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Value of Pleuropulmonary Ultrasound in the Etiological Diagnosis of Dyspnea in the Emergency Department

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Abstract

Introduction: The aim was to evaluate the interest of bedside pleuropulmonary ultrasound in diagnosing dyspnea in emergencies. **Materials and methods:** The study was prospective, descriptive, and analytical over a duration of six months. The study population consisted of patients admitted to the Emergency Department of Akanda Army Training Hospital for dyspnea. All subjects underwent pleuropulmonary ultrasound and thoracic CT scan during their hospital stay. **Results:** In total, 63 cases were included, representing a prevalence of 12.4%. The average age was 58 years, and women accounted for 61.9% of the population. Infectious-type pneumonia represented 84.1% of the etiologies. For the diagnosis of pulmonary consolidation, pleuropulmonary ultrasound had a Kappa coefficient of 0.7. Sensitivity was 94% and specificity was 80%. The area under the curve (AUC) was 0.8. For alveolar-interstitial involvement, the Kappa coefficient was 0.9 and ultrasound had a sensitivity of 96% and specificity of 92% (AUC = 0.9). The Kappa coefficient was 0.9 for pleural effusion. Sensitivity was 92% and specificity was 80% (AUC = 0.8). For the diagnosis of asthma/COPD, the Kappa coefficient was 0.9. Pleuropulmonary ultrasound had a sensitivity of 100% and a specificity of 50% (AUC = 0.7). **Conclusion:** This series, although with a small sample, confirms the diagnostic performance of ultrasound in emergency reception services with performance tests close to the literature. Nevertheless, it requires good training in techniques and protocols for more relevant use.

Keywords

Acute Dyspnea, Emergencies, Pleuropulmonary Ultrasound

1. Introduction

In 2012, the American Thoracic Society (ATS) defined dyspnea as a "subjective experience of respiratory discomfort of varying quality and intensity" [1]. Medical history and clinical examination alone are not sufficient to guide etiological diagnosis. It is very useful to resort to additional tests [2]. However, it has been shown that additional radiological tests increase the duration of treatment [3]-[5]. Yet one of the main objectives of emergency physicians and/or urgent care physicians is to make a rapid and accurate diagnosis of an episode of acute dyspnea. Among patients consulting the emergency department for dyspnea, 65% are hospitalized and often admitted to intensive care [6].

Although chest CT scans are considered the gold standard, they are often not performed and involve significant exposure to ionizing radiation, limiting their use in unstable patients. It is in this context that Focused Assessment by Sonography for Trauma Patients (FAST) ultrasound has found its place in the emergency department.

Pleuropulmonary ultrasound is now an integral part of clinical examination, which explains the increase in publications on this imaging technique [7]. Its low cost, availability, speed, and reproducibility make it an appropriate tool [3], particularly in emergency departments. In fact, the JAMA journal defines ultrasound as the fifth pillar to be added to the physical examination at the patient's bedside to improve the diagnostic-therapeutic pathway [7]. Its use is already well codified in many indications [8]. For dyspnea, it is recommended to integrate Lichtenstein's BLUE protocol [8].

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2. Materials and Methods

This was a prospective, descriptive, and analytical study conducted over six months, from July 24, 2023, to January 31, 2024. The Emergency Department of Akanda Army Training Hospital (HIAA) served as the setting for the study. All patients over the age of 18 with dyspnea who had undergone a pleuropulmonary ultrasound or chest CT scan during their hospitalization and whose informed consent

had been signed by the patient or a legal guardian were included. Dyspnea was defined as:

- A respiratory rate greater than or equal to 22 cycles per minute or a respiratory rate less than 14 cycles per minute;
- The presence of at least one sign of respiratory distress such as suprasternal retraction, intercostal retraction, nasal flaring, xiphoid funneling, or extreme thoracoabdominal rocking;
- Desaturation ≤ 94% in ambient air.

