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Intercostal tube drainage vs manual aspiration clinical effectiveness and safety considerations for treating spontaneous pneumothorax in emergency department

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Abstract

Primary spontaneous pneumothorax is a type of pneumothorax occur in a patient who has no underlying pulmonary disease. The purpose of this study was to conduct a systematic evaluation of research on the efficacy of tube thoracostomy vs manual aspiration in treating spontaneous pneumothorax. The 2009 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement used as the guide for this investigation. From 2012 to 2024, we searched the Cochrane Library, PubMed, and EMBASE. Only full-text publications published in English were included in the search. We also searched review references and included the relevant publications we found to ensure that all relevant literature was reviewed for our analysis. A total of 342 patients from 5 randomized controlled trials were included in this investigation. A shorter hospital stay and fewer adverse events are the outcomes of beginning treatments with manual aspiration as opposed to tube thoracostomy. Manual aspiration is an effective first treatment for patients experiencing their first episode of primary spontaneous pneumothorax. The manual aspiration technique is similar to tube thoracostomy in terms of quick lung re-expansion in spontaneous pneumothorax patients.

Keywords: Intercostal Tube Drainage; Thoracostomy; Manual Aspiration; Primary Spontaneous Pneumothorax; Emergency Department

1. Introduction

Pneumothorax (PTX) that occurs spontaneously in a patient who has no underlying pulmonary illness is known as primary spontaneous pneumothorax (PSP) [1]. PSP has a diverse pathophysiology that includes the rupture of bullae or blebs, which are lung parenchymal alterations resembling emphysema brought on by inflammation and blockage of the distal airway [2,3]. PSP can be treated with tube thoracostomy (TT), manual aspiration (MA), surgical intervention, and monitoring with O2 inhalation [4]. There is agreement that observation with O2 inhalation is the best course of action for PSP patients who have a minor PTX (size less than 25%) [4,5]. International recommendations and clinical practice vary, and there are no clear guidelines for PSP patients with a large PTX (size more than 25) [6]. The paucity of high-quality information gathered from several prospective research is the cause of these disparities [4].

Restoring normal anatomical circumstances by eliminating the air from the pleural space and preventing recurrences are the two main objectives of the therapeutic plan for SP. While the second objective only pertains to individuals who have recurrent PTX, the first aim is applicable to all patients who experience an acute episode of PTX. The recurrence rates following the initial PSP episode are predicted to be between 23 and 37% [7]. Lung re-expansion and air evacuation from the pleural space are frequent issues that pulmonologists, thoracic surgeons, and general surgeons deal with on a daily basis. Chest tube drainage with underwater seal or suction, manual aspiration, and conservative therapy

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with oxygen supplementation are among the available therapeutic options [8]. In this study we aimed to systematically review studies discussed the effectiveness of MA vs TT in the treatment of SP.

2. Method

This study was conducted according to The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement, published in 2009. Using the search phrases (thoracostomy, aspiration, spontaneous pneumothorax, intercostal, tube, and catheter), we looked through EMBASE, PubMed, and the Cochrane Library between 2012 and 2024. Search was limited to full text articles published in English language. To make sure that all pertinent research were examined for our analysis, we additionally looked through review references and incorporated the pertinent papers we discovered.

We considered studies which included adult patients (older than 18 years) with a first episode or recurrence of PSP (defined as SP in patients without prior lung illness) who required an intervention, had no concomitant conditions, and were RCTs. Studies were disqualified if they provided insufficient or unavailable data; reviews or experimental trials; only included patients with SSP; include patients with tension pneumothorax, or traumatic pneumothorax.

Immediate success rate, hospitalization rate, hospital stay, recurrence time, chest surgery rate, and complication rate were among the outcomes that were assessed. Immediate success was the main outcome. Full or almost full and continuous lung expansion right after MA was considered immediate success. For TT, immediate success was defined as full lung expansion, no air leaks, and removal of the chest drain within 72 hours of the tube being inserted.

Initially, duplicate studies were not included. The titles were examined by two separate scholars. The abstract was examined to see whether the study could be retrieved for the study if the title indicated any chance of the study fulfilling the inclusion requirements. The two researchers then independently evaluated the entire texts of the papers that were retrieved in accordance with the qualifying requirements. The two researchers thoroughly discussed and settled any disagreements, with a third researcher making the final decision if needed.

Using a systematic data extraction approach, two researchers independently retrieved the pertinent data on the results of each of the included studies. Data collection form include (the year of publication, names of the authors, research design, study purpose, number of patients in each group, patient characteristics, and key findings).

