

## Pleurodesis: technique and indications\*

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### ABSTRACT

Recurrent pleural effusion, which is commonly seen in clinical practice, compromises patient quality of life, especially in patients with advanced malignant disease. The therapeutic approach to the pleural space involves a wide range of techniques, including aggressive procedures such as pleurectomy. Among such techniques, pleurodesis is the most frequently used. Pleurodesis can be induced through the insertion of pleural catheters, as well as through major surgical procedures (such as thoracotomy). There are various recommended sclerosing agents, including talc (which is the most widely used), silver nitrate and, recently, proliferative cytokines. This article summarizes the principal approaches to the treatment of recurrent pleural effusion, pleurodesis in particular, addressing the indications for, as well as the advantages and disadvantages of, their application in daily pulmonology practice.

**Keywords:** Pleural effusion, malignant/prevention & control; Pleural neoplasms; Pleura/surgery; Pleurodesis/methods; Silver nitrate; Talc; Recurrence

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## INTRODUCTION

Recurrent pleural effusion is commonly seen in clinical practice, and results from the anatomic or functional impairment of the pleural surfaces by benign or malignant processes. Among the wide range of clinical entities responsible for the production of these effusions are the transudates (resulting, in particular, from heart, liver or kidney failure), and the exudates (principally generated by nonspecific infections, tuberculosis or neoplasms).

In this context, we must highlight the significant predominance of cancer, which accounts for approximately 50% of the total number of these deposits.<sup>(1)</sup> It is estimated that there are approximately 200,000 new cases of malignant pleural effusion per year in the USA.<sup>(2)</sup> In Brazil, despite the lack of precise epidemiological surveys, it is believed that, due to the common characteristics of the two countries, the number of patients with malignant pleural effusion is of the same magnitude in both.

The treatment for recurrent pleural effusion is complex and is aimed at arresting and preventing fluid collection, maintaining the pleural cavity free from new fluid accumulation. The first step is to address the pathological process responsible for the formation of the effusion. In the case of transudates, the treatment is aimed at treating the heart, kidney or liver failure, whereas it is aimed at treating the infection or cancer in the case of exudates. However, when the systemic treatment of the condition responsible for the formation of the effusion does not control the fluid accumulation and does not prevent its recurrence, local treatment should be recommended, allowing the free expansion of the lung with subsequent functional improvement. The methods in reference include initial thoracentesis, pleural drainage, pleuroperitoneal shunt, pleurectomy and pleurodesis.

The objective of the initial thoracentesis is the removal of fluid from the pleural cavity in order to achieve lung expansion and subsequent functional improvement. However, due to the potential risks of this procedure, caution is called for regarding the volume to be removed from the pleural cavity. Therefore, it is recommended that, even in large effusions, fluid removal should not exceed 1200 ml (maximum, 1500 ml), since the removal of larger volumes of fluid increases the risk of developing pulmonary edema, in addition to respiratory or

hemodynamic alterations that can ultimately result in respiratory distress syndrome or hemodynamic shock. The pleural fluid removal, performed with all the necessary precautions, is well tolerated and significantly improves the dyspnea caused by the effusion. Nevertheless, since the fluid can rapidly re-accumulate, performing multiple thoracenteses becomes a temporary alternative in the control of recurrent pleural effusion. The need for multiple punctures is physically and emotionally invasive, resulting in evident protein and electrolyte depletion.

The second option to be considered is prolonged drainage to maintain the pleural cavity free of fluid. It should be noted that leaving a drain in place for long periods (a month or more) can, in itself, result in symphysis of the pleural surfaces, which is highly positive. Nonetheless, prolonged drainage results in great nutritional deprivation,<sup>(3)</sup> increases the risk of pleural infections and can decrease survival.<sup>(3)</sup> Until recently, such drainage was performed with large-caliber tubular thoracic drains (34 to 40 F), which have been currently replaced by small-caliber catheters (maximum, 16 F). There are very effective pleural catheters in the market, such as the pig-tail or pleurex, which are highly functional, although their equally high cost can be an obstacle. Commercial production of these catheters has just recently begun in Brazil (Figure 1). This will certainly decrease costs, simplify the procedure and benefit our patients.