Any patient who had not undergone a chest CT scan was excluded. The sample was non-probabilistic, exhaustive, and based on the recruitment of all patients admitted to the emergency department who met the inclusion criteria. The minimum sample size was determined using Schwartz's formula, taking into account the prevalence of dyspnea in emergency departments, internal medicine, and cardiology at the Parakou Military Teaching Hospital and in the anesthesia-intensive care, emergency, medicine, and medical specialty departments at the Borgou Departmental Hospital [9]. The calculation was performed with a prevalence of 2.9%, a confidence level of 95%, and a margin of error of 5%.

The principal investigator (PhD student) underwent five hours of prior training in pleuropulmonary ultrasound techniques and the BLUE Protocol. Designed by Daniel A. Lichtenstein in 2008, this is an ultrasound approach to the lung and venous system in appropriate cases, enabling rapid etiological diagnosis of acute respiratory failure at the patient's bedside. This approach analyzes each hemithorax at the anterior, lateral, and posterior levels to identify specific profiles indicative of a specific pathology [8]:

- A Profile: bilateral predominant anterior A lines associated with the presence of pleural sliding (normal pulmonary surface);
- A' Profile: corresponds to profile A with abolition of pleural sliding. Barcode image in real-time (pneumothorax);
- B Profile: multiple bilateral predominant anterior B lines associated with the presence of pleural sliding (acute hemodynamic pulmonary edema);
- B' Profile: corresponds to profile B with abolition of pleural sliding;
- A/B Profile: predominant anterior B lines on one side, associated with predominant A lines on the other side;
- C Profile: corresponds to anterior alveolar consolidation, pulmonary hepatization (pneumonia);
- Nude Profile: corresponds to A profile diffusely present in the anterior region with no PLAPS. Pleural sliding may be slight but present (acute asthma or COPD).

This training was supervised by a mentor (a specialist in emergency and disaster medicine). It began with theoretical lessons on the signs and artifacts of pleuropulmonary ultrasound, followed by practical sessions on healthy and pathological subjects who volunteered. Data were collected using a standardized individual form, administered face-to-face by the principal investigator after the pleuropul-

monary ultrasound was performed. Patients were examined on the consultation bed by physicians other than the primary operator. The official diagnosis was established in the hospitalization report using standardized tests performed by emergency department staff, without including lung ultrasound data. All patients underwent an ultrasound scan by the principal investigator at the time of admission, who did not participate in or interrupt the care provided by emergency department staff.

The pleuropulmonary ultrasound was performed at the patient's bedside, without any knowledge of the laboratory results or chest CT scan. The examination was performed in accordance with expert recommendations, with the patient in a sitting or 30˚ prone position. A portable EDAN U2 ultrasound machine equipped with a linear and convex probe was used. A convex probe was first used to provide a panoramic view of the pleural line and ultrasound artifacts associated with the status of the lung parenchyma (A lines, comet tail artifacts such as B lines, and consolidations). A linear probe was then used for a more detailed study of the appearance of the pleural line and subpleural abnormalities. The depth was set at approximately 8 to 10 cm, depending on the patient's morphology. Gain was used to optimize the images obtained. We systematically examined the front and back of each hemithorax. They were divided into anterior and lateral sectors. The anterior sector was then divided into upper and lower halves. The probe was placed on the thorax so that it touched both ribs at the same time, cutting the intercostal space in the sagittal direction.

All CT scans were performed in the supine position with or without contrast injection. The images were interpreted using pulmonary and mediastinal window settings. A physician specializing in medical imaging examined the CT scans to determine the presence or absence and extent of chest lesions. Most of the chest CT scans were performed in three facilities. Different brands of scanners and different types of bars were used depending on the facility where the scans were performed. However, all images were reviewed by the HIAA radiologist.

After verification and validation, the data were collected in an Excel file (version 2013) and then imported and analyzed using SPSS (Statistical Packages for the Social Sciences) software (version 20). Quantitative variables were described as means with standard deviations after performing normality tests. Qualitative variables were described in terms of numbers and percentages.

The univariate analysis consisted of:

- Searching for associations between anomalies in the different imaging techniques and all the variables in the sample. The tests used for the univariate analysis were the chi-square test (or Fisher's test in the absence of chi-square validity criteria) for cross-referencing with qualitative variables and a Student's t-test with quantitative variables.
- Measuring the concordance between the different imaging techniques using the Kappa concordance test. The scale proposed by Landis and Koch was used for its interpretation.

