

Interdisciplinary teamwork for chest tube insertion and management: an integrative review

Daniel Aiham Ghazali^{1,2}, Patricia Ilha-Schuelter³, Sarah Soares Barbosa³, Jennifer Truchot⁴, Pierre Francois Ceccaldi⁵, Francis Solange Vieira Tourinho³, Patrick Plaisance⁵

¹Emergency Department and EMS, University Hospital of Amiens, 80000 Amiens, France

²Simulation center SimUSante, University Jules Verne and University Hospital, 80000 Amiens, France

³Federal University of Santa Catarina, Brazil

⁴University Hospital of Lariboisiere, France

⁵University of Paris, France

Abstract

Thoracostomy requires interdisciplinary teamwork. Even though thoracic drainage is a technical surgical procedure, nurses play an important role with major responsibilities during the procedure. This literature review aimed to identify articles related to the interdisciplinary management of thoracostomy. An integrative literature analysis between 2012 and 2019 with a qualitative approach was conducted. An analysis of articles written in English, French, Portuguese, and Spanish was conducted. A search of the PubMed and SCIELO databases was performed using combinations of the terms "Chest Tube; Nursing; Care; Drainage; Insertion". The search terms were included in 11,277 articles. After excluding articles that did not meet the objective of our study, 475 abstracts were analysed. Finally, 19 articles were selected with content focused on nursing care, content related to surgical procedures, and interdisciplinary content. Themes included the following: description of the procedure, interdisciplinary action, quality of the procedure, use of protocols for patient safety, and new technologies. In conclusion, interdisciplinary courses should be encouraged to improve interprofessional teamwork organization. Notwithstanding all these publications, the literature was fragmented into disciplines and isolated analyses. Each medical or nursing discipline addressed the aspects that pertain to its own responsibilities in the execution of the procedure. This review highlighted the need to develop interdisciplinary research and brought a source of rich information that can instrumentalize the creation of optimized processes for the interdisciplinary chest tube insertion.

Key words: thoracostomy, chest tube, drainage, nursing, surgical procedure, interdisciplinary teamwork.

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CORRESPONDING AUTHOR:

Dr. Daniel Aiham Ghazali, Emergency Department and EMS, University Hospital of Amiens, 80000 Amiens, France, e-mail: aiham@hotmail.com

The importance of an interdisciplinary endeavour is the capacity of multiple professionals with different backgrounds working together to deliver higher quality care [1]. The concept of medicine as an isolated discipline concerned with the restoration of health has been replaced with the concept of different health professionals working together to maintain health [2]. This type of team-based learning can occur in either academic or clinical settings, during medical school and residency, and consist of any combination of professional groups [3]. Interdisciplinary collaboration in health care is crucial to offering patient-centred care, and working collaboratively is not only essential but also crucial in providing quality and safety in patient-centred care [2]. In the thoracostomy procedure, the physician/surgeon and nursing teams must work together to achieve patient care, sharing tasks and responsibilities [2].

Thoracic drainage is a surgical technical procedure that is frequently used in urgent and critical, potentially life-threatening traumatic situations [4]. These drains have been integrated into routine practice because they are simple, effective tools to manage chest trauma and pleural pathologies [5]. However, it is important to highlight the invasiveness of such techniques. Insertion of the tube remains the physician's responsibility [6]. The physician's proficiency during an emergency and anatomical knowledge of the involved structures are required for the accurate positioning and standardized execution of the procedure [7]. However, even though nurses do not insert the tube, they play an important role with major responsibilities during the thoracostomy procedure. These include, for example, monitoring the container and the suction level and recording the quantity, characteristics,

and content of the drainage; monitoring air-leakage; administration of pain medicine; and providing information and education strategies to patients so that they can be active in their self-rehabilitation process [6]. Nurse practitioners and physician assistants can also be involved in this teamwork.

Nursing care can be pre-procedure or post-procedure. During pre-procedural care, consent is required to perform the procedure and provision of information about the reason for and risks of the thoracostomy. Depending on the country and legislation, this action may be the responsibility of the surgeon or the physician or the nurse. They must also ensure that the patient has no doubts, and understands what will happen and what the course of treatment will entail. It is important that the nurse prepare the appropriate materials for insertion of the chest tube and later assist in the procedure, or as mentioned above, according to country and legislation, they can also perform it. During the procedure, the nurse's priority is to monitor the patient's response. Post-procedural care involves monitoring vital signs, helping the patient to change position, protecting the drainage system, and helping to remove the tube when necessary [8, 9]. Nurses must also teach the patient proper management of the drainage device: how to keep the bottle or the closed plastic system below the level of the chest, and to report any dysfunction [5]. Because inefficient nursing care can cause complications, educational material with information for safety and care strategies should be available for these patients [5, 8].

