

# The efficacy and economical benefits of blood patch pleurodesis in secondary spontaneous pneumothorax patients



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## Abstract

**Introduction:** Prolonged air leak in secondary spontaneous pneumothorax (SSP) patients remains one of the biggest challenges for thoracic surgeons. This study investigates the feasibility, effectiveness, clinical outcomes, and economical benefits of the autologous blood patch pleurodesis method in SSP.

**Material and methods:** First-episode SSP patients undergoing autologous blood patch pleurodesis for resistant air leak following underwater-seal thoracostomy, between January 2010 and June 2013 were taken into the study. Timing and success rate of pleurodesis, recurrence, additional intervention, hospital length of stay, and complications that occurred during follow-up were examined from medical records, retrospectively.

**Results:** Thirty-one (27 male, 4 female) SSP patients with expanded lungs on chest X-ray and resistant air leak on the 3<sup>rd</sup> post-interventional day were enrolled. Mean age was 53.7 ± 18.9 years (range: 23-81). Twenty-four patients were treated with tube thoracostomy, 2 with pezzier drain, and 5 with 8 F pleural catheter. 96.8% success was achieved; air leak in 29 of 31 patients (93.5%) ceased within the first 24 hours. No procedure-related complication such as fever, pain or empyema was seen. Late pneumothorax recurrence occurred in 4 (12.9%) patients; 1 treated with talc pleurodesis where the other 3 necessitated surgical intervention.

**Conclusions:** Autologous blood patch pleurodesis is a safe, effective, and easily performed procedure with no need of any additional equipment or extra cost. This method can be applied to all patients with radiologically expanded lungs and continuous air leak after 48 hours following water-seal drainage thoracostomy, to reduce hospital stay duration, unnecessary surgical interventions, and the expenses.

**Key words:** autoantigens, blood, pleurodesis, pneumothorax, spontaneous.

## Streszczenie

**Wstęp:** Długotrwały wyciek powietrza u pacjentów z wtórną, samoistną odmą opłucnową pozostaje nadal jednym z największych wyzwań dla chirurgów klatki piersiowej. Prace badawcze mają na celu określenie skuteczności, korzyści oraz powikłań wynikających ze wstrzyknięcia autologicznej krwi do jamy opłucnej (pleurodeza).

**Materiał i metody:** Badania zostały przeprowadzone na grupie pacjentów z wtórną, samoistną odmą opłucnową, którzy w okresie między styczniem 2010 r. a czerwcem 2013 r. przeszli nieefektywną torakotomię, a następnie pleurodezę polegającą na wstrzyknięciu autologicznej krwi do jamy opłucnej. W badaniach uwzględniono retrospektywną analizę dokumentacji medycznej, przebieg czasowy oraz pomyślność zabiegu pleurodezy, nawrót problemu, konieczność dodatkowej interwencji, długość pobytu pacjenta w szpitalu oraz wszelkie komplikacje wynikłe podczas kontynuacji leczenia.

**Wyniki:** Grupa 31 pacjentów z długotrwałym wyciekaniem powietrza spowodowanym wtórną, samoistną odmą opłucnową (27 mężczyzn oraz 4 kobiety) została zakwalifikowana do badania na 3 dni po wykonaniu zabiegu. Średnia wieku pacjentów to 53,7 roku (grupa wiekowa od 23 do 81 lat). Dwudziestu czterech pacjentów leczono za pomocą drenażu opłucnowego, 2 za pomocą cewnika Pezzera, a 5 za pomocą cewnika opłucnowego 8 F. Średni czas między pierwszą interwencją a pleurodezą krwi wyniósł 6,9 dnia (od 4 do 15 dni). Sukces został osiągnięty w 96,8%; wyciek powietrza u 29 z 31 pacjentów (93,5%) ustąpił w ciągu pierwszych 24 godzin, a pacjenci zostali wypisani ze szpitala. U żadnego z pacjentów nie zaobserwowano komplikacji związanych z zabiegiem, takich jak gorączka, ból czy ropniak. Późniejszy nawrót odmy zaobserwowano u 4 pacjentów (12,9%); 1 pacjenta wyleczono za pomocą pleurodezy talkiem, stan 3 pozostałych pacjentów wymagał interwencji chirurgicznej oraz pleurodezy mechanicznej.