The significance threshold was set at 0.05. The sensitivity and specificity between the different ultrasound diagnoses compared to CT scans were evaluated using ROC (Receiver Operating Characteristic) curves. The closer the value of the area under the curve (AUC) is to 1, the better the test.

3. Results

During the study period, we collected 63 cases that met our inclusion criteria. The mean age of the patients was 58.8 years with a standard deviation of 18.2 years, ranging from 27 to 93 years. Of the 63 patients examined, 39 (61.9%) were women and 24 (38.1%) were men, giving a sex ratio (M/F) of 0.6.

Pleuropulmonary ultrasound was performed in all patients, and an abnormality was found in 59 patients (93.7%). The profiles were C profile in 44.4% and B profile in 33.3%. Fluid effusion was observed in 13 patients (20.6%) (Table 1).

Table 1. Distribution of patients according to the profiles obtained.

Ultrasound profiles	Number (N)	Percentage (%)
A Profile	4	6.3
B Profile	8	12.7
B' Profile	**21**	**33.3**
A/B Profile	5	7.9
C Profile	**28**	**44.4**
PLAPS Profile	3	4.8
Nude Profile	2	3.2
Fluid effusion	13	20.6

*Some patients may have had associated profiles.

Regarding abnormalities, alveolar-interstitial involvement was detected in 58.7% of patients, followed by pulmonary consolidation in 28.6% of patients. Some patients had associated lesions (Table 2).

Table 2. Pulmonary lesions in patients undergoing ultrasound.

Ultrasound lesions	Number (N)	Percentage (%)
Alveolar-interstitial involvement	**37**	**58.7**
Condensation pulmonaire	18	28.6
Pleurisy	15	23.8
Hypoventilation	2	3.2
Normal lung	4	6.3

*Some patients may have had associated lung lesions.

CT scans were abnormal in 58 patients, or 92.1%, and 55.6% of patients had alveolar-interstitial lesions. Pulmonary condensation was found in 26 patients, or

41.3%. Mixed lesions were identified on CT scans in some patients (Table 3).

Table 3. Distribution of patients according to chest CT abnormalities.

CT scan lesions	Number (N)	Percentage (%)
Alveolar-interstitial involvement	**35**	**55.6**
Pulmonary condensation	26	41.3
Pleurisy	15	23.8
Pulmonary hypoventilation	1	1.6
Normal lung	5	7.9

*Some patients may have had associated lung lesions.

Pleuropulmonary ultrasound detected 37 cases of alveolar-interstitial involvement, 34 of which were confirmed by CT scan. One false negative and three false positives were identified. The kappa coefficient was calculated at 0.9 (Table 4). Ultrasound had a sensitivity of 96% and a specificity of 92%, with an area under the curve (AUC) of 0.9 (Figure 1).

Table 4. Diagnostic concordance between ultrasound and CT scan for alveolar-interstitial involvement, number and percentage.

Alveolar-interstitial involvement	CT scan +	CT scan −	Total	Kappa Coefficient
Ultrasound +	34	3	37	
Ultrasound −	1	25	26	**0.9**
Total	35	28	63	

(+) indicates the presence of the syndrome and (−) indicates its absence.

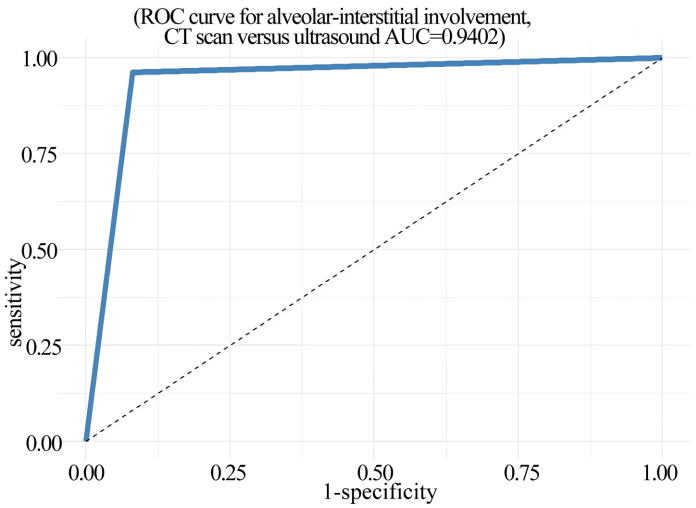

Figure 1. ROC curve for alveolar-interstitial involvement.