The third option is using a pleuroperitoneal shunt, which is nothing more than a thin catheter with a receptacle (a unidirectional valve) at its midpoint. The extremities of the shunt are placed in the pleural and peritoneal cavities, and the catheter, including the receptacle, follows a subcutaneous trajectory (Figure 2). When the patient presents worsening of symptoms (basically dyspnea), the receptacle is repeatedly compressed, removing fluid from the pleural cavity and, by virtue of its unidirectionality, sending it to the peritoneal cavity. The inconvenience of this system lies in the small volume of the valve chamber (+ 2 ml), which can require an exhaustive number of compressions of this compartment. For the removal of 400 ml pleural fluid, more than 200 compressions are necessary. Other negative aspects of the system are the high valve obstruction rate, the risk of neoplastic implantation in the abdominal cavity<sup>(4)</sup> and the high cost, which makes it practically unviable in Brazil.

The fourth option is pleurectomy. It is undoubtedly the most effective procedure.

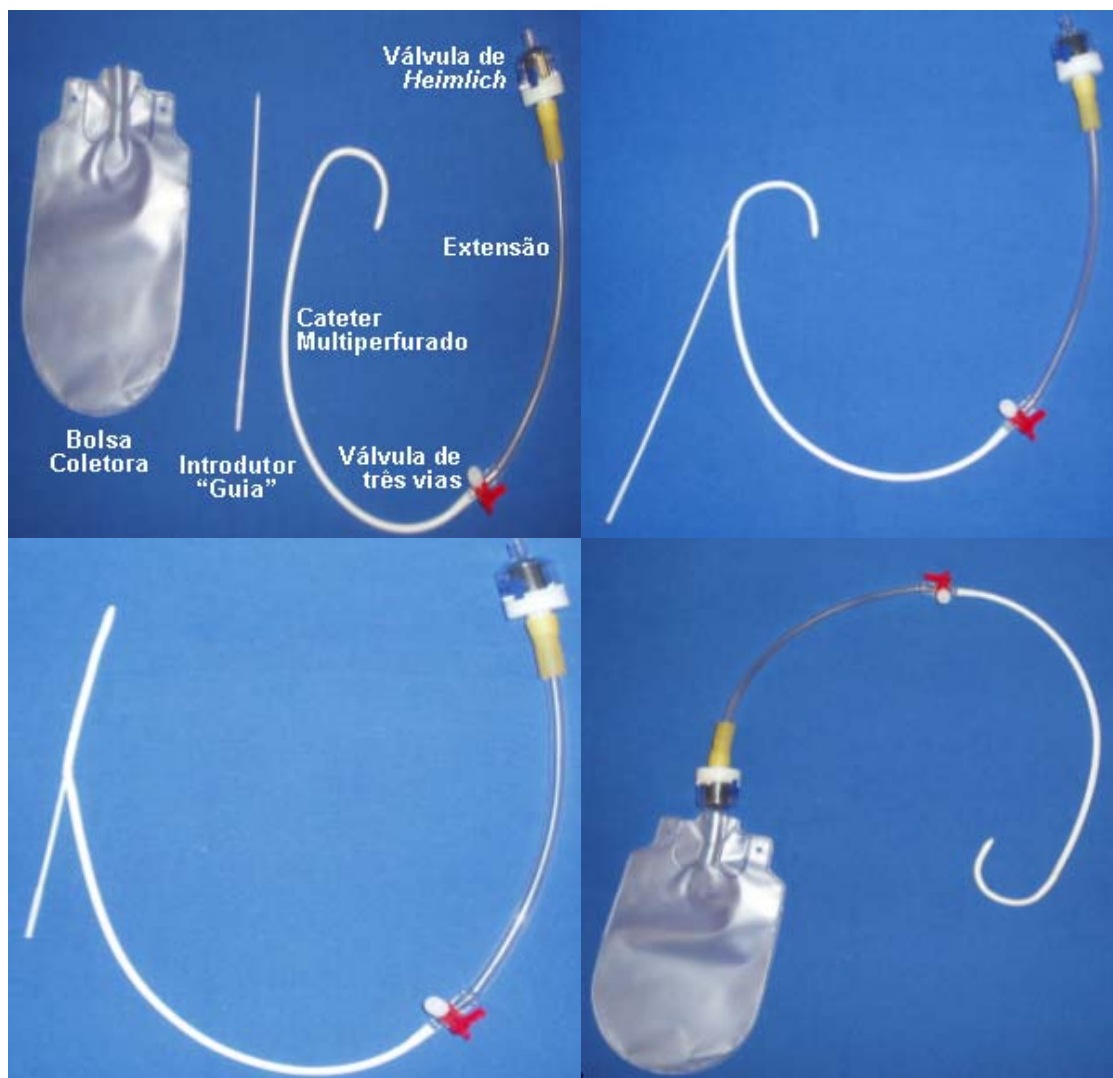


Figure 1 - Catheter for pleurodesis (manufactured in Brazil); A) drainage/pleurodesis kit and components; B) introduction of the guidewire into the catheter; C) catheter ready to be introduced into the pleural cavity and D) simulation of the assembled kit draining the pleural fluid

However, it has been contraindicated due to the accompanying high rates of morbidity and mortality.<sup>(5)</sup> In fact, the high risk of complications is justifiable since it is major surgery and the candidates are patients with impaired general health status. It represents highly aggressive treatment of a group of patients with limited survival.

Finally, there is pleurodesis, that is, the intentional collapse of the pleural surfaces (visceral and parietal) resulting in the symphysis of the pleural space, which hinders the accumulation of

fluid. This has been the procedure most often used in the case of complete pulmonary expansion and the general condition of the patient is good. It is currently the best option for the control of recurrent malignant pleural effusion.<sup>(6)</sup>