For these skills, an interdisciplinary care approach is fundamental. In this context, the theme of interdisciplinarity has recently been more widely addressed and studied. Interdisciplinary means integrated across disciplinary knowledge and methods from different fields in the interests of problem solving [10].

Lastly, to organize interdisciplinary care, the use of protocols is required. Care protocols are defined as systematized orientations that prioritize critical and basic situations to streamline the decision-making process. These protocols can be organized as flowcharts, usually elaborated by the institution's experts [11]. Care protocols facilitate the organization of the work process by standardizing procedures [12]. These protocols are an interdisciplinary approach to care, which encourages teamwork and consistency in patient care.

LITERATURE REVIEW

Aim

This integrative literature review aimed to search for articles related to the thoracostomy procedure that convey the procedure and the standard care to

the medical staff and the nursing team, and interdisciplinary teamwork.

The databases searched and other information sources

The search was performed in the following databases: Medical Literature Analysis and Retrieval System Online – PubMed® (National Library of Medicine) and Scientific Electronic Library Online – SciELO. PubMed® includes citations for biomedical literature from MEDLINE, life science journals, and online books. SciELO is an electronic library providing access to scientific journals in Portuguese and Spanish.

Search strategy and intervention

This is an integrative literature review, with a qualitative approach [13]. The steps were: (1) choice of research objective; (2) definition of the criteria for inclusion and exclusion of studies; (3) search of databases; (4) inclusion of selected studies in frame format; (5) analysis of results, identifying differences and conflicts; and (6) discussion and analysis of results.

Data collection process and search outcomes

Application of inclusion and exclusion criteria (1st stage), which contained the descriptors listed in the medical subject headings (MeSH): "Chest Tube AND Nursing; Chest Tube AND Care; Chest Tube AND Drainage; Chest tube AND Insertion (this descriptor was not defined by the MESH, but by its appearance in many articles)". And the descriptors should refer to the insertion of the chest drain into humans. Publications were selected when they were available in English, Portuguese, Spanish, or French. Exclusion criteria were as follows: theses; dissertations; abstracts of works published in annals of events; editorials; letters to the editor; and articles not available online and not free to access.

The second step was to read the titles and abstracts, and the third step was to read the full article and delete repetitive or irrelevant studies. Five relevant manuscripts were used in addition to the development of the literature review because they were of great relevance, so they did not go through the selection process [14–18]. Critical evaluation of the studies was based on the results of the aforementioned reference documents, and from reviewing of the articles found in the databases, and selection of information relevant to the theme in its context in the study.

Study design

Data collection on teamwork in thoracostomy from the literature, between January 2012 and September 2020, was done in December 2020.

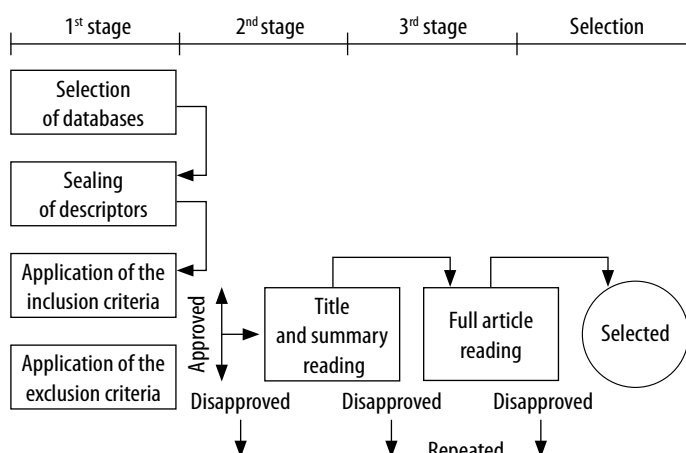


FIGURE 1. Organization chart of integrative literature review

Quality assessment

To validate the integrative review methodology, prior to conducting the research, a protocol was developed. This research protocol was endorsed by an expert researcher on methods of integrative review and another expert researcher in the area of thoracostomy and interdisciplinary teamwork. This was done in order to validate the descriptors and their relevance to the subject. This research was exempt from Ethics Committee approval because it did not involve human beings.