Among the 18 patients with pulmonary consolidation on ultrasound, 17 pa-

tients had a correct diagnosis. Ultrasound gave 9 false negatives and one false positive. Interobserver agreement was calculated at 0.7 (Table 5). Sensitivity was 94% and specificity was 80% (AUC = 0.9) for ultrasound (Figure 2).

Table 5. Diagnostic concordance between ultrasound and chest CT scan for pulmonary consolidation, number and percentage.

Pulmonary consolidation	CT scan +	CT scan −	Total	Kappa Coefficient
Ultrasound +	17	1	18	
Ultrasound −	9	36	44	**0.7**
Total	26	37	63	

(+) indicates the presence of the syndrome and (−) indicates its absence.

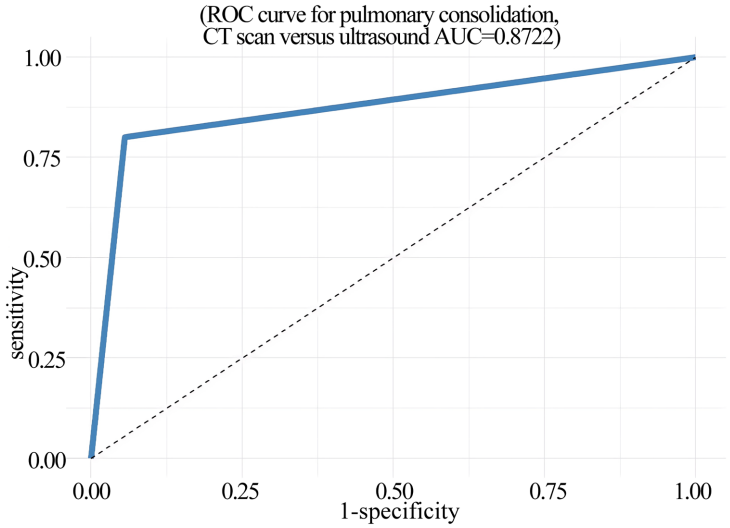

Figure 2. ROC curve for pulmonary consolidation.

For the diagnosis of fluid effusion, 12 cases were seen on CT scan out of the 16 detected by pleuropulmonary ultrasound. Four patients with fluid effusion on CT scan did not have effusion on ultrasound, and three cases detected by ultrasound were not seen on CT scan. Interobserver agreement yielded a kappa coefficient of 0.7 (Table 6). The sensitivity and specificity of ultrasound were 92% and 80%, respectively. The area under the curve was 0.9 (Figure 3).

Table 6. Diagnostic concordance between ultrasound and chest CT scan for fluid effusion, actual and percentage.

Fluid effusion	CT scan +	CT scan −	Total	Kappa coefficient
Ultrasound +	12	3	15	
Ultrasound −	4	44	48	**0.7**
Total	16	47	63	

(+) indicates the presence of the syndrome and (−) indicates its absence.