It is important to mention that pleurodesis only represents the local therapy of a clinical manifestation, which is generally the treatment for dyspnea. Therefore, the objective of this procedure is not to change the progression of the cancer, and it is not aimed at prolonging patient survival. In view of this, pleurodesis reduces the dyspnea

caused by fluid accumulation in the pleural space and consequently results in greater functional capacity and better quality of life.

## OBJECTIVE

Our intention is to discuss the strategies for inducing pleurodesis in patients with recurrent pleural effusion, especially that of neoplastic origin. We endorse certain methods of execution cited in the medical literature.

In this review, due to the current tendency toward simplification of the pleurodesis procedure, we discuss the integration of the skills of clinical pulmonologists, thoracic surgeons and oncologists in a joint analysis of the patients, in order to promote effective and minimally invasive pleurodesis.

This review is consistent with the line of research pursued by the Pleura Group of the Pulmonology Department of the University of São Paulo School of Medicine, and our objective is quite clear: the comprehensive evaluation of patients suffering from pulmonary diseases. We believe that patients with lung cancer should be submitted to holistic treatment by the pulmonologist, rather than being referred to the oncologist immediately after confirmation of the diagnosis. Therefore, we disagree with those who recommend referring such patients to a surgeon for the induction of pleurodesis immediately after recurrent pleural effusion has been confirmed. Thanks to recent technological advances and simplification of procedures, the physician should develop the necessary skills to create continuity in the treatment of these patients, as well as to coordinate clinical-surgical-oncological integration, in order to offer the best treatment options to patients with neoplasms. (See our proposal regarding minimally invasive outpatient pleurodesis performed by a pulmonologist.)

Therefore, the aim of this discussion is to answer the following questions: What are the indications for pleurodesis? What is the best agent for pleurodesis? What is the best method for the performance of pleurodesis?

