front wall of the chest due to the poor muscular cover. The case report presents a 71-year-old man who underwent aortocoronary bypass, replacement of the mitral valve, repair of the tricuspid valve, and the MAZE procedure 9 years ago, as well as transapical implantation of the mitral valve through thoracotomy half a year ago. Repeat pleural puncture due to pleural effusion after valve implantation was needed. The patient came to the hospital because of a painful resistance at the site of the thoracotomy scar which increased during the Valsalva manoeuvre. Ultrasonography and computed tomography confirmed the diagnosis of an intercostal lung hernia. A resection of the hernial sac was performed, and the defect was closed by implanting a polypropylene mesh. The patient was discharged in a good condition. Transapical valve implantation represents a unique combination of risk factors for the formation of an intercostal lung hernia, both from the patient's side and from the operative approach. Consistent monitoring of patients for the purpose of early identification of the presence of an intercostal lung hernia should be an unconditional part of the postoperative monitoring of patients after transapical valve implantation.

Address: Doc. MUDr. Tomáš Toporcer, PhD., Department of Heart Surgery, East Slovak Institute of Cardiovascular Diseases and Medical Faculty, University of Pavol Jozef Šafárik in Košice, Ondavská 8, 04001 Košice, Slovakia, e-mail: topyto@gmail.com
DOI: 10.33678/cor.2024.086

Please cite this article as: Lukačin Š, Toporcer T, Bereš A, et al. Intercostal lung hernia as a complication of minithoracotomy for transapical valve implantation – a case report. Cor Vasa 2024;66:615–619.

Background

Intercostal lung herniation is a very rare diagnosis, with only about 300 case reports in the literature up to 2021.[1–3] It is defined as a protrusion of lung tissue beyond the normal limits of the chest wall.[3,4] The first case of pulmonary hernia was described in 1499 by Roland and corresponded to a supraclavicular hernia.[2,5] According to anatomical localisation, three types of lung herniation are known: cervical, intercostal, and diaphragmatic.[1] In addition, based on the aetiology, Morel-Lavallée classified pulmonary hernias as congenital and acquired.[2,3,6] A thoracic hernia occurs most often posttraumatically or postoperatively, but the literature also describes instances of congenital, spontaneous, and pathological thoracic hernia.[1,4] While congenital hernias arise from a disturbance in embryogenesis and represent only 20% of all hernias, spontaneous hernias are the result of a combination of preexisting weakness and increased strain on the chest wall caused by increased intrathoracic pressure.[1,3,7] Congenital hernias are often associated with costal or cartilage defects, such as rib hypoplasia, intercostal hypoplasia or weak endothoracic fascia.[2] A posttraumatic hernia, most often caused as a result of high-energy trauma during a traffic accident, has a higher incidence compared to postoperative hernias, which occur in the area when the rib cage is broken.[8,9] Most congenital hernias are detected in childhood, but sometimes they may remain asymptomatic and manifest later in life.[6] In the case of posttraumatic and postoperative hernia, the weakness of the thoracic wall is represented by a wound or a scar in the chest wall caused by an injury or surgery. In the past, hernias were most often described after an anterior thoracotomy, but with the development of miniinvasive techniques, hernias are also reported to occur after video-assisted thoracoscopic surgery.[4,10] Finally, in pathological hernias, the weakening of the chest wall is caused by inflammation, neoplasia or by tuberculous osteitis.[1,6] According to the literature, causes of increased intrathoracic pressure include chronic obstructive pulmonary disease (COPD), cough, heavy lifting, vigorous sneezing, the Valsalva manoeuvre, playing a wind instrument, and strength training.[4,5] The literature also lists obesity, chronic steroid use, smoking, and male gender as risk factors.[1,7,10] Rarely, the use of cocaine may also be associated with lung herniation.[5]