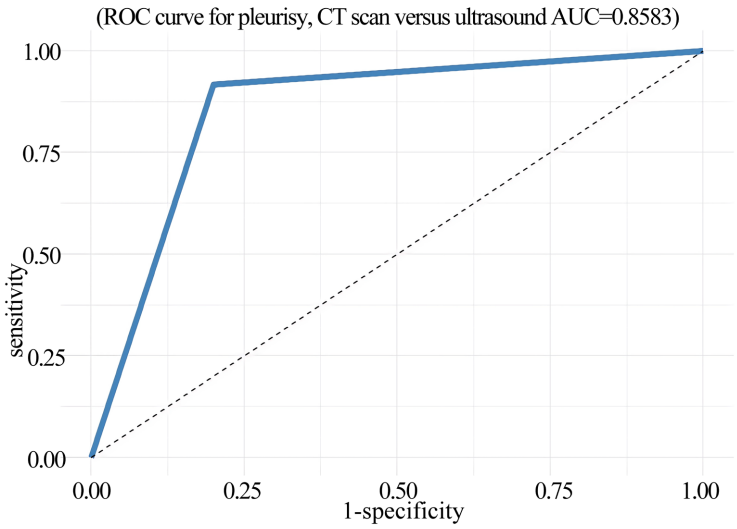

Figure 3. ROC curve for pleurisy.

Regarding alveolar hypoventilation, two cases were seen on ultrasound and one case was identified by CT scan (**Table 7**). The sensitivity for the diagnosis of alveolar hypoventilation was 100% and the specificity was 50%. The area under the curve was 0.8 (**Figure 4**).

Table 7. Diagnostic concordance between ultrasound and CT scan for hypoventilation, number and percentage.

Asthma/COPD	CT scan +	CT scan −	Total	Kappa coefficient
Ultrasound +	1	1	2	
Ultrasound −	0	61	61	**0.7**
Total	1	62	63	

(+) indicates the presence of the syndrome and (−) indicates its absence.

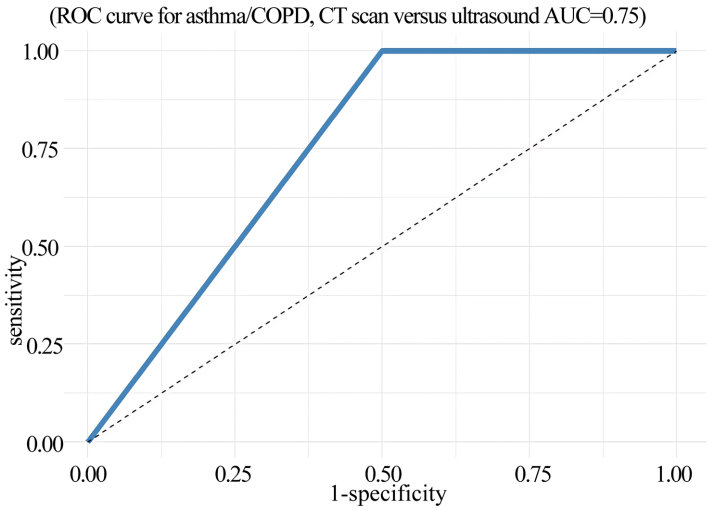

Figure 4. ROC curve for asthma/COPD.

4. Discussion

The major limitation of the study is related to the small sample size. The sample size obtained for the study period (six months) may be related to the difficulties some patients had in undergoing additional tests, due to their high cost and unavailability at the time of data collection. Although the sample size allows for statistically significant results, it would have been desirable to include more patients. Given that the etiologies of dyspnea are medical and/or traumatic, it would also be interesting to conduct a study over a longer period. The results presented were subject to two main biases. First, a selection bias, due to the fact that the reference examination (chest CT scan) was paid for by the patients. Second, an information bias due to the delay in performing the CT scan.

The main strength of the study was that the ultrasound was performed by a single operator, thus limiting selection and information bias. The results obtained show that, despite a short training period, learning pleuropulmonary ultrasound can be quick and achievable in situations where resources are insufficient. This is consistent with the data found in the literature. Pleuropulmonary ultrasound is considered an examination that is easy to learn with minimal training [10].

Due to its gaseous composition, the lung has historically posed diagnostic difficulties for ultrasound. Further research into this technique has made it an indispensable tool in the diagnosis of lung diseases. In addition, data from previous studies comparing pleuropulmonary ultrasound with chest CT in critically ill patients are limited due to multiple methodological weaknesses.