## METHODS

The selection of studies was based on bibliographic searches of the following electronic databases: Medline; the Cochrane Controlled Trials

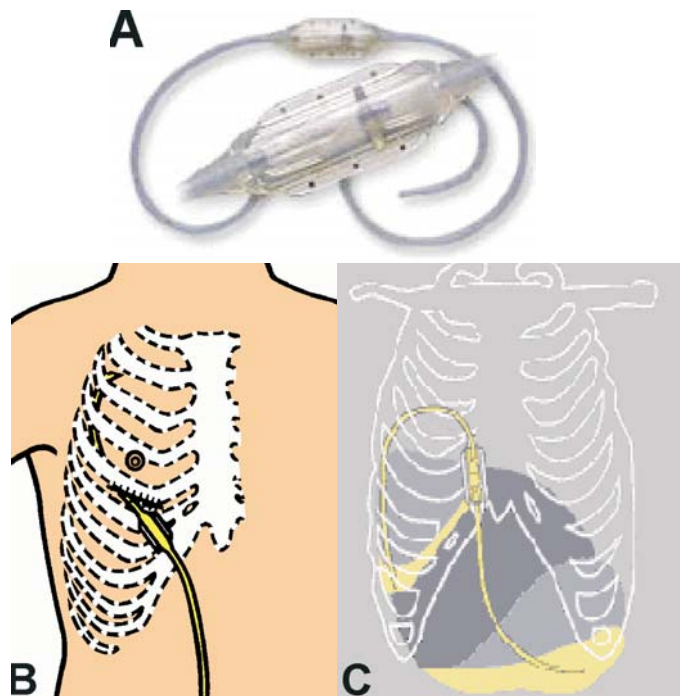


Figure 2 - "Pleuroperitoneal shunt": A) catheter with interposed receptacle (unidirectional valve); B) insertion of one of the extremities into the pleural cavity; and C) shunt in position, draining fluid from the pleural cavity and directing it toward the abdominal cavity

Register; and the Evidence-Based Medicine Cochrane Database of Systematic Reviews. The search terms used were 'pleurodesis' and 'pleural effusion'. We limited our search to articles that focused on efficacy and safety, ruling out case descriptions, letters to the editor and editorials.

## INDICATIONS

### Recurrent benign pleural effusions

The performance of pleurodesis in recurrent benign (transudative) pleural effusion is controversial and should be regarded as a procedure reserved for use in exceptional cases.<sup>(7)</sup>

We found no controlled, randomized or comparative studies evaluating the efficacy and safety of pleurodesis in benign processes. The findings of observational studies suggest that, in these situations, pleurodesis is efficacious and safe. However, there is the theoretical fear that, after pleurodesis of the transudates, the pleural fluid will begin to accumulate in other tissues, such as those of the pulmonary parenchyma.<sup>(8)</sup>

Therefore, the performance of pleurodesis in recurrent benign pleural effusion is only acceptable in those rare situations in which there is absolute failure of the clinical treatment of the underlying disease.

Among the causes of recurrent benign pleural effusion, we should mention liver, kidney and heart failure, as well as hypoproteinemia and myocardial revascularization.

### Recurrent malignant pleural effusions

The main indication for pleurodesis resides in this group of patients. However, not all the patients with malignant pleural effusion benefit from the procedure. In some situations, there is a consensus regarding the induction of pleurodesis (Chart 1); in others, it is absolutely controversial.

Once these conditions have been considered, the ideal moment at which to perform the procedure should be analyzed. Some authors defend the idea that pleurodesis should be performed as soon as possible after the diagnosis has been confirmed.<sup>(9)</sup> Others recommend its performance only if chemotherapy fails to control the pleural effusion. However, there is no evidence to support the use of the latter strategy. In this situation, the analysis of the control of the pleural

effusion (radiological regression of the effusion and decreased number of thoracenteses to promote dyspnea relief) is preceded by the performance of one or two cycles of chemotherapy (after two to three months or even at the end of the chemotherapy treatment). Although there are factors in favor of and against these approaches, both indications are currently accepted (Chart 2).

