

# Pleural fluid collections and ultrasound guided percutaneous drainage



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Massimo Cajozzo, Girolamo Geraci, Chiara Lo Nigro, Manuela Palazzolo, Francesco Raffaele, Roberto Pinna, Marta Cajozzo, Giuseppe Modica.

Department of Surgery and Oncology, Operative Unit of General and Thoracic Surgery, University of Palermo, Palermo, Italy

## Pleural fluid collections and ultrasounds guided percutaneous drainage

**INTRODUCTION:** *The presence of fluid collection in the pleural cavity is a frequent clinical problem that requires drainage for diagnostic and therapeutic purposes.*

*Aim of our study is the retrospective evaluation of our experience in diagnostic and therapeutic thoracic drainage, to stress the cause of failure and to emphasise the cost-effectiveness of the technique.*

**MATERIALS AND METHODS:** *From January 1995 to May 2009, 564 therapeutic and diagnostic ultrasound (US) guided percutaneous drainages of pleural fluid collection were performed in 412 patients.*

**RESULTS:** *The macroscopic, biochemical, cytological and microbiological examination of the drained fluid diagnosed the presence of 80 (19.4%) transudates, 101 (24.5%) non neoplastic exudates, 55 (13.4%) neoplastic exudates, 152 (36.9%) empyema and 24 (5.8%) haemothorax.*

*There were no major complications. Minor complications were present in 23/564 cases (4.0 %).*

**CONCLUSIONS:** *The US guided puncture of the pleural fluid collection allows a high rate of success (in correct detection and drainage of chronic pleural effusions), reduces the rate of complications and is well accepted by patients.*

**KEY WORDS:** Pleural fluid collections, Ultrasound guided percutaneous drainage.

## Introduction

The presence of fluid collection in the pleural cavity is a frequent clinical problem that requires drainage for diagnostic and therapeutic purposes. In the past many retrospective and prospective studies reported complications related to pleural fluid collection drainage<sup>1-4</sup>. Actually, ultrasonography (US) represents an important diagnostic imaging technique; it is not expensive and is easy to perform. It can also supply correct information

on the size and location of the pleural fluid collection, and on the relationship with other anatomic structures. Aim of our study is the retrospective evaluation of our experience in diagnostic and therapeutic thoracic drainage, to stress the cause of failure and to emphasise the cost-effectiveness of the technique.

## Materials and methods

We retrospectively studied patients hospitalized in our Department from January 1995 to May 2009, for pleural fluid collection.

564 therapeutic and diagnostic US guided percutaneous drainages of pleural fluid collections were performed from January 1995 to May 2009; 63.8% were males and 36.2% females; the age ranged from 33 to 82 years; median age was 51 years.

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*Per corrispondenza: Dott. Girolamo Geraci, Ricercatore Universitario, Università degli Studi di Palermo, Sezione di Chirurgia Generale ad Indirizzo Toracico (Direttore: Prof. Giuseppe Modica) (e-mail: ggeraci@unipa.it)*

All patients needed a diagnostic and/or therapeutic thoracic drainage.

The diagnosis was supported by clinical and laboratory examinations, imaging tests and bronchoscopy.

The study was carried out with Prisma Diasonic portable ultrasonograph, with a 3.5 MHz real-time probe, which allowed US guided percutaneous drainage; the catheter size ranged between 7-8 and 11-12 French (F); we always performed local anesthesia and used Seldinger's technique for positioning the catheter.

Pleural drainage was performed by the medical staff of our department, expert and used to US guided procedures: an US operative laboratory has existed since 1987 for abdominal, breast and thyroid procedure; our experience in operative US guided thoracic procedures began in 1995.

A pre and post-procedure chest radiography was always performed on all patients.

We assessed the biochemical, microbiological and cytological features of the drained fluid collections and retrospectively evaluated:

- the effectiveness and feasibility of US guided percutaneous drainage of pleural fluid collection;
- the related complications and success rate;
- the role of this technique and its cost-effectiveness for a wider use in a Unit of pneumology and Thoracic surgery.

For statistical analysis we used the  $\chi^2$  Test.

## Result

The macroscopic, biochemical, cytological and microbiological examination of the drained fluid diagnosed, in 412 patients, the presence of 80 (19.4%) transudates, 101 (24.5%) non neoplastic exudates, 55 (13.4%) neoplastic exudates, 152 (36.9%) empyema and 24 (5.8%) haemothorax.

The average time for visualizing the pleural effusion recognizing the anatomical structures and performing the US guided procedure, was 7 minutes.

A double puncture was performed in 47/564 patients (8.3%) because of technical problems (incorrect procedure); the success single needle pass puncture rate was 91.6 % (517/564).

We performed 330 diagnostic procedures; the diagnosis was correct in 293/330 cases (88.7%) and incorrect because of a bad catheter position (14 cases) and false negative of cytological examination (23 cases) (subsequently submitted to other surgical diagnostic procedures).

In 234 patients submitted to therapeutic procedures, the success rate was 73.5% (172/234), referred as complete fluid evacuation with symptoms relief without short term relapse.

We repeated the US guided percutaneous therapeutic drainage in 33/234 cases because the drainage size was too small in calibre or too short, so we cannot achieve the

complete evacuation and relief of dyspnoea and cough (above all in chronic pleural effusions).

Moreover we operated 29/234 of therapeutic drainage for chronicized haemothorax (6 cases) and empyema (23 cases). The overall success rate was 82.4% (465/564) and we had no major complications.