Data abstraction and process

The collection of the articles was carried out in each database individually. The beginning and/or ending was not predefined, i.e. it occurred randomly. The selection criteria and the process are shown in Figure 1.

Synthesis

For the analysis procedure, we opted for content analysis [19]. This analysis was developed via 3 steps: (1) pre-exploration of the material or floating readings; (2) selection of units of analysis (or units of meanings); and (3) the non-priority categorization and sub-categorization process. The categories

emerged entirely from the context of the research material. This procedure required the researchers to go back and forth from the reading of the material analysed and the objectives of the study. Each emerging category was discussed in the form of a frame within the information relevant to the study in a comparative way, along with the extraction of new information to enrich the theme.

Study risk of bias assessment and confidence in the assessment process

Two reviewers systematically evaluated the abstracts and articles to limit the risk of bias in the included or excluded studies. Only studies approved by the 2 reviewers were retained. During the analysis process, the reviewers worked independently. In the case of discrepancies in the outcome analyses, a third reviewer designated by the principal investigator reread the article.

RESULTS

After insertion of the descriptors, and before the application of the inclusion criteria, 11,277 articles were found. Most of the articles were found in Medline (99.0%). Inclusion and exclusion criteria, as well as the subsequent stages of evaluation of the articles, were applied. After excluding articles that did not meet the objective of our study, 475 abstracts were analysed (Table 1). Finally, the 19 selected articles were categorized according to Table 2, in articles with content focused on nursing care, content related to medical and surgical procedures, and interdisciplinary content.

After categorization and analysis of the data, extra information emerged regarding new simulation technologies in the insertion of the chest drain that can influence the quality and success of the procedure, or even contribute to the development of new interdisciplinary procedures (Table 3). Additional themes were developed, and they included the following: experimentation with a new method and/or technology, using an alternative model to teach and evaluate drainage, considering patient characteristics

TABLE 1. Articles found by database and selection of articles

Crossing descriptors	Articles found by database				Total		Loss after application of exclusion criteria						Selected	
	PubMed		SciELO				1 st stage		2 nd stage		3 rd stage			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Chest tubes AND Nursing	260	2,3	0	0.0	260	2.3	225	2.1	28	5.9	3	11.5	4	21.1
Chest tubes AND Care	1525	13.7	2	1.9	1527	13.5	1465	13.6	52	11.0	8	30.8	2	10.5
Chest tubes AND Drainage	8613	77.1	103	96.2	8716	77.3	8338	77.5	365	76.8	7	26.9	3	15.8
Chest tubes AND Insertion	772	6.9	2	1.9	774	6.9	736	6.8	30	6.3	11	30.8	10	52.6
Total	11170	100	107	100	11277	100	10764	100	475	100	29	100	19	100

TABLE 2. Selected articles and organization by category, title, principal author, year, country of production, methodology, and focus