Once the timing of pleurodesis has been decided, other factors that, despite not enjoying a consensus, can modify the indication criteria should be considered, since they can interfere with the result expected. Therefore, acid pH (< 7.3),<sup>(10)</sup> low glucose level (< 60 mg/dl) and incidence of chylothorax have been related to worse prognosis and worse efficacy of pleurodesis, independently of the technique and of the drug used<sup>(5)</sup> (Chart 3). The presence of lymphangitis and a performance status index lower than 70 have been associated with worse clinical evolution of the patient after the induction of pleurodesis.<sup>(5)</sup> Finally, lung entrapment, either due to pleural loculations or to a lack of pulmonary expansion, reduces the efficacy of pleurodesis, as well as increasing the risk of infections in the pleural space.<sup>(3)</sup> Therefore, pleurodesis is not recommended under these conditions.<sup>(3)</sup>

## PERFORMANCE OF PLEURODESIS - METHODOLOGY

### Types of procedures

Pleurodesis can be achieved through the use of various stimuli: direct physical lesion (abrasion); instillation of caustic or irritating chemical substances (talc, doxycycline, silver nitrate or bleomycin) into the pleural space; or immunological induction with *Corynebacterium parvum*, transforming growth factor-beta (TGF-β) or interferon-alpha 2 (IFN-α 2).

Chart 1 - Indications for pleurodesis

<p><b>Indications</b>                  Failure of oncological treatment to control pleural effusion                  Dyspnea relief after drainage of the pleural cavity                  Full pulmonary expansion (chest X-ray)                  Karnofsky performance status index &gt; 70                  Absence of lymphangitis</p>
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Chart 2 - Ideal moment for the performance of pleurodesis

Indication	Pros	Cons
Before chemotherapy	Greater efficacy Safer Better quality of life during chemotherapy	Invasive procedure Chemotherapy could control the effusion Occasional postpleurodesis empyema Makes oncological treatment more difficult Can delay the beginning of chemotherapy
After chemotherapy	Certainty that other treatments have failed	Can delay the next cycle of chemotherapy Greater risk of empyema Poorer performance status



Chart 3 - Prognostic factors of the efficacy of pleurodesis

<p>Worse prognostic and least efficacy</p> <ul style="list-style-type: none"> <li>Acid pH (&lt; 7.3)</li> <li>Low glucose level (&lt; 60 mg/dl)</li> <li>Presence of chylothorax</li> <li>Presence of lymphangitis</li> <li>Performance status &lt; 70</li> <li>Lung entrapment</li> </ul>
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### Mechanical stimuli

Among the mechanical stimuli, abrasion is the principal method. Abrasion is carried out during a surgical intervention, whether conventional or video-assisted, in which the surgeon exfoliates the pleural mesothelium, creating friction with a rough-surfaced material (gauze, for example). This irritation results in the desquamation of the mesothelium and activation of the inflammation and coagulation pathways, with subsequent proliferation of fibroblasts and collagen deposition, resulting in pleural symphysis.

Pleural abrasion is not currently used in the control of recurrent neoplastic pleural effusions due to its lesser efficacy, as well as to the high risk of bleeding in the regions involved and to the possibility of tumor dissemination. These two risks are related to the direct manipulation of the tumor with lesion of newly formed vessels and embolization of tumor cells that are released during the manipulation of the tumor mass. Another inconvenience of pleural abrasion is that it requires surgical intervention. Its indication has been currently recommended only for selected cases of recurrent pneumothorax.

### Chemical stimuli

Pleurodesis induced by chemical stimuli was first carried out at the beginning of the last century. There are references to the fact that, in 1901, Spengler injected silver nitrate into the pleural cavity for the control of recurrent pneumothorax.<sup>(5)</sup>

Apparently, talc was first introduced into the pleural cavity, with the objective of collapsing the existing residual space after pulmonary resection, by Bethune in 1935.<sup>(5)</sup> Since then, various substances have been used to induce pleurodesis, although there is as yet no consensus regarding

the ideal sclerosing agent (Chart 4).

Chemical stimulation has the advantage of allowing various routes of access to be combined. The most important aspect, in this particular case, is that pleurodesis can be achieved surgically or through simple drainage.