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## Introduction

Spontaneous pneumothorax is the presence of air within the pleural space, without any intervention or trauma. Primary spontaneous pneumothorax (PSP) is seen in patients with no previous underlying lung disease. Secondary spontaneous pneumothoraces (SSP) develop in patients with an underlying lung disease or pathology [1].

Persistent air leak seen after SSP or pulmonary resections is one of the most challenging problems in modern thoracic surgery [2]. Despite being a cause for other infective pulmonary complications, prolonged hospital stay or increased expenses, there have been controversies over the optimal treatment of this devastating complication [2, 3]. It has been advised in recent guidelines that SSP patients with persistent air leak on the 48<sup>th</sup> hour after underwater-seal tube thoracostomy should be evaluated by a thoracic surgeon and surgery may be planned after 3 days [4, 5].

After being described by Robinson in 1978 [6] as instillation of someone's own blood into the pleural space, autologous "blood patch" pleurodesis has successfully been used for treating persistent prolonged air leaks after pulmonary resections and in spontaneous pneumothorax patients [7-9].

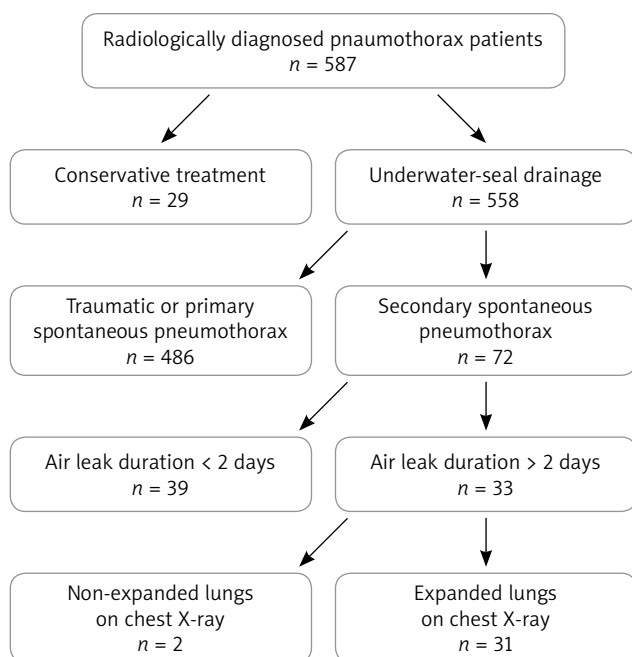


Fig. 1. CONSORT 2010 flow diagram

**Wnioski:** Pleurodeza autologiczną krwią to bezpieczna, efektywna i łatwa do przeprowadzenia procedura, niewymagająca dodatkowego sprzętu czy też kosztów. Metoda ta może być zastosowana w celu skrócenia czasu hospitalizacji i uniknięcia zbędnych interwencji chirurgicznych czy też wydatków u wszystkich pacjentów ze zmianami radiologicznymi płuc oraz ciągłym wyciekaniem powietrza w ciągu 48 godzin po przeprowadzeniu drenażu opłucnej i torakotomii.

**Słowa kluczowe:** autoantygen, krew, pleurodeza, odma samoistna.

In this paper, our clinical outcomes, recurrence rates, and possible economical benefits of patch pleurodesis in SSP patients have been given, with a review of latest literature.

## Material and methods

### Patient selection

All first-episode SSP patients with radiologically expanded lungs but persistent air leak on the 72<sup>nd</sup> hour, despite a properly placed chest tube are included in the study (Fig. 1). After the written informed consent of each patient was given, data files of eligible 31 (9 female, 22 male) out of 587 pneumothorax patients admitted to our clinic between January 2010 and June 2013, were examined retrospectively in terms of primary lung disease, timing and success rate of pleurodesis, recurrence of pneumothorax, hospital length-of-stay (LOS), procedure related complications, and additional interventions required.