Category	Title	Principal author	Year	Country of production	Journal	Methodology	Focus
Nursing practices	Evidence-based care of patients with chest tubes	Carroll <i>et al.</i> [15]	2016	USA	American Association of Critical-Care Nurses National Teaching Institute	Evidence-based practice	To compare traditional practices with evidence-based practices and to develop evidence-based standards of practice for patients with chest tubes
	Nurses' knowledge of care of chest drain: a survey in a Nigerian semiurban university hospital	Kesjeme <i>et al.</i> [8]	2016	Nigeria	Annals of African Medicine	Prospective cross-sectional study	To ascertain the level of knowledge of care of chest drains among nurses working in wards in a teaching hospital in Nigeria
Medical practices	Impact of a thoracic nurse-led chest drain clinic on patient satisfaction	Williams <i>et al.</i> [20]	2012	UK	Interactive Cardiovascular and Thoracic Surgery	Prospective cross-sectional survey	To assess patient's satisfaction with the clinic's ability to manage their postoperative needs
	The application of low-fidelity chest tube insertion using remote telesimulation in training healthcare professionals	Garland <i>et al.</i> [21]	2019	Canada	Cureus	Technical report	To increase the technical performance of learners using a 3D-printed model
	Evaluation of app-based serious gaming as a training method in teaching chest tube insertion to medical students	Haubruck <i>et al.</i> [22]	2018	Germany	Journal of Medical Internet Research	Randomized controlled trial	To investigate serious gaming in teaching chest tube insertion
	Ensuring basic competency in chest tube insertion using a simulated scenario: an international validation study	Hertz <i>et al.</i> [23]	2018	Denmark and Kingdom of Saudi Arabia	BMJ Open Respiratory Research	Prospective multicentre study	Aim was to assess the validity of a scale for chest tube insertion and to establish pass/fail score
	Steering the wheel towards the standard of care: proposal of a step-by-step ultrasound-guided emergency chest tube drainage and literature review	Menegozzo [24]	2018	Brazil	International Journal of Surgery	Literature review	To standardize a simple step-by-step technique of ultrasound-guided pleural drainage and to present a review of the potential benefits of applying ultrasound to the procedure
	Development and validation of an objective assessment scale for chest tube insertion under 'direct' and 'indirect' rating	Ober <i>et al.</i> [25]	2018	Germany	BMC Medical Education	Randomized controlled trial	Primary objective of this study is to assess reliability and validity of the developed scale of chest tube insertion
	Teaching residents chest tubes: simulation task trainer or cadaver model?	Tan <i>et al.</i> [26]	2018	USA	Emergency Medicine International	Prospective randomized study	Efficacy of simulation and cadaver models in teaching tube thoracostomy and the effect on a resident's clinical success
	Chest tubes: indication sizing, placement, and management	Ritchie <i>et al.</i> [27]	2017	USA	Clinical Pulmonary Medicine	Literature review	Provide a straightforward layout to educate those new to tube thoracostomy placement and enough nuance to improve the practice of some of those experienced in tube thoracostomy
	Impact of simulation-based training in surgical chest tube insertion on a model of traumatic pneumothorax	Léger <i>et al.</i> [28]	2016	France	Advances in Simulation	Prospective, randomized, controlled, bicentric study	To evaluate the success rate of surgical insertion of a chest tube in a task trainer simulator of traumatic pneumothorax

TABLE 2. Cont.

Category	Title	Principal author	Year	Country of production	Journal	Methodology	Focus
	Teaching project: low-cost pig model for training thoracic drainage	Netto <i>et al.</i> [4]	2016	Brazil	Revista do Colégio Brasileiro de Cirurgiões	Feedback questionnaire about the experimental model	To describe and evaluate the acceptance of the low-cost swine model for thoracic drainage in a medical teaching project
	Chest drainage teaching and training for medical students. Use of a surgical ex vivo pig model	Tube <i>et al.</i> [29]	2016	Brazil	Acta Cirúrgica Brasileira	Experimental, prospective, analytic, and controlled study	Implement a constructivist approach in thoracic drainage training in surgical ex vivo pig models, to compare the acquisition of homogeneous surgical skills between medical students
	A new instrument to assess physician skill at chest tube insertion: the TUBE-iCOMP	Salmonsens <i>et al.</i> [30]	2015	Australia	Thorax	Experimental, prospective study	Objective is to develop and examine the validity of tool to assess physician skill at chest tube insertion
	The TACTIC: development and validation of the tool for assessing chest tube insertion competency	Shefrin <i>et al.</i> [31]	2015	Canada	Canadian Journal of Emergency Medicine	Prospective study	Aim is to develop and validate a scoring tool to assess chest tube insertion competency for paediatric emergency physicians
	An innovative non-animal simulation trainer for chest tube insertion in neonates	Gupta <i>et al.</i> [33]	2014	USA	Paediatrics	Prospective cohort study	The objective of this study was to assess the effectiveness of teaching the chest tube insertion procedure by using an easily constructed, non-animal simulation model
	Technical validation of pulmonary drainage for the treatment of severe pulmonary emphysema: a cadaver-based study	Lopez <i>et al.</i> [32]	2013	Brazil	Jornal Brasileiro de Pneumologia	Experimental, prospective cadaver-based study	To describe the pulmonary drainage surgical technique, to determine whether the site for the insertion of the chest tube is appropriate and safe, and to determine the anatomical relationship of the chest tube with the chest wall, lungs, large blood vessels, and mediastinum
Interdisciplinary practices	Nurses' knowledge and practice regard care of patient with chest drains in Sudan Heart Center, Khartoum, Sudan	Elfaki <i>et al.</i> [5]	2016	Sudan	Journal of Nursing and Health Science	Quantitative descriptive hospital-based study	To assess nurses' knowledge and practice for patients connected to chest drain; to raise nurses' level of knowledge and enhance their practice; to prevent and minimize chest drain risk and complications in view of improving patient outcome
	Nurses' knowledge levels of chest drain management: a descriptive study	Tarhan <i>et al.</i> [6]	2016	Turkey	Eurasian Journal of Pulmonology	Descriptive study using a questionnaire	To determine nurses' level of knowledge regarding the care of patients with chest drains