Talc is classically considered the most efficacious sclerosant. When compared with other agents, it presents a relative risk of 1.34 for therapeutic success (95% confidence interval: 1.16 to 1.55) and a success rate of over 90% in most studies.<sup>(11)</sup> However, in a recent multicenter study conducted in Europe, talc was found to be efficacious in 71% to 78% of the patients submitted to pleurodesis, all of whom survived for more than 30 days after the procedure.<sup>(12)</sup> Talc has been considered the agent of choice, since it presents many of the characteristics cited in the definition of an ideal agent (low cost, wide distribution, easy administration, high efficacy and low rate of side effects). It can be administered, either by insufflation during thoracotomy or through drains of various calibers, in the form of so-called talc slurry (talc suspension in saline solution). Despite its low rate of complications, its use has been associated with acute respiratory distress syndrome, which affects 1.2%<sup>(7)</sup> to 9% of patients<sup>(13)</sup> and can be fatal. It is believed that this complication is related to the size of the talc particles. The smaller ones would be more easily absorbed from the pleural cavity and distributed throughout the circulation, resulting in a greater risk of remote complications.<sup>(14)</sup> Due to the severity of this type of complication, other drugs again began to be studied.

Chart 4 - Characteristics of the ideal sclerosant agent

<p>Characteristics</p> <ul style="list-style-type: none"> <li>Low cost</li> <li>Ample worldwide distribution</li> <li>Easy to handle and administer</li> <li>Easy to sterilize</li> <li>Low indices of pleural infection</li> <li>No cavity drainage required</li> <li>No intense pain or discomfort</li> <li>Null mortality</li> <li>Minimal, easily controlled morbidity</li> <li>Near 100% efficacy</li> </ul>
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Doxycycline has proven efficacious and safe for the induction of pleurodesis. However, it is not available in many countries (including Brazil). In the past, some health facilities in Brazil utilized oral tetracycline/doxycycline derivatives to induce pleurodesis. Nevertheless, there are doubts as to whether the sclerosing effect observed is due to the agent used or to the excipient (talc). In addition, we should also be concerned with the sterilization of the agent introduced in the pleural cavity, since the capsules are in fact commercially distributed for oral ingestion and their content is not sterile and are therefore not recommended for pleurodesis.<sup>(6)</sup>

Silver nitrate was the first substance utilized in the induction of pleurodesis, being abandoned, for reasons that remain unclear, in the 1980s. Our group recently posited that the adverse effects observed in the past were secondary to the high concentrations of silver nitrate used (from 1% to 10%), and we therefore suggested that the use of lower concentrations would be safer and more efficacious.<sup>(15)</sup> In studies with laboratory animals (rabbits), 0.5% silver nitrate proved highly efficacious and presented a low rate of complications.<sup>(16)</sup> The pathophysiological mechanism involved in the induction of pleurodesis seems to be, to a certain extent, different from that observed with the talc, since, in this rabbit model, the corticosteroid did not reduce the efficacy of the pleurodesis obtained with silver nitrate, in contrast to what occurs with the talc. A recently published study involving human subjects with neoplastic pleural effusion and utilizing 0.5% silver nitrate, demonstrated efficacy indices similar to those found for talc, with low rates of side effects.<sup>(15)</sup> Naturally, further comparative studies of the safety and efficacy of silver nitrate in humans are required.

Bleomycin is an antineoplastic agent that was used to induce pleurodesis in past decades. However, its low efficacy and high cost have significantly limited its use.

### Immunological stimuli

Chief among the immunostimulants is *C. parvum*. Its principal advantage is that it does not require surgical intervention or pleural drainage and can be introduced into the pleural space through a simple puncture. However, the described

efficacy of this agent has not been reproduced in Brazil, and there are currently difficulties in its production, and there is no distribution network.