### Pleurodesis technique

Blood "patch" pleurodesis was accomplished for all SSP patients with resistant air leak on the 3<sup>rd</sup> day of drainage, prior to any surgical intervention. According to the method described in previous publications [2, 6], 50 cc of blood is drawn from the patient's median cubital or cephalic vein, and injected directly into the chest drain aseptically, without applying any analgesics or sedation. In addition to this method, we injected an additional 50 cc of saline right after the blood, in order to inhibit clotting inside the drain, and ensuring all the blood is kept in the thoracic cavity, as it is recommended in only one paper in the literature [10].

In order to achieve continuous air drainage but keep the injected blood in the thorax, the chest tube line is elevated 40-50 cm above the patient and kept unclamped for 2 hours (Fig. 2). During this period, the patient was asked to change his position in bed every 15 minutes, to attain homogenous distribution of blood within the pleural cavity. Neither antibiotic prophylaxis nor negative suction was applied to any patient.

## Results

Underlying pulmonary disease was tuberculosis (Tbc) in 10 patients, chronic obstructive pulmonary disease (COPD) in 9, bronchogenic carcinoma in 7, COPD + Tbc in 4, and histiocytosis in 1 patient. For underwater seal drainage,

28 French chest tube was used in 21 patients, 24 French tube in 3, 28 French pezzet drain in 2, and 8 French small-bore catheter in 5. Demographic variables of the patients are given in Table I.

Air leak control was established in 29 patients (93.5%) within the next 24 hours, and on the 40<sup>th</sup> hour in one patient. Only 1 patient did not respond to pleurodesis, repeated on the 54<sup>th</sup> hour, and underwent surgical resection of a big ruptured bulla on the 5<sup>th</sup> day after the initial blood instillation. No mortality or intervention-related complication like fever, chest pain, empyema, or acute respiratory distress syndrome (ARDS) was seen after blood pleurodesis. Chest drains of 30 patients (96.8%) were removed within 24 hours of air leak cessation, and were discharged accordingly. Median length of stay after pleurodesis was 1 day.

Late recurrence of pneumothorax was seen in 4 (12.9%) patients, during an average follow-up period of 28.9 months. Mean recurrence time for these patients was  $19.7 \pm 9.8$  months (range: 11.4-29.2). Surgical resection was preferred in 3 patients, where one patient was treated with talc pleurodesis.

## Discussion

There are numerous diseases in the etiology of SSP. The most frequent factor seen is COPD, and it is responsible approximately in 70% of all patients [1, 11, 12]. Airway and parenchymal infections, malignancies, connective tissue or interstitial lung diseases, and thoracic endometriosis causing catamenial pneumothorax can be listed as other underlying factors in SSP patients [11-15]. Secondary spontaneous pneumothorax seen in pediatric patients should bring up the probability of a congenital malformation or a foreign body aspiration [13].

Because of reported mortality rates between 1% and 17%, all patients are recommended to be hospitalized and followed with an underwater seal drainage; advocating a conservative approach has no place in the treatment of SPP [4, 11]. Because of its severity and resistance to tube drainage, SSP is a dreaded clinical condition for thoracic surgeons. Prolonged air leak, commonly seen in these patients, may cause an infection or a venous thrombosis due to immobility, increases the length of stay and the overall hospital costs [6, 9, 12].

Underwater seal tube thoracostomy (TT) is the first-line treatment of choice in the first attack in SSP patients. It has been advocated by many authors and recent guidelines that chemical pleurodesis and/or video-thoracoscopic surgical intervention should be planned for patients with resistant air leak on the 48<sup>th</sup> hour following TT [4, 5, 11, 12, 16]. Recurrence rates of 40-50% have been reported in SSP patients without additional treatment other than TT [11, 14].

It has been shown that SSP patients undergoing surgery for prolonged air leak have a long preoperative hospitalization period between 5 and 21 days [13]. Additionally, despite all the improvements in medical equipment and surgical methods, surgery for SSP still has morbidity of 23-30% and mortality of 5-50% [14-17]. Surgical trauma and



Fig. 2. "Blood patch" pleurodesis application technique

Tab. I. Patient demographics ( $n = 31$ )

Age (years/mean $\pm$ SD)	53.7 $\pm$ 18.9	
Sex (male/female)	27/4	
Primary lung disease	Tbc	10
	COPD	9
	Malignancy	7
	COPD + Tbc	4
	Histiocytosis	1
Drainage technique	8 F catheter	5
	24 F chest tube	3
	28 F chest tube	21
	28 F Pezzet drain	2

COPD – chronic obstructive pulmonary disease, Tbc – tuberculosis

postoperative pain are held responsible for worsening the scenario in presence of an underlying lung disease, with already compromised physiology and lung functions [5, 16].