Interstitial syndrome, by its radiological definition, encompasses a set of signs that reflect damage to the lung's supporting tissue: the interstitium. Its diagnosis is therefore primarily radiological. However, radiography has shown its limitations in intensive care units. Ultrasound, which has proven its superiority, has been used to overcome these limitations [11]. Detecting interstitial syndrome on ultrasound is easy thanks to the comet-tail artifacts present on the lung surface (B-lines). These lines correspond to Kerley B-lines on X-rays. Their presence indicates partial alveolar filling and suggests several pathologies, depending on whether they are localized (pneumonia, atelectasis) or diffuse in both fields (pulmonary edema, pulmonary fibrosis).

A review of the literature has shown a sensitivity of 94% and a specificity of 92% for the use of B-lines in the diagnosis of acute cardiac decompensation and acute pulmonary edema [12]. Similarly, pleuropulmonary ultrasound has proven effective in the diagnosis of Diffuse Interstitial Lung Disease (DILD). Numerous studies have shown a close correlation between interstitial involvement in lung diseases and B-lines, with a sensitivity and specificity of approximately 93% [13]-[15]. There is a good correlation between chest CT and pleuropulmonary ultrasound with 7 mm B-lines (B7) and 3 mm B-lines (B3). These correspond respectively on CT scans to thickened interlobular septa and ground-glass opacities [15].

During this study, interstitial involvement was correctly detected by ultrasound in 34 patients. One case was not detected by ultrasound and three cases observed

by ultrasound were not recognized by CT scan. Sensitivity was 97% and specificity was 89%. These results are superior to those of Smit, who found sensitivity and specificity of 60% and 69%, respectively [16]. The reason for this may be related to the definition of interstitial syndrome. It was characterized by the presence of a B profile (B line with pulmonary sliding), an A/B profile, or a B' profile (B line without pulmonary slip). This is not often the case in other studies. In Smit's analysis, for example, profile B' corresponded to anterior consolidation. However, it should be noted that a B profile without pulmonary slip has been shown to correlate with ARDS and pneumonia [8] [17].

The degree of agreement yielded an almost perfect kappa coefficient (k = 0.9). Ultrasound is justified by the fact that there are no physical signs specific to interstitial syndrome. Radiological indicators are often not visible on emergency X-rays taken of dyspneic patients. Given the data in the literature showing the high sensitivity and specificity of pleuropulmonary ultrasound in the diagnosis of interstitial syndrome, the three cases that were not confirmed by CT scan can be attributed to scanning constraints: remote performance of pleuropulmonary ultrasound. Several factors prolonged the time required to perform the scan, ranging from cost to equipment unavailability, the instability of certain patients who had to be moved, and the inability of other patients to lie in the supine position. Some lesions seen on ultrasound may no longer be present on the scan after a delay of more than 24 hours. This was particularly true in cases of pulmonary congestion, where emergency treatment consists of depleting the patient and the response to treatment is fairly rapid. This problem was ruled out in Smit's study, which excluded any patient who had undergone a chest CT scan more than 8 hours earlier [16]. This information allows ultrasound to be considered a determining factor in the management of critically ill bedridden patients and even in monitoring response to treatment. The number of B-lines can respond quickly to changes in the water content of the lungs. Thus, when a patient with fluid overload is depleted invasively (dialysis) or non-invasively (diuretics), it is possible to monitor a change (decrease) in their number [18].

Pulmonary consolidation is a major concern in critically ill patients because X-rays are an imprecise tool, CT scans pose transportation problems, and there are issues with radiation exposure and cost. Consolidation is characterized by four features:

- The disappearance of A lines;
- The hepatization of the lung;
- Dynamic air bronchogram**,** *i.e.*, the presence of air in the bronchi, revealed by branched hyperechoic structures within the consolidated lung that move with breathing;
- The direct correlation between the images and the pathology, with pneumonia occurring only where consolidation is found.