3. Result

In this study we included 5 randomized controlled trials (Fig 1) with a total of 342 patients (Table 1). The success rate of MA was 68%, whereas for TT, it was 80.60% according to Parlak et al., (2012) [9]. After two weeks, the success rates for both groups were 100%. For MA, the hospital stay differed considerably (2.4 versus 4.4). Compared to TT, MA had decreased one-year recurrence rates, albeit these differences were not statistically significant. Fast success was predicted by both female sex and traumatic PTX. One patient died during follow-up from heart failure. Out of the 40 patients who had their first episode of PSP, 21 and 19 patients were allocated to the MA group and the TT group, respectively, according to the Kim et al., 2019 [10] research. The hospital stays for each group were 2.1 and 5.4 days, respectively. However, there was no significant difference in the first treatment success rate or the 1-month and 1-year recurrence rates. According to Thelle et al. (2017) [11] study the initial success rate for MS was 69%, whereas the rate for TT, according to. Sub-analyses for SSP showed that MA's positive effects were remained significant. There was little difference in the one-week success rates. The TT was the sole instance of problems. Main findings of the studies included were presented in (Table 2).

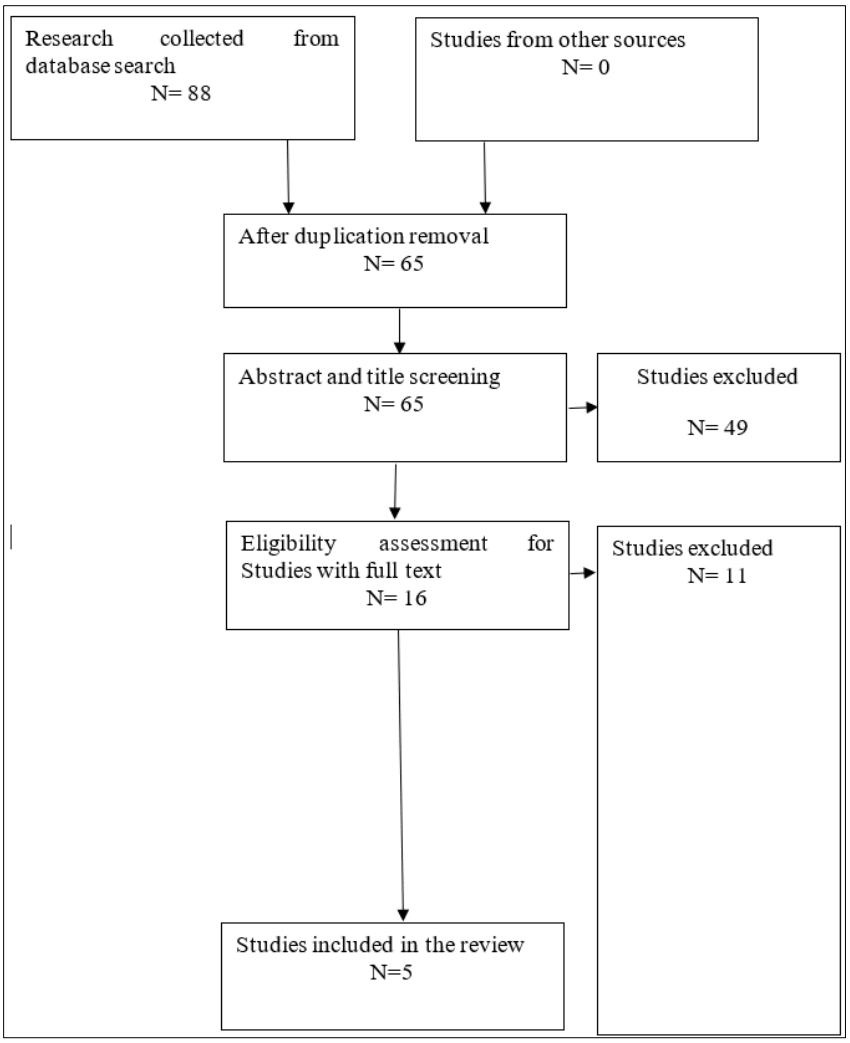

Figure 1 PRISMA consort chart of studies selected

Table 1 study aim and main findings of the include studies

Citation	Method	Study aim	Manual aspiration group	Thoracostomy group
Parlak et al., 2012 [9]	Prospective, randomised trial	To determine the outcome of tube thoracostomy versus manual aspiration in cases of simple primary spontaneous pneumothorax	25	31
Kim et al., 2019 [10]	Prospective Randomized Trial	The outcome of closed thoracostomy and needle aspiration in PSP episode that required intervention.	21	19
Ramouz et al., 2018 [12]	Randomized controlled trial	To assess TT's and MA's effectiveness in treating PSP.	35	35
Thelle et al., 2017 [11]	Randomized controlled trial	Authors hypothesized that MA would be better than TT in the first treatment of both PSP and SSP based on clinical experience. Using the length of hospital stay as the main outcome, they sought to test the hypothesis in a randomized research.	64	63

Korczyński et al., 2015 [13]	Randomized controlled trial	To examine the short-term effects of MA therapy for SP against TT	22	27