Other immunostimulant agents include interleukin 2-alpha, staphylococcal superantigen and TGF- $\beta$ . In a comparative, randomized, prospective, parallel study carried out in 2004, IFN- $\alpha$  2b was found to be less efficacious than bleomycin,<sup>(17)</sup> and its use was not indicated for pleurodesis induction. Staphylococcal superantigen seems to be a promising agent, despite having been little studied. In a study carried out in 2004,<sup>(18)</sup> staphylococcal superantigen was instilled in fourteen patients with low performance status indices. It was successful in eleven patients (71%), without any side effects. Its principal advantage is ease of administration, not requiring hospitalization or thoracic drainage. Since these results are still preliminary, further studies of efficacy and safety are required. Finally, TGF- $\beta$  is a cytokine that stimulates tissue proliferation and collagen formation, without inducing an inflammatory reaction or tissue lesion. The major concern regarding its use is related to its systemic absorption, with development of fibrosis in other organs, including the lung. It was successfully tested in experimental animals with low short-term complication rates.<sup>(19)</sup> However, studies analyzing its efficacy and safety in humans have yet to be carried out. It is rather unlikely that TGF- $\beta$  will prove to be the ideal sclerosing agent, since its cost is higher than that of other agents.

Therefore, we can conclude that, despite the lack of consensus, talc, in the dosage of five to ten grams, remains the most accepted agent.

### Route of access

Route of access is defined as the method by which the sclerosing agent is given access to the pleural space, either through classical thoracotomy, through video-assisted surgery, through thoracic drainage with local anesthesia or through thoracic drainage with thoracic puncture and a small-caliber catheter.

All of these techniques present advantages and disadvantages that can interfere with the final result of the procedure (Chart 5). Among the advantages, we can cite the complete drainage of the pleural cavity, the more homogeneous

distribution of the sclerosing agent in the pleural space, less aggressiveness of the procedure and less need for hospitalization. These factors influence the choice of the technique that is most appropriate for a given patient.

In these past few years, the route of access for pleurodesis has been thoroughly studied. There is a tendency to reduce the aggressiveness of the treatment, migrating from talc insufflation during thoracotomy to video-assisted insufflation and eventually to the instillation of sclerosant through a thoracic drain. Even when the thoracic drain is used as a route of access to the pleural cavity, there is a tendency toward reducing its complexity and morbidity (pain). Therefore, we have evolved from using large-caliber to using small-caliber drains and ultimately to the use of pleural catheters.

In parallel with the reduced aggressiveness, the efficacy of the treatment must be maintained. The ideal route of access for striking a balance between efficacy and safety in pleurodesis has yet to be defined. Unfortunately, many studies comparing routes of access have not employed the same sclerosing agent for each route, thereby making it difficult to interpret the isolated effect of the route of access to the pleural space. A meta-analysis carried out in 2004<sup>(11)</sup> by the Pain, Palliative Care and Supportive Care Group of the Cochrane Database of Systematic Reviews (112 patients), evaluated the efficacy of talc pleurodesis using video-assisted surgery or using drainage/talc slurry (talc in suspension). The authors showed that the instillation through video-assisted surgery was more efficacious, with favorable relative risk of 1.19 (95% confidence interval: 1.04 to 1.36) and similar mortality in the two groups. Unfortunately, in this meta-analysis, it was not possible to compare the adverse effects of the two treatments due to the lack of pertinent data in the studies involved. Despite the fact that video-assisted surgery was found to be more efficacious than slurry pleurodesis, the level of success for both procedures was over 90%, which is quite acceptable in clinical terms.

The current evidence suggests there is no difference between the use of large-caliber thoracic drains and small-caliber thoracic drains (catheters). Although a consensus has yet to be reached, small-caliber drains provides more comfort to the patient

and can be more easily introduced, being currently recommended as an option for the initial approach to recurrent pleural effusion and for the induction of pleurodesis.<sup>(20)</sup>

Small-caliber drains have been successfully used in the performance of rapid pleurodesis. In this new form of pleurodesis induction, the pleural catheter is put in place, the sclerosant is instilled, the drain (with a unidirectional valve system that allows the outflow of the fluid but does not allow the air to get in and prevents backflow of the fluid into the pleural space) is left open, and the drain is generally removed within 48 h.<sup>(21)</sup> The combination of small-caliber drains with a valve system, such as the Heimlich valve, which is a unidirectional valve system that allows the replacement of the water-seal (Figure 2), has facilitated pleurodesis induction, allowing greater patient mobility and comfort, as well as allowing pleurodesis to be performed in outpatient clinics.