Case report

The case report presents a 71-year-old man who underwent aortocoronary bypass, replacement of the mitral valve, repair of the tricuspid valve and the MAZE procedure in our department 9 years before. According to the documentation, no significant complications were recorded during the operation or in the postoperative period. Eight and a half years after the primary operation, the patient was hospitalised for progressive dyspnoea. Coronary examination confirmed the patency of the aortocoronary bypass without the need for further revascularization. Echocardiographic examination showed a severe stenosis of the prosthesis in the position of the mitral valve. Transapical implantation of the mitral valve (valve-in-valve procedure) through minithoracotomy was performed. After transapical valve implantation, the patient underwent repeated left pleural punctures for pleural effusion. The patient was discharged to home care in a good condition. Half a year after transapical valve implantation, the patient was admitted for painful reposable resistance at the site of the thoracotomy scar (**Fig. 1**). The resistance was accentuated during the Valsalva manoeuvre. Physical examination confirmed reposable resistance in the 4th intercostal space, anterior axillary line. An x-ray examination showed no significant pleural effusion, while an ultragraphic examination noted the presence of an anechoic collection with a diameter of 9.5×2.6×3.9 mm located at the site of the thoracotomy scar. During the Valsalva manoeuvre, the collection increased to 19.6 mm. A CT scan also noted the presence of the protrusion/herniation of adipose tissue and lung parenchyma ventrobasally at the site of the thoracotomy scar (**Figs 2, 3**). Due to the symptomatology, the patient was indicated for surgery.

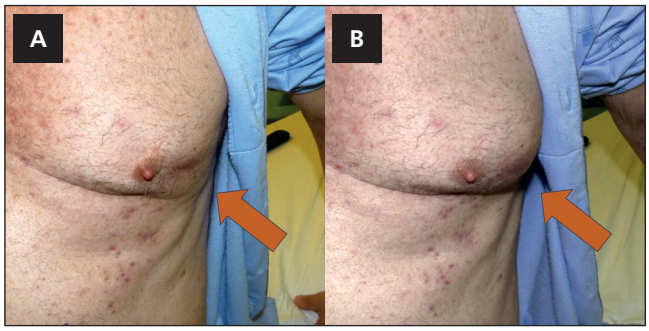

Fig. 1 – Pictures of the patient before surgery (A – during inspiration; B – during the Valsalva manoeuvre; the orange arrows show the scar after thoracotomy for transapical valve implantation).

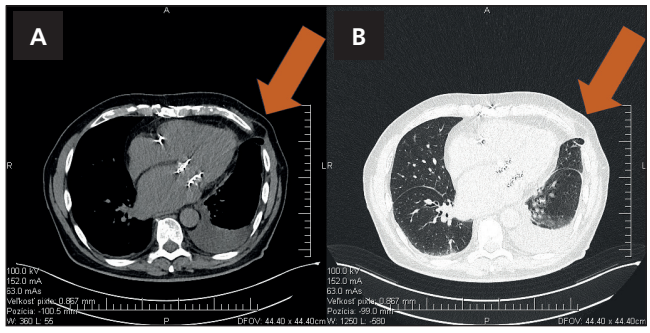

Fig. 2 – Computed tomography (transverse slices) of the patient with lung hernia before surgery (the orange arrows show the sac of the hernia).

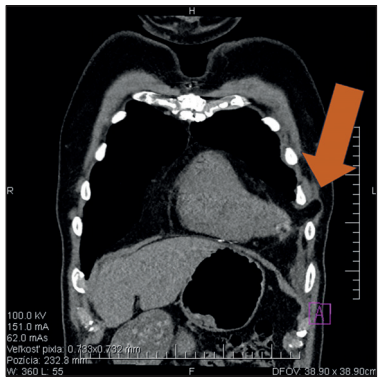

Fig. 3 – Computed tomography, frontal slice with the lung hernia of the patient before surgery (the orange arrows show the sac of the hernia).

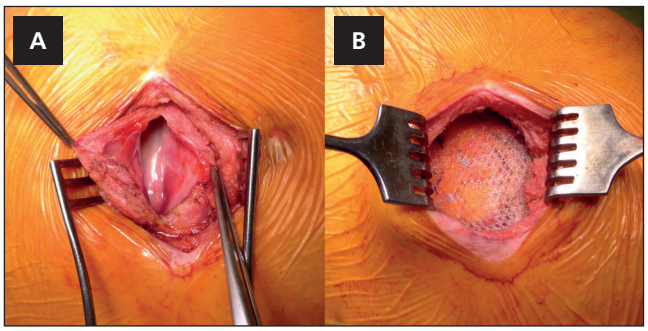

Fig. 4 – Perioperative pictures (A – visualised sac of the hernia; B – implanted mesh).