Table 2 findings of the studies included

Citation	Findings
Parlak et al., 2012 [9]	For MA, the immediate success rate was 68%, whereas for TT, it was 80.60%. Both groups had 100% success rates after two weeks. The hospital stay was significantly different for MA (2.4 versus 4.4). Although not statistically significant, the one-year recurrence rates in MA were lower than those in TT. Female sex and traumatic PTX were predictors of quick success. Heart failure claimed the life of one patient during follow-up.
Kim et al., 2019 [10]	Twenty-one and nineteen patients were assigned to the MA group and the TT group, respectively, out of the forty patients who had experienced their first episode of PSP. Each group spent 2.1 and 5.4 days in the hospital, respectively. The 1-month and 1-year recurrence rates, as well as the initial treatment success rate, did not, however, differ significantly.
Ramouz et al., 2018 [12]	Patients in the TT and MA groups experienced initial treatment success rates of 68.5% and 54.2%, respectively, with no discernible difference between the research groups. After a week, 91.4% of patients in the MA group and 94.2% of patients in the TT group showed full lung expansion. Thirteen patients had a pneumothorax recurrence (4 in the MA group and 9 in the TT group). In the first hour following the surgery, the first postoperative day, and the first week following the intervention, the mean pain intensity was considerably lower in the MA group.
Thelle et al., 2017 [11]	There were 127 patients total, 48 of whom had SSP. 63 individuals had TT, while 65 patients had MA. MA had a substantially shorter median hospital stay (2.4 days) than TT (4.6 days). In comparison, the SSP subgroup's equivalent values were 2.54 days, while MA and TT's were 5.53 days. For MS, the immediate success rate was 69%, whereas for TT, it was 32%. Sub-analyses for SSP revealed that the favorable impact of MA was still considerable. The one-week success rates did not differ much. The only time there were complications was during the TT.
Korczyński et al., 2015 [13]	The baseline characteristics of the patients in the two treatment groups did not differ significantly. The MA and TT groups had first line therapy success rates of 64% and 82%, respectively; the difference was not statistically significant. Compared to TT, the median duration of therapy with MA was much shorter.

4. Discussion

The purpose of this study was to evaluate the clinical effectiveness and safety of MA against TT in the treatment of SP. We included studies which evaluated both treatment methods in patients with PSP, SSP or both. Regarding the effectiveness of first-line therapy, Korczyński et al. (2015) showed no statistical difference between small bore MA and TT. About 64% of individuals treated with MA and 82% of those treated with TT were able to reach the treatment target. The success rate was somewhat skewed toward the later approach, which may have clinical significance even if the difference was statistically small. Furthermore, it is impossible to rule out the possibility that TT might benefit from higher statistical power of the difference if there were more individuals in both treatment groups [13]. These findings are consistent with a research by Ayed et al. [14] that indicated that patients treated with chest tube drainage (68%) and small bore manual aspiration (62%), had similar therapeutic effectiveness.

The findings of the randomized controlled study by Ramouz et al. (12) revealed no discernible difference between the MA and TT approaches in terms of the treatment's immediate and one-week success rate; nevertheless, patients who benefitted from the MA technique experienced less severe pain and a shorter hospital stay. Although there was no discernible difference in the length of hospital stay or the risk of pneumothorax recurrence, the TT approach produced superior results and a higher success rate in an early trial by Andrivet et al. that evaluated 61 patients with SP. A bias in the mean length of hospitalization resulted from the extended hospital stays in MA patients assessed in the Andrivet research, which was related to certain patients' 72-hour intervention delay [15].

The length of hospitalization following MA is about half that of TT, according to the Thelle et al. research. Both PSP and SSP patients showed this result. Compared to TT, the rate of complications was minimal for NA [11]. The results of other randomized studies comparing TT and MA have been inconsistent with regard to the impact on hospital stay duration. Despite a 72-hour delay in MA intervention, several researchers reported no difference between the two treatment approaches [15]. Others discovered that patients treated with MA had a shorter hospital stay than those treated with TT [9,14,16]. According to the findings of previous trials [9,14,16], MA is easy to use, safe, causes little discomfort for the patient, and has no discernible variation in 1-year recurrence rates.

NA is not always advised as the initial course of therapy for patients with secondary pneumothorax, according to recommendations [17,18]. SSP may have a difficult-to-heal air leak [1] and a reduced tolerance to the impact of the pneumothorax on dyspnea [19], which has been the justification for the initial drainage therapy in this group. The length of hospital stay in the NA group was around half that of the CTD group, according to separate analyses of people with SSP in our research. Additionally, Thelle et al. discovered that NA had a considerable edge over CTD in terms of instant success for both PSP and SSP. The recommendations for the initial management of pneumothorax should be reassessed if this discovery is supported by more research.

5. Conclusion

Compared to TT, starting intervention with MA results in fewer adverse events and a shorter hospital stay. When a patient has their first episode of PSP, MA is a good first therapy. In terms of immediate lung re-expansion in patients with SP, MA approach is comparable to TT.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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