Minor complications were present in 23/564 cases (4.0 %), (12 vagal hypotension; 11 mild pain).

When we analyzed the complications and the success rate in the loculated and non-loculated pleural effusions, we observed, respectively, 5.5% (12/215) versus (vs.) 3.1% (11/349) complications ( $p > 0.1$ ) and 85.58% (184/215) versus 89.1% (311/349) success rate. Of the 215 loculated collections, 181 were uniloculated and had a success rate of 88.9% (161/181), while 34 were multiloculated and had a success rate of 67.6 % (23/34) ( $p < 0.01$ ).

We did not observe any statistical difference in the complication rate between the group treated with the larger size catheter (11-12 French) and smaller one (7-8 French): 4.7% (11/234) vs. 3.4%(12/330) ( $p > 0.1$ ).

Analyzing the procedure performed in two different periods, we respectively observed more failure drainage caused by technical problems (procedure not correctly performed). We observed a failure rate of 13.1% (25/189) in the period 1995-2002, vs. 5.8% (22/375) in the period 2003-2009 ( $p < 0.01$ ), vs 13.9% ( $p < 0.01$ ) in the era before US-guide, performed by the same medical staff, with a rate of 15% of minor complications, above all in chronic pleural effusions.

US-guided percutaneous drainage allows lower rates of catheter malpositioning, better comfort for the patient and lower rates of complications: all these factors contribute to make this procedure cost-effectiveness.

## Discussion

The drainage of pleural fluid collections could have several related complications (pneumothorax and/or damage intrathoracic or sub-diaphragmatic anatomical structures), and a high rate of failure especially in some clinical situations (loculated or multiloculated or small size collections). Pneumothorax is one of the most frequent complications, documented in both retrospective (3-19%) and in prospective clinical studies (5.4%)<sup>5-9</sup>, but not in our experience.

In our University Hospital almost all cases of fluid pleural collections (loculated, multiloculated minimal or medium pleural fluid collection) were treated in our Unit. US gives us correct information about location and size of fluid collection and its relationship with thoracic and sub-diaphragmatic structures<sup>6-7</sup>. Probably this is the reason why we did not observe any different complications using different drainage sizes.

We did not observed different success rate in loculated vs. non-loculated pleural effusions, but if we analyze the data inside the multiloculated group, we observed a dif-

ference between the two sub-groups, probably related to the difficult treatment of multiloculated collections, which often need multiple, US guided drainages or different kinds of treatment (TC guided drainage – surgical procedure) <sup>8</sup>.

The different results obtained in the two different periods were related to the learning curve (observed during the first year) of the US guided percutaneous drainage; we had no more complications, probably because during US examination we have more correct information about location of fluid collection and its relationship with various kinds of structures; moreover, we have real-time imaging that allows us to see the introduction of the catheter.

On the basis of our results, the US approach is a good cost-effective procedure, there is no ultrasound related risk and it allows good real-time visualization of the catheter into the fluid inside the pleural cavity.

Some authors use US guided percutaneous pleural drainage on selected cases with loculated and small size fluid collections or coagulation disorders <sup>3,10,10</sup>.

We have extended the use of US guided drainage to all kinds of eligible pleural effusion (detectable by ultrasound) thanks to the high success rate, absence of major complications, a high single pass puncture success rate (good patient compliance) and performing time.

## Conclusion

The cause of failures and complications, performing a pleural drainage, is generally due to the incorrect position of the catheter, to the presence of the loculated or multiloculated pleural fluid collection, to the minimal amount of fluid collection and to the limited experience of the operator <sup>8-9</sup>.

In our Unit of Thoracic Surgery, an US operative laboratory for guided thoracic procedures has been operative since 1995; for this reason we prefer to perform (as first diagnostic or therapeutic step) an US guided percutaneous drainage of pleural fluid collections; We think that the US guided technique is the gold standard technique, especially in some clinical cases, but it is an operator dependent procedures and needs training on US, but with a short learning curve, as we observed in our experience <sup>12</sup>.

We think that it could be useful techniques, in both surgical and medical units, especially for the treatment and/or diagnosis of minimal, loculated, multiloculated pleural fluid collections, lowering the related risk and quickly resolving the clinical problems, with better cost management.

## Riassunto

INTRODUZIONE: La presenza di versamento pleurico costituisce spesso un problema clinic di complessa soluzione,

che comunque richiede necessariamente il drenaggio a scopo diagnostico e terapeutico.

Obiettivo della nostra valutazione retrospettiva è evidenziare la possibili cause di fallimento della procedura senza la guida ecografica e di enfatizzare il suo rapporto di costo-efficacia.

MATERIALI E METODI: Nel periodo Gennaio 1995-Maggio 2009, sono state eseguiti 564 drenaggi percutanei ecoguidati consecutivi in 412 pazienti.

RISULTATI: I risultati clinici, biochimici, citologici e microbiologici del materiale drenato hanno dimostrato la presenza di 80 trasudati (19.4%), 101 essudati non neoplastici (24.5%), 55 essudati neoplastici (13.4%), 152 empiemi (36.9%) e 24 emotoraci (5.8%).

Non si sono registrate complicanze maggiori. Complicanze minori, risolte a letto del paziente, si sono registrate in 23/564 casi (4%).

CONCLUSIONI: Il drenaggio ecoguidato di raccolte pleuriche consente di raggiungere elevati tassi di successo (migliore identificazione ed evacuazione delle raccolte pleuriche saccate), riduce le complicanze legate alla procedura ed è ottimamente tollerato dai pazienti.

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