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Authors' Affiliation:
[1]Saudi and Jordanian Board Emergency Medicine, Head of Emergency Research Unit, Emergency Department, First Health Cluster, Riyadh, Saudi Arabia
[2]Saudi Board Emergency Medicine Resident, Emergency Department, First Health Cluster, King Saud Medical City, Riyadh, Saudi Arabia

***Corresponding author**
Mazi Mohammed Alanazi; Saudi and Jordanian Board Emergency Medicine, Head of Emergency Research Unit, Emergency Department, First Health Cluster, Riyadh, Saudi Arabia

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Effectiveness of observation vs interventional methods in treating adult patients with pneumothorax in emergency department: Systematic review

Mazi Mohammed Alanazi[1]*, Abdullah Khalid Alqasim[2], Abdulelah Hasan Alkhudairi[2]

ABSTRACT

Background: Pneumothorax (PTX) is a life-threatening illness caused by the air accumulation in the pleural space. It presents as primary, secondary, or traumatic, and its treatment differ depending on size, symptoms, and patient stability. Observation management better than interventional methods such as chest tube insertion, recent evidence supports conservative observation in select cases. This review aimed to study the effectiveness of observation and interventional methods in adult patients with PTX. *Methods*: This study was conducted according to PRISMA guidelines. Searched databases included PubMed, MEDLINE, and Google Scholar for studies published between 2013 and 2024. Inclusion criteria covered original research on adult patients with primary, secondary, or traumatic PTX, comparing observation with interventional methods. Four original studies were included, with a range of clinical settings and PTX types. *Result:* In primary spontaneous PTX, conservative management showed a 94.4% lung re-expansion rate with fewer adverse events and shorter hospital stays compared to chest tube insertion. In trauma-related PTX, observational approaches were effective in 90% of cases, including those on positive pressure ventilation, with no increase in mortality or ICU stay duration. Recurrence was higher in conservatively managed cases of recurrent PTX, but observation remained viable for secondary cases with long recurrence-free intervals and high surgical risk. *Conclusion*: Observation is a safe and effective alternative to interventional treatment in selected patients with PTX. Conservative management decrease complications and hospital burden and maintain better outcomes in stable individuals.

Keywords: PTX, Conservative treatment, Interventional management, Emergency department

1. INTRODUCTION

Pneumothorax (PTX) is an abnormal buildup of air in the pleural space between the lung and the chest wall. PTX can be categorized based on its size and etiology. There are two types of spontaneous PTX that can happen without thoracic trauma: primary and secondary (Light, 1993). While secondary PTX happens in people who have underlying lung illness, most frequently chronic obstructive pulmonary disease, primary PTX happens in persons who do not have clinically evident lung disease.

Different methods are used in the American Chest Physicians College and British Thoracic Society recommendations to assess the extent of the PTX (Baumann et al., 2001; MacDuff et al., 2010). The standard radiograph is used by the ACCP to classify the size based on the distance between the ipsilateral thoracic cupola and the lung apex at the parietal surface. A PTX is considered small if its size is less than 3 cm, and large if its size is greater than or equal to 3 cm. The gap between the chest wall and the outer edge of the lung at the level of the hilum is how the BTS categorizes PTX. PTX is considered small if its size is less than 2 cm, and large if its size is greater than or equal to 2 cm.

Primary spontaneous PTX admissions are more common in males than females, with a rate of 14.1 per 100,000 persons aged 15 and older, which is greater than in previous years (Hallifax et al., 2018). PTX therapy varies depending on size and hemodynamic stability. Regardless of its size, any bilateral, unstable, or symptomatic pneumothorax (PTX) should be actively treated, according to British Thoracic Society (BTS) standards. It is advisable to observe minor, stable PTX with more oxygen. For certain asymptomatic individuals with a high PSP, the observation could be an option, but it doesn't explain why. According to earlier research, assuming there is no underlying pulmonary illness, conservative treatment of a bigger PTX is feasible (Simpson, 2004). The safety of observation as a therapy option for traumatic PTX has been demonstrated by recent research (Demetri et al., 2018). The aim of this study is to systematically review and compare the effectiveness of observation versus interventional methods in the treatment of adult patients with PTX presenting to the emergency department.

2. METHODS

The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement was followed in the conduct of this study. This systematic review was conducted to compare interventional to conservative treatment approaches for spontaneous PTX. The databases searched included PubMed, MEDLINE, and Google Scholar. The search was carried out for publication years (2013 to 2024) The following search terms were used: “spontaneous Pneumothorax,” “conservative treatment,” “interventional management,” “primary spontaneous Pneumothorax,” “secondary spontaneous Pneumothorax,” “traumatic Pneumothorax,” “chest tube,” and “ambulatory management.”

Inclusion criteria were: (1) original peer-reviewed research articles; (2) studies comparing conservative and interventional (e.g., chest tube, aspiration, pleural drainage) treatment for spontaneous PTX; (3) participants aged 14 years and older with primary, secondary, or traumatic PTX; and (4) full-text availability in English. Both randomized controlled trials and observational studies were eligible for inclusion. Case reports, review articles, editorials, and studies without a comparison group were excluded.

Initial screening was performed by examining titles and abstracts to identify relevant articles. Full texts of selected studies were retrieved and assessed for eligibility based on the inclusion criteria mentioned above. Four studies were included in this review (Fig 1). The included studies covered diverse populations of those with primary spontaneous Pneumothorax (PSP), secondary spontaneous Pneumothorax (SSP), and traumatic PTX.

Data collection and extraction were carried out using a standardized designed for this review. Data extracted from each study included study design, population characteristics, sample size, type of PTX, treatment modalities (conservative vs. interventional), clinical outcomes (resolution rates, recurrence, and complications), hospital stay duration, and mortality. Each study was reviewed independently by two reviewers to ensure accuracy and reduce bias in data extraction. Any discrepancies were resolved by consensus discussion. The extracted data