TABLE 3. New technologies

Article	Author	Year	Thematic	Theme to be used
The application of low-fidelity chest tube insertion using remote telestimulation in training healthcare professionals	Garland <i>et al.</i> [21]	2019	3D-printed model for teaching the medical procedure of chest tube insertion	They used an alternative simulation evaluation model
Evaluation of app-based serious gaming as a training method in teaching chest tube insertion to medical students: randomized controlled trial	Haubruck <i>et al.</i> [22]	2018	Use of serious gaming for teaching the medical procedure of chest tube insertion	
Teaching project: a low-cost swine model for chest tube insertion training	Netto <i>et al.</i> [4]	2016	Use of a pig model for insertion of a chest drain	
Chest drainage teaching and training for medical students. Use of a surgical <i>ex vivo</i> pig model	Tube <i>et al.</i> [29]	2016	Use of a pig model for insertion of a chest drain	
Teaching residents chest tubes: simulation task trainer or cadaver model?	Tan <i>et al.</i> [26]	2018	Participants were coached through an objective assessment checklist of 15 critical steps in chest tube insertion on simulated or cadaver model	Both sim and cadaver models are effective modalities for teaching chest tube placement
Steering the wheel towards the standard of care: proposal of a step-by-step ultrasound-guided emergency chest tube drainage and literature review	Menegozzo <i>et al.</i> [24]	2018	Standardization of the chest drainage procedure based on individual ultrasound techniques	The ultrasound-guided technique provides several benefits: the potential to avoid visceral injuries, intercostal artery laceration and subcutaneous drain placement are some of them
Nurses' knowledge of care of chest drain: a survey in a Nigerian semiurban university hospital	Kesime <i>et al.</i> [8]	2016	To identify the knowledge of nurses in the care and insertion of a chest drain	The importance of developing techniques of chest drainage and care with nurses
Nurses' knowledge levels of chest drain management: a descriptive study	Tarhan <i>et al.</i> [6]	2016		
Impact of a thoracic nurse-led chest drain clinic on patient satisfaction	Williams <i>et al.</i> [20]	2012	The quality and progression of patient care with a chest drain compared to nursing actions	Methodology of the research, in accomplishment of a simulation for experimentation of a new method and technology
An innovative non-animal simulation trainer for chest tube insertion in neonates	Gupta <i>et al.</i> [29]	2014	New technologies for training and training of doctors in the insertion of the chest drain	
Technical validation of pulmonary drainage for the treatment of severe pulmonary emphysema: a cadaver-based study	Lopez [33]	2013	Measurement of positioning and insertion of the chest drain in reference to other anatomical structures	The importance of considering the parameters of the patient (weight, height, etc.) and the pathophysiology in the insertion of the chest drain to prevent complications

and pathophysiology in the insertion of the chest drain in view of preventing complications, as well as highlighting the importance of involving nurses in the development of new techniques and procedures of chest drainage.

DISCUSSION

After exhaustive reading of selected articles and seeking to meet the study objective, according to the application of the content analysis method, the categories discussed below emerged.

Divergences in carrying out the procedure

When comparing the literature for insertion of chest drains [14–18] and articles found in the literature review, we identified differences between the procedure and care guidelines, with some divergences that could change fundamental aspects of practice, one of which is in the execution of a surgical procedure. This category, in which the closed thoracostomy is included, is strict regarding surgical asepsis. It involves patient safety as a key point, to avoid unnecessary patient complications such as discomfort and risk of death [27].

Given the importance of this, one of the divergences in the literature concerns the most adequate antiseptic in the preparation of the patient for the chest drain insertion procedure. While some studies [5] mention povidone-iodine as the preferred solution, other studies refer to alcohol-based products (chlorhexidine) [18]. Chlorhexidine may be 6% to 10% more effective in preventing infections in surgical procedures compared to povidone-iodine in patients with the same characteristics [34, 35]. Another systematic review achieved the same level of evidence and considered the reduction of costs when using alcoholic chlorhexidine (up to \$26 per procedure) [36]. Several authors state that the option with the lowest incidence of infection and the highest cost-benefit is chlorhexidine alcohol [14, 34–36]. Another point of divergence in the literature is the use of 1% lidocaine [14] versus using 2% lidocaine [29] versus using neither [8]. In the literature, there are no high-quality studies on the benefits or efficacy of one over the other, only indications of different dosages, and other articles also indicate that both concentrations are acceptable [37, 38].

