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Thoracentesis Guided By Focused Ultrasonography Performed By the Intensivist Physician in Malignant Pleural Effusion: A Safe Strategy

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ABSTRACT

The wide use of pulmonary and cardiac ultrasound in critical medicine allows early diagnoses and the performance of certain procedures that achieve a prompt intervention in a type of patient who does not wait. Thoracentesis is a percutaneous procedure for collecting pleural fluid, and it has diagnostic utility and therapeutic applications. The use of ultrasound to perform an evacuative and diagnostic thoracentesis has proven to be a simple, safe, low-cost, and especially reproducible procedure in personnel under training and with training already established. We present an algorithm on the realization of a successful Thoracentesis Guided by Focused Ultrasonography Performed by the Intensivist Physician in Malignant Pleural Effusion, which is based on different protocols of daily practice in intensive care units. This algorithm follows certain steps and with good performance for the identification of pleural effusion, catheter passage and drainage of the effusion.

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Introduction

The wide use of pulmonary and cardiac ultrasound in critical medicine allows early diagnoses and the performance of certain procedures that achieve a prompt intervention in a type of patient who does not wait. Thoracentesis is a percutaneous procedure for collecting pleural fluid, and it has diagnostic utility and therapeutic applications [1]. The use of ultrasound to perform an evacuative and diagnostic thoracentesis has proven to be a simple, safe, low-cost, and especially reproducible procedure in personnel under training and with training already established [2].

The prevalence of pleural effusion in the Oncologic Intensive Care Unit can vary between 40 and 60% [3]. The commonly reported causes of pleural effusion in this population are infectious exudates (43%), non-infectious exudates (33%) and transudates (24%) [4]. This condition provokes alterations in the ventilatory mechanical, like an alteration in the gas exchange, hemodynamic inestability and increased respiratory work. Vetrugno et al, in a metaanalysis that included 31 studies with 2265 patients showed that drainage of pleural fluid produces improvement in PaO2/FiO2 as an oxygenation index and tends to increase endexpiratory volume [5].

The incidence of pneumothorax through blind thoracentesis is around 11% [6]. The Ultrasound is strongly recommended for performing interventions in the pleural space and using smalldiameter catheters on the other hand, the diagnostic sensitivity of ultrasound for pleural effusion is higher compared to that of chest X-ray [7,8,9]. Next, we present an algorithm on the realization of a successful Thoracentesis Guided by Focused. Ultrasonography Performed by the Intensivist Physician in Malignant Pleural Effusion, which is based on different protocols of daily practice in intensive care units [10-13].

This algorithm follows certain steps and with good performance for the identification of pleural
effusion, catheter passage and drainage of the effusion.
The operational steps of the algorithm are: (Figure:1)

1. Prior to sepsis and antisepsis, sterile fields are placed on the work area.
2. Low frequency ultrasonography transducer is placed with the head in the cephalic direction, on the 5-7 intercostal space, axillary midline.
3. Using 2D/B mode, locate hyperechoic image (diaphragm) that is superimposed on the upper part of solid organs depending on laterality (liver or spleen).
4. Recognize devices that confirm the presence of pleural effusion: Curtain sign, Medusa/tongue sign, Sinusoid sign, etc.
5. Measure the approximate volume of pleural fluid using the formula of [14]. V (ml) = 20 × Sep (mm) (Sep: maximum distance between the visceral and parietal pleural at the end of an expiration).
6. Identify the safety margin, remembering that anatomically the intercostal irrigation runs below each posterior costal arch,

avoiding at the time of puncture, impact on the lower costal edge.

7. Locate the pleural space where there is less chance of puncturing some intrathoracic structure and apply on the local anesthetic skin as needed.
8. After this, by using a fine needle, it is punctured over the safety margin and with permanent ultrasonographic visualization we observe the passage of the needle tip into the pleural space.
9. A fine needle is connected to an anesthesia extension device adapted to a 3-way key to reduce the risk of air passing through the intrapleural needle (risk of pneumothorax).
10. Verification of the correct location of the needle is performed by aspiration with a 50-60 cc syringe, obtaining if the puncture is positive, the presence of pleural fluid at the end of the embolus.
11. Samples of cytological, cytochemical, cultures, etc. are taken. And after that, an extension of anesthesia is connected to a collection bag with free drainage.