Pleurodesis by autologous blood has been initially used by Robinson, for treatment of persistent air leak after TT in spontaneous pneumothorax patients [2, 6]. Dumire *et al.* have used the same technique for treating prolonged air leak after pulmonary resections [2, 12]. Recently, this method has widely been used as a treatment of choice for air leaks seen after

lung resection and in primary or secondary SSP patients, in light of numerous researches [2, 3, 5-9, 12]. Autologous blood patch pleurodesis is known to reduce the recurrence rate in SSP patients [8, 9], and has success rates of 73-100% on single admission for prolonged air leak [2, 4, 7, 12].

Aghajanzadeh *et al.* have reported a decreased success rate of blood pleurodesis in patients with air leak duration longer than 10 days; uncovering an indirect correlation between the success rate and timing of pleurodesis [12]. Repeating this technique in unsuccessful cases is shown to end up with a 100% pleurodesis rate [3]. In our series, we have achieved 94% success in 24 hours, and 97% in 48 hours. In our unsuccessful patient, it is thought that the pleurodesis was applied to an overlooked not-expanded lung, thus the “patch” effect did not take place over the lesion site. Additionally, we advise to identify the process “unsuccessful” if the air leak continues for longer than 48 hours, and immediately repeat the procedure.

As advocated by many authors, we also believe that the effectiveness of this technique comes from “patching” of air leak sites on the visceral pleura by the autologous blood, and not from the inflammation effect caused by its autoantigens [3, 7].

Besides this impressive efficiency, its side effects are almost neglectable; pain and fever which can be seen with usage of other chemical pleurodesis agents are rarely encountered in this method. Except 3 empyema cases [8], and 1 tension pneumothorax case caused by the clotting that occurred in the chest tube [10], no procedure-related morbidities have been reported in the literature. As also used in our study, application of 50 ml of saline flush into the drain right after blood instillation will prevent lumen obstruction during the procedure. Our results revealed no decreased “patch” effect of blood after 50 cc saline dilution; moreover, flushing with lower volumes of saline or air may be inadequate, especially for large-bore (24-28 F) drains, and may cause obstruction. Hanging the line of drain 50-60 centimeters above the patient and leaving it unclamped during the procedure will ensure the evacuation of air from the thoracic cavity and keep the lung expanded, at the same time maintaining the blood in to produce the optimal patch effect over the visceral pleura.

Instillation of blood does not predispose to any infection within thorax if aseptic techniques are strictly applied, and therefore no antibiotic prophylaxis is necessary.

In our study, the median duration of hospital stay after the pleurodesis was 1 day, revealing a faster discharge with no morbidity for the patients. Even if a repetition is necessary on the 48<sup>th</sup> hour after the first application, the approximate decrease in LOS was 3-4 days in non-operated patients and more than a week in SSP patients who necessitated the operation. When taking into account the cost of additional medications for chemical pleurodesis (e.g. sterile talc etc.) and/or anesthesia during the operation, the estimated minimum economic burden involved in this practical procedure is around 750 Euros/patient in our country [18].

Retrospective design and low sample size were the main limitations. Different methods of air drainage by different surgeons at our institution also may have caused a bias and decreased the power of our study. Large prospective trials are further needed to signify the importance and efficacy of this procedure.

## Conclusions

The “patch” pleurodesis, created by application of autologous blood is an easily tolerated, repeatable, simple and rapid procedure for all SSP patients with persistent air leak on the 3<sup>rd</sup> day of tube thoracostomy, at no cost, and without any additional morbidity. With a success rate of 96.8% within the first 48 hours, it can be applied to all patients with radiologically expanded lungs, even via small-bore thorax catheters. As a result of shortening the hospital LOS and eliminating the need for unnecessary surgical interventions, autologous blood patch pleurodesis may greatly reduce the health care expenses for SSP patients. Talc pleurodesis and/or surgery should be reserved as the last-line treatment of choice.

## Disclosure

Authors report no conflict of interest.

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