Success in performing a thoracostomy is related not only to the insertion of the chest tube but also to its maintenance. Basic care to ensure its effectiveness and patency are necessary. Dressing was one of the points addressed in the articles and literature of reference [8, 15–18]. Some studies recommend, as a cover, a simple dressing with petroleum gauze or lint gauze covered with micropore or tape [14–16], while others recommend transparent

dressing [8]. When comparing issues such as level of skin irritation, the literature reveals that both dressings showed the same performance, but that with regards to the level of wound recovery and costs, transparent dressing presented more positive results [39, 40]. In addition to other benefits, transparent dressing decreases the risk of infection and requires a smaller number of exchanges because it can be maintained for 3 to 7 days. To conclude, transparent dressing is the most suitable for the protection of the insertion site on the chest.

As a complementary aspect, 2 studies discuss pain control and analgesia as one of the fundamental procedures in pre- and post-surgical care [6, 8]. Pain can cause patient instability leading to failure, and/or it can become the main cause of complications during and after the procedure, and it increases the length of hospital stay. Therefore, professionals should value assessment of the aspects that involve the reduction of pain and reinforce patient's confidence in safe relevant strategies [41, 42].

Interdisciplinary action and the quality of the procedure

It is essential to promote interprofessional healthcare education and training [43]. Among the 19 studies in the systematic review, 14 only approached chest drain insertion techniques for physicians or medical students [4, 21–33]. None studied interdisciplinary work in drain insertion or chest drain care, and only 1 presented any protocol for teaching and training students in drainage [28]. On the other hand, 5 studies presented nurses as the main actors, 1 of which was an evidence-based guideline on nursing practices in the management and care of the chest drain [15], while the other 4 evaluated nurses' knowledge and practices about chest drain care [5, 6, 8, 20]. One study, elaborated by a surgical department of thoracic surgery [8], showed how important it is to know the other professions' roles and their importance in patient health care. It also demonstrated how it is possible to enlarge vision to interdisciplinary teamwork to improve health care. When the general principles on the care of patients with thoracic drains are implemented correctly and effectively by nurses, it will accelerate the healing process [6]. Other studies confirm the importance of the procedure protocols; once they are standardized and systematized, patient care is substantially improved. In addition, the authors suggest that nurses' knowledge of chest anatomy and physiology is critical for rapid intervention when patients with chest drains present complications, and that the nurse must also know the reason for insertion of the drain, thereby raising awareness of the care procedures needed to maintain patient safety [6].

Finally, only 1 study directly approached the doctor-nurse partnership in the procedure and care of the chest drain, including multidisciplinary collaboration as a key point in patient care. An interdisciplinary approach to patient care is fundamental because each professional has his/her own functions and roles during chest drain insertion and care; however, all must work together for the best patient outcome [20]. Collaboration among nurses and physicians allows better patient-centred care [2]. It is also important to emphasize that the chest drain training programs should include the presence of a nurse during the insertion procedure and that national and international guidelines should emphasize the roles and duties of the nurse in the care of the patient with a chest drain [6].

Use of protocols for patient safety

Among the 20 studies evaluated in the integrative review of the literature, only 5 reported the use of protocols for insertion and management of the chest drain [6, 20, 24, 29, 33]. Two of them approached the use of protocols for teaching and training for medical students and physicians in the technique of insertion of the drain [29, 31]. Another study commented on the partnership between doctors and nurses in the care of patients with a chest tube [20]. This study assessed patient satisfaction with the ability of nurses to manage postoperative needs in a ward-based nurse-led clinic managing patients after thoracic surgery. The use of a protocol for outpatient care was created with the aim of allowing the nurses to provide their own independent care, with the option to request a physician if necessary. Most of the patients (99%) were satisfied with the care. Among the two-thirds of patients who were treated according to the protocol and without referring to a physician, very few considered that a medical consultation was necessary. Another article described a step-by-step approach for ultrasound-guided chest tube drainage [24]. Finally, a study evaluating nurses' knowledge on chest drains suggested the creation of protocols for drainage care [6].