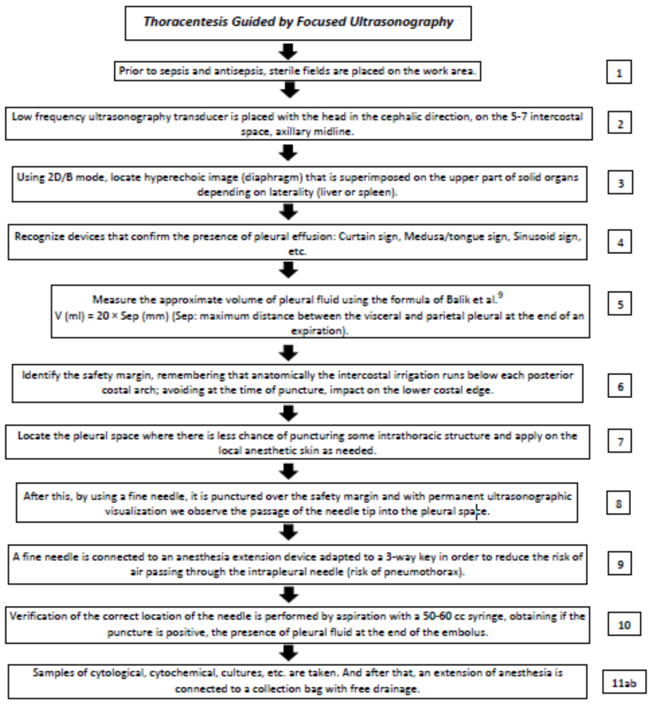

Figure 1: Thoracentesis Algorithm Guided by Focused Ultrasonography. (Adapted with permission of the autor: Rodriguez Lima DR, Yepes AF, Birchenall Jiménez CI, Mercado Díaz MA, Pinilla Rojas DI. Real-time ultrasound-guided thoracentesis in the intensive care unit: prevalence of mechanical complications. Ultrasound J. 2020 Apr 26;12(1):25. doi: 10.1186/s13089-020-00172-9. PMID: 32337606; PMCID: PMC7184066.)

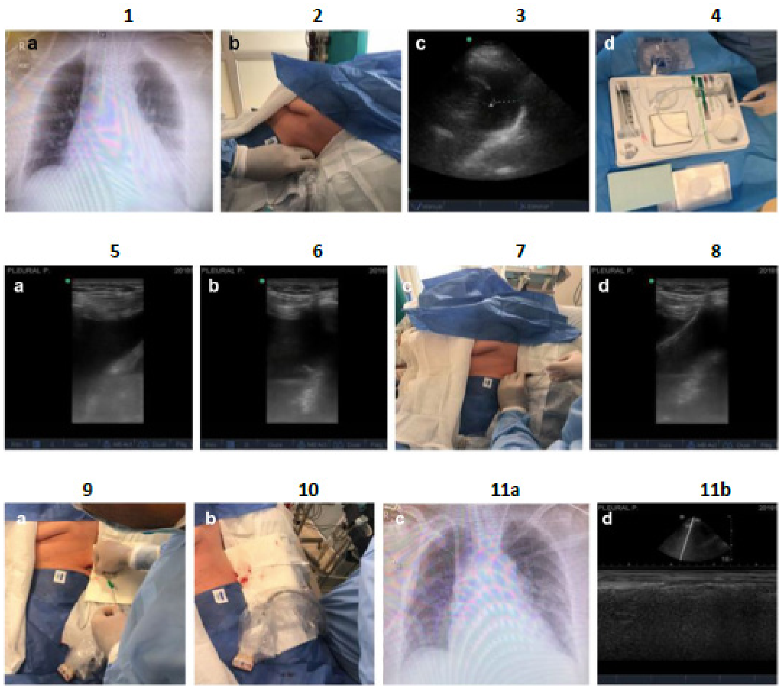

Figure 2: Thoracentesis Algorithm Guided by Focused Ultrasonography (Adapted with permission of the autor: Rodriguez Lima DR, Yepes AF, Birchenall Jiménez CI, Mercado Díaz MA, Pinilla Rojas DI. Real-time ultrasound-guided thoracentesis in the intensive

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Discussion

The application of this algorithm guarantees the use of focused ultrasound as a tool of great diagnostic and therapeutic value, which, through its proper use, allows to identify potential errors and complications inherent to this type of interventions, in addition to ensuring rapid interventions which by other methods (Chest x-ray, computed axial tomography, etc.) However, like all medical discipline, you need certain equipment and staff training to achieve maximum performance.

Authors' contributions

DMSP and DDBM contributed substantially to the design and writing of the manuscript. DDBM and YRCB was responsible for review and editing of the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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