Of the 63 cases evaluated, 26 patients had pulmonary consolidation. Ultrasound detected 18 of these, 17 of which were confirmed by CT scan. However, there were

9 false negatives and one false positive. Sensitivity was 92% and specificity was 80%. Smit's study found lower sensitivity (76%) and higher specificity (92%) [16]. In 2004, Lichtenstein found an even better sensitivity of 90% and specificity of 98% [19]. Chavez *et al.* Conducted a meta-analysis in 2014 of 10 studies involving 1172 patients, finding an even better sensitivity (94%) and specificity of 96% [20]. Pulmonary consolidations are fluid disorders and are therefore easily penetrated by ultrasound. They affect the wall in 98% of cases [19] and can occur anywhere. This means that the sensitivity of ultrasound depends on the site, size, time, and age of the lesion. Indeed, some lesions located deep within the parenchyma may go unnoticed on ultrasound. In addition, the presence of a large effusion may obscure parenchymal lesions. Noirez and Nicod state in their article that parenchymal consolidation has better sensitivity and specificity when the lesions are in pleural contact [15].

The concordance test showed a Kappa coefficient of 0.7, which is a high degree of concordance according to the scale proposed by Landis and Koch. This result is similar to that of Lichtenstein's study on the ultrasound diagnosis of alveolar consolidation in critically ill patients (k = 0.8) [19]. In the BLUE Protocol, consolidation is represented by the presence of a C profile corresponding to pneumonia. In this context, there is a strong correlation between pleuropulmonary ultrasound and CT scan for the detection of pulmonary consolidations [20] [21]. A meta-analysis conducted in 2017 proved that ultrasound is reliable for the diagnosis of pneumonia, with a sensitivity of 91% and a specificity of 100% [22].

Pleural effusion consists of the presence of fluid in the pleural space, which may be blood, purulent fluid, or non-purulent fluid. Several medical conditions are responsible for this: volume overload, congestive heart failure, and pleuropulmonary infection are the most common causes in the Intensive Care Unit (ICU) [23]. Ultrasound diagnoses effusion by the presence of a hypoechoic and homogeneous image, associated with a specific dynamic sign: the sinusoidal sign, with a very high sensitivity of 92% and a specificity of 93%. It can detect even the smallest amount of fluid effusion provided that the probe is placed opposite it. This is in contrast to chest X-rays, where approximately 200 ml of fluid is required for it to be visible [15]. In addition to making the diagnosis, ultrasound can be used to quantify fluid effusion, estimate its nature, and guide its puncture.

In this study, ultrasound detected 15 cases of fluid effusion, 12 of which were seen on CT scan. There were 3 false positives and 4 false negatives. Sensitivity was 92% and specificity was 80%. Smit *et al.* found lower results with a sensitivity of 85% and a specificity of 77% [16]. In Lichtenstein's study, the results were much higher. The sensitivity of pleuropulmonary ultrasound for pleural effusion was 94% and the specificity was 97% [19]. We believe there are two reasons for the difference observed in this study and those found in the literature. Firstly, the level of experience of the operator and secondly, the delay in performing the scans.

With regard to the level of experience, a few difficulties were encountered. On the one hand, in differentiating between the lung and abdomen in the sloping ar-

eas in patients with large amounts of ascites. And on the other hand, cases of millimetric effusions that may have gone unnoticed by the operator, for which the position of the probe should have been adjusted to examine a more appropriate area [15]. With regard to the delay in performing the reference examination, patients could either present with a worsening of the initial condition due to the onset of effusion during hospitalization, or clinical improvement with the disappearance of the effusion. The kappa coefficient showed a strong correlation (k = 0.7). Ultrasound is not only the reference test for detecting effusion with a sensitivity close to 100% [23], but it can also help to distinguish its nature.

In the BLUE Protocol, the presence of an A profile prompts analysis of the venous trunks for the diagnosis of pulmonary embolism. If the venous analysis is normal, the BLUE Protocol recommends returning to the lung and analyzing the posterolateral areas. If alveolar or pleural involvement is observed, pneumonia will be considered; otherwise, the most likely diagnosis would be asthma or COPD [8]. These are bronchial diseases, so it is assumed that they produce a normal lung surface. This explains the ability of ultrasound to distinguish these entities from pulmonary edema [24].