Patient safety needs to be the priority to the health care team [44]. Studies show that the use of evidence-based protocols contributes to patient safety, because nurses are thereby trained in patient care and are given knowledge of drainage systems [45] and the types of drainage to expect from whichever device is inserted into a patient. They can also contribute to patient safety and prevent potential harm because they can collaborate in the rehabilitation process since adequate drainage management improves effectiveness [45]. In addition, some authors argue that protocols may improve communication between doctors and nurses during

care and that a standardized document improves interdisciplinary communication and drainage care [45]. Thus, it is fundamental that protocols involving procedures and patient care can be developed to delineate each discipline's roles and responsibilities. Another fundamental factor in patient care is education. Providing patients with accurate and easy to understand information decreases recovery time and increases positive outcomes [16].

New technologies for the insertion of chest tubes

Studies also discussed the use of technology for the instruction of procedural techniques [4, 29, 33]. The use of animal models that mimic human physiology enables the development of practical skills, given the high cost and lack of accessibility of simulators or cadaver labs. Other studies go further and seek alternatives with materials that can achieve high fidelity without high-cost technology, developing their own instruments with recycled materials and proving their effectiveness for improved learning [30]. Low-cost training models for chest tube insertion were developed and tested [28, 46]. The use of a low-cost 3D-printed model for medical teaching of the procedure was analysed [21]. This model is cost-effective and valid for teaching thoracostomy. Another approach emphasized the importance of expanding knowledge of the procedure beyond the medical domain, encouraging interdisciplinary activity, and deepening knowledge and nursing responsibilities in chest drain insertion [5, 8, 20]. In this context, it behoves us to mention digital chest drainage, using digital devices that have been proven to have important benefits such as objective assessment of real air-leak, early active intervention or conversion to a one-way valve system that would allow for outpatient management, early patient mobilization, and therefore early hospital discharge [47]. Another important component is thoracic ultrasound, an imaging diagnostic technique that helps to identify the best puncture site and guides the procedure for insertion of the drainage. Chest ultrasound is essential during these invasive manoeuvres to increase safety and decrease potentially fatal complications [48].

Future research

Interdisciplinarity represents the combined courses of 2 or more disciplines like nursing and medicine [49]. In healthcare settings, clinical situations like life-threatening events require interprofessional management of the patient based on the unique disciplinary knowledge of the health professionals [49]. Reeves and Zwarenstein [50–53] have demonstrated in several studies that that interprofessional teamwork improves healthcare outcomes. When

analysing the existing literature on thoracostomy and care, we can identify a large number of studies. Notwithstanding this vast amount of information, the literature is fragmented into disciplines and isolated analyses. Each discipline addresses the aspects that pertain to its own responsibilities in the execution of the procedure, but in practical reality, all actions have the same orientation (the patient's well-being), and the different disciplines need to act together. This study enabled a comparison of surgical and nursing practices in the placement of chest drains through a dialogue with several authors on integration review and content analysis, compiling the information and defining an international standard for the procedure and materials used. From this study, it was possible to define an interdisciplinary and updated practice with safe means promoting safe chest drain insertion. Future research should aim to develop a learning and assessment tool for interdisciplinary chest tube insertion. Finally, future studies should concentrate on extensive patient education. It is essential in this type of interdisciplinary care to consider patient education and, more specifically, to train him/her in the management of thoracic drainage [54, 55].

CONCLUSIONS

Chest tube insertion should be interdisciplinary, to encourage improved teamwork organization, and not fragmented into disciplines and isolated analyses. This review is a source of rich information that can instrumentalize the creation of optimized processes for the interdisciplinary procedure of insertion of the chest drain. Therefore, it is necessary to develop interdisciplinary research bringing these results closer to multidisciplinary reality. The protocols are a good strategy, which are oriented and stimulated by health organizations promoting increased patient safety. The evaluation of interprofessional practices could also create a standard of techniques and materials that could be used internationally to become a reference for safe practice. Construction of interdisciplinary practice promotes improvement and qualification in health services, contributing to the development of research processes and the evolution of healthcare as a whole. It is also important to emphasize the importance of expanding this study, considering aspects such as patient education for self-care, monitoring air-leakage with an interdisciplinary view, proper handling during patient transport, and care according to each context (emergency, hospitalization, home).

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