## CONCLUSIONS AND RECOMMENDATIONS

We can conclude that pleurodesis can be indicated in benign pleural effusions, with restrictions. The principal indication for pleurodesis is recurrent malignant pleural effusions, with full pulmonary expansion, in patients with good performance status indices.

Pleurodesis via chemical stimulus, especially talc pleurodesis, remains the first option for the treatment of recurrent malignant pleural effusion. Silver nitrate seems to be a reasonable option for use in Brazil, although more studies of its safety are needed.

The most efficacious route of access is video-assisted surgery. However, the use of small-caliber thoracic drains (catheters) provides a good cost-effectiveness/comfort ratio, especially for patients in advanced stages of neoplastic disease.

The most significant aspect to be considered is that pleurodesis has become a procedure to can be carried out in outpatient clinics by physicians. This simplifies its execution considerably while maintaining the indices of efficacy. Therefore, there is no need for hospitalization, which would deprive patients, during this difficult phase of their life, of contact with their families.



Chart 5 - Techniques employed in the performance of pleurodesis

Technique	Pros	Cons
Conventional thoracotomy	Greater efficacy Safer Better analysis of the pleural cavity	Invasive procedure Greater postoperative morbidity Hospitalization required Complicates use of soluble drugs
Video-assisted surgery	Greater efficacy Relatively safe Adequate analysis of the cavity	Invasive procedure Less post-operative morbidity Hospitalization required Complicates use of soluble drugs
Conventional thoracic drainage	Less invasive No surgical center required Soluble drugs can be used	Slightly less efficacy Pain caused by drain Hospitalization required Talc slurry not possible
Thoracic drainage with catheter via puncture	Less morbidity Less aggressive Hospitalization not required Feasible with lower performance status Soluble drugs can be used	More risk of loculation Less effective pleural drainage Talc slurry not possible

Chart 6 - Proposal/protocol for outpatient pleurodesis by a physician or surgeon

<ul style="list-style-type: none"> <li>• Confirm the diagnosis of neoplastic pleural effusion through cytological or anatomopathological study.</li> <li>• Confirm lung expansion after initial thoracentesis (X-ray or tomography).</li> <li>• The better the general status of the patient (Karnofsky &gt; 60), the better the result.</li> <li>• Introduce small-caliber catheter/drain, connect Heimlich valve draining into collection bag (or colostomy bag).</li> <li>• The patient can go home after detailed explanation about special care and how to change the collection bag. Provide guidance on access to medical treatment in case of emergency. Patient can return after seven days.</li> <li>• Induce pleurodesis. There are basically two options, injecting through the catheter: a) 5 g of talc in suspension with 100 mL of saline solution; or b) 20 ml of a solution of 0.5% silver nitrate.</li> <li>• Confirm the diagnosis of neoplastic pleural effusion through cytological or anatomopathological study.</li> <li>• There is no need for analgesia. The procedure is well tolerated. However, it is convenient to have access to an opioid (morphine, meperidine or tramadol), since significant pain can be observed, which will be reduced by the medication, allowing the proposed procedure to continue.</li> <li>• After the intrapleural introduction of the sclerosant agent, inject 20 ml of saline solution to wash the catheter, clamp it for one hour, and then open it to allow the drainage of the fluid. Leave it open. There is no need to move (rotate) the patient while the catheter is clamped.</li> <li>• The patient can be discharged after receiving guidance regarding necessary care. In general, common painkillers (dipyron or equivalent) are sufficient. More potent drugs are rarely necessary, and we suggest tramadol or opioids. Avoid the use of nonsteroidal anti-inflammatory drugs or corticosteroids, since they can reduce the efficacy of the pleurodesis. Ask the patient to write down the volume drained daily, and schedule an appointment for the following week.</li> <li>• If the drainage is inferior to 100 ml/day, and there is no sign of obstruction of the catheter or of pleural loculation, remove the catheter. Conduct clinical follow-up evaluation and follow-up imaging studies (X-ray, ultrasound or tomography).</li> </ul>
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