During the study, five patients had a final diagnosis of asthma/COPD (three exacerbations of COPD and two exacerbations of asthma). Two cases were identified by ultrasound, one of which was confirmed by chest CT scan. As clinical findings and spirometry are the elements used to make the diagnosis, it was difficult to obtain more cases that had undergone CT scans. However, for COPD and asthma (considered together for simplicity), sensitivity was 100% and specificity was 50%. In 2019, a meta-analysis showed that profile A had a sensitivity of 78% and a specificity of 94% for COPD and asthma exacerbations [25]. In 2014, Lichtenstein found that profile A, or normal, had a sensitivity of 89% and a specificity of 97% [13].

The difference observed in sensitivity is thought to be related to the reference test used (chest CT scan) to evaluate the diagnostic performance of pleuropulmonary ultrasound in the diagnosis of asthma and COPD. Indeed, ultrasound lesions were compared to CT scan lesions and not to the final diagnoses mentioned in the medical records. This was not the case for the other studies.

The Kappa coefficient calculated, based on the limited data obtained, was strong (k = 0.7). The reason for the three cases not identified by ultrasound was that the patients had mixed diagnoses, such as decompensation secondary to pneumonia. They were therefore identified by profiles corresponding to the type of parenchymal lesions identified. This information highlights another limitation of ultrasound for patients with multiple pathologies. This is the case in this study, where 46% of patients had a mixed final diagnosis. Lichtenstein already described this problem in his original study. He said that it "would require a precise means of determining the respective role of each mechanism involved in respiratory distress" [8]. It is important to note that the BLUE protocol was developed to provide a distinct profile leading to a specific ultrasound diagnosis. However, if the initial

approach suggests a mixed diagnosis, such as decompensation secondary to pneumonia, it is possible to expand the BLUE Protocol by adding cardiac ultrasound. This expanded approach could increase the potential of pleuropulmonary ultrasound, at the expense of its simplicity, in order to provide a more comprehensive and accurate picture of the patient's condition [26].

This study clearly demonstrated that pleuropulmonary ultrasound was highly informative in the diagnostic investigation of dyspneic patients [27]. It described pleuropulmonary lesions with a degree of accuracy close to that of CT [28]. It was found to be superior to clinical examination and chest X-ray in a comparative study, with CT as the reference. The high specificity for interstitial syndrome (92%), pulmonary consolidation (80%), and pleurisy (80%) is useful in emergency practice for ruling out life-threatening diagnoses. The goal of the emergency physician/emergency medicine specialist is first to determine the etiology and initiate appropriate treatment.

The presence of multiple respiratory conditions in an intensive care population is a common phenomenon, making it difficult to conduct a diagnostic accuracy study. Care must be taken to interpret the results in an absolute sense. The aim was to provide clinicians with arguments for incorporating pleuropulmonary ultrasound into the diagnostic process. If a C profile is present, the differential diagnosis must include pneumonia, but the possibility of a secondary diagnosis should not be overlooked.

This study did not focus on the effectiveness of ultrasound, but rather on its use in emergency situations. It was the subject of a correlation study between pleuropulmonary ultrasound and chest CT data. This revealed a significant correlation between the results of the different imaging techniques, in line with the literature, thus demonstrating the diagnostic performance of pleuropulmonary ultrasound in detecting consolidations, effusions, interstitial syndrome, and in diagnosing asthma and COPD. Although it has been shown that significant results can be achieved with an average level of skill [29], sensitivity and specificity nevertheless increase with the operator's experience [22].

Based on the results of this study, it is crucial to emphasize the importance of using pleuropulmonary ultrasound as a diagnostic aid. It should reduce the number of X-rays taken.

5. Conclusion

Pleuropulmonary ultrasound is becoming a widely recommended investigative tool for pleuropulmonary pathologies in emergency situations. The results of the study show that chest CT scan data and pleuropulmonary ultrasound data are strongly correlated. The impact of the latter has been proven in the triage and management of patients using simple protocols. It provides diagnostic guidance and rapid treatment at the patient's bedside, even with a clinical examination showing few symptoms. Early diagnosis in the management of dyspnea requires the availability of ultrasound equipment for medical staff, given the advantages of-

fered by this technique. Thus, everything seems to indicate that ultrasound training has a promising future as a complement to clinical examination in emergency situations.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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