Thus, following the induction of general anaesthesia after endotracheal tube placement, the patient was situated on his right side. An incision was made in the scar from thoracotomy. The 8×4 cm hernia sac was dissected in the fifth intercostal space (**Fig. 4A**). After incision of the hernia sac, no cancerous contents were found in the sac, only thickened pleura, and 700 mL of serous fluid were aspirated from the pleural cavity. A 20Ch drain was placed in the pleural cavity, and the thoracic fascia around the hernia was then carefully dissected. The hernia sac was resected and a rooflike structure was created, which was then covered with a mesh. The polypropylene mesh was anchored to the periosteum above and below the hernia gate (**Fig. 4B**). A Redon's drain was inserted into the subcutaneous tissue, and suture of the subcutaneous tissue and skin was performed. The postoperative course was without significant complications. On the 16th postoperative day, the patient was discharged to outpatient care in a good condition.

Discussion

As early as 1847, thoracic hernias were described as cervical, thoracic or diaphragmatic and either congenital and acquired.[11] Intercostal lung hernia represents a supermajority of all lung hernias. The most likely localisation is at the 5th, 6th, 7th and 8th intercostal space.[12] The risk zone is a zone of weakness below the pectoralis major muscle, with the external intercostal muscle being reduced to a simple aponeurosis and the internal muscle originating more laterally.[2] From 1968 to 2000, 16 spontaneous hernias were reported, all of which were described as anterior.[11] Brock et al. noted that all spontaneous anterior hernias reported in the literature occurred in men, a third of whom were obese and a half of whom were smokers.[13] The front wall of the chest remains a higher risk area even with posttraumatic or postoperative hernia. A minimally invasive approach is another risk factor for the occurrence of weakness for herniation, especially due to the limited possibility of treating the structures of the intercostal space. From the point of view of cardiac surgery, transapical implantation of the valve fulfils the conditions of a minimally invasive approach, which predisposes it to a higher risk of incidence of this complication. Some authors have described a higher incidence of intercostal lung hernia after video-assisted procedures compared to thoracotomy.[8,10] The most widely used classification of pulmonary hernia is the Morel–Lavellée classification, which differentiates pulmonary hernias based on both localisation and aetiology.[7,14]

Traumatic or postoperative hernias may appear immediately after injury or surgery or be delayed for years.[6] The clinical manifestation of an intercostal pulmonary hernia can vary from an asymptomatic random attack to a relatively dramatic course.[10] Patients often present with a history of cough, pain, and soft swelling or a bulking mass, which may be associated with an overlying crepitus.[5,8] Chest wall ecchymosis and a soft, bulking subcutaneous mass that protrudes from the chest wall and enlarges with the Valsalva manoeuvre, coughing or physical strain is evident upon examination.[7] Palpation reveals a crepitus swelling, often ecchymotic, increased by the Valsalva manoeuvre, often reducible.[2] These symptoms described in the literature were also present in the presented case report. Like abdominal hernias, thoracic hernias can be both symptomatic and asymptomatic, as well as complicated and uncomplicated. The most common complications include incarceration, inflammation, haematoma, rib fracture due to hernia, haemothorax and laceration of the diaphragm, as well as herniation of abdominal organs into the chest cavity.[1]

Differential diagnosis for a palpable mass includes subcutaneous emphysema, bronchopleural fistula, lipoma and the resulting abscess, delayed seroma, cutaneous metastasis or pectoralis major tendo rupture, making a definitive diagnosis somewhat problematic.[2,6,8] Diagnosis of a thoracic hernia is, in addition to the clinical findings themselves and the anamnesis and symptomatology of the patient, most often based on computed tomography (CT), again optimised by the Valsalva manoeuvre.[1,2,15] It shows an aerated, parenchymal, extrathoracic image, with a "lung beyond the rib" sign on the side view and a "lucent lung" sign on the front view and is often associated with subcutaneous emphysema and enlargement of the intercostal space involved.[2] Three-dimensional volume rendering of CT data can provide additional benefits.[4] Thoracic CT optimised by the Valsalva manoeuvre should be a reference radiological examination. This confirms the diagnosis of herniation and its characterisation, including location, size, extent, and content.[2] This method was effectively used in the case study herein presented. Chest CT images may show the herniated lung, the hernia orifice in the chest wall, the hernia sac, as well as their anatomical relationship with the pectoral and intercostal muscles. Multiplanar reconstruction in the axial, sagittal, and coronal planes may be of crucial importance, because they better define the exact localisation and size of the chest wall defect, as well as the dimensions of the herniated lung tissue.[6] It can show possible fractures and costal disjunctions, specify the state of the underlying lung parenchyma and, finally, specify the anatomical relationship with the surrounding structures.[2] Thoracic ultrasound (USG) can be useful in the diagnosis of lung hernias when CT is not immediately available, if the presentation is atypical or if x-ray evaluation is contraindicated.[2] Due to the rapid availability of ultrasound imaging in the conditions of cardiac surgery and cardiology, ultra-

sound examination was used as the first diagnostic method. The examination led to suspicion of the presence of an intercostal hernia, which was subsequently confirmed by CT. USG showed that the aerated lung tissue of the palpable intercostal lump, due to its high acoustic impedance, must be intensively hyperechoic and may cause shadowing.[6] Differential diagnosis is based on different results of imaging methods. Subcutaneous emphysema is usually depicted as multiple subcutaneous radiolucent areas in a plain chest radiography, hyperechogenic subcutaneous regions with dirty posterior shadowing in USG and an air-density subcutaneous region in a chest CT. A bronchopleural fistula in a chest radiograph is recorded as an air-fluid level that typically extends from the pleural cavity to the chest wall. A seroma will be mostly radiopaque in a chest radiograph and a circumscribed water-density area in thoracic CT. In the case of pectoralis major tendo rupture, musculoskeletal ultrasound can demonstrate the loss of continuity of the tendon fibres and the presence of intramuscular haematoma. For identifying injury to the muscle and pectoralis tendo, magnetic resonance imaging (MRI) is the preferred method over CT.[6] Contrary to the low number of case reports that include a diagnosis of thoracic hernia in the literature, a study focused on the identification of thoracic hernias after lung resection found 3 cases in a set of 650 patients.[4] This may mean a significant suboptimal level for this diagnosis, as well as a high incidence of asymptomatic patients with this anatomical constellation.

Spontaneous disappearance of a thoracic hernia is very unlikely. Conservative observational management and nonoperative treatment by thoracic strapping have been described and practiced in the past. Management includes cough medication and thoracic strapping.[9,11] Rarely, some authors have presented the applicable effectiveness of conservative therapy, with several reported symptomatic cases showing successful treatment in this way. Spontaneous resolution of the hernia has even been reported.[5,16] Another group of authors, however, drew attention to the risk of infection and other complications when prolonging attempts at conservative therapy without surgical intervention.[12] Development of respiratory distress and increased pain or size of the herniation accelerate the indication of surgical therapy.[7] Furthermore, as with abdominal hernias, the small size of the hernia represents a higher risk of incarcerated hernia and the development of life-threatening complications.[1,4] In the presented case study, the severity of the hernia was already manifested by pain at the time of diagnosis, which led to an early indication of surgery.

The basic principles of surgical intervention include identification of the hernia, the freeing of all adhesions, repozition of the lung tissue back into the thoracic cavity, elimination of the hernia sac, bringing the ribs closer together and strengthening the intercostal space.[1,4] The literature mentions both the classical approach and thoracoscopic intervention.[1] Video-assisted thoracoscopy can be helpful for localising the hernia sac in the terrain of an obese patient or localising the sac posterior to breast tissue.[8] Other authors prefer to use Vicryl for an approximation of the ribs in the first step.[4] The use of a mesh for stabilisation of the intercostal space is the method of choice mentioned by several authors.[1,4,15] This method is also useful for larger defects with adequate coverage, and no recurrence has been reported.[3] Autologous tissue usage for repair was also reported in the literature.[17] Hernia repair without the use of mesh has also been reported with an acceptable result in the literature.[7] For patients with a higher cardiovascular risk, isolated stabilisation of the intercostal space without massive intervention in the chest cavity is recommended; this was also done in the presented case study.[1]

Conclusion

Transapical valve implantation represents a unique combination of risk factors for the formation of an intercostal lung hernia, both from the patient's side and from the operative approach. Patients undergoing this technique are borderline cardiopulmonary compensated with a high risk of higher intrathoracic pressure postoperatively, due either to cardiac or respiratory decompensation. Surgical access to the front of the chest will only further increase the riskiness of this intervention. Consistent monitoring for early identification of the presence of an intercostal lung hernia should be an unconditional part of the postoperative monitoring of patients after transapical valve implantation. An early indication for surgery allows for a less extensive surgical procedure, which is optimal in this group of high-risk patients. This paper is the first to describe intercostal lung herniation as a complication after transapical valve implantation.

Conflict of interest
The authors declare no conflict of interest.

Funding
This research received no external funding

Ethical statement
The case report was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of East Slovak Institute for Cardiovascular Diseases (protocol code A5062024 and date of approval: 4 June 2024).

Informed consent
Informed consent was obtained from the patient and it is available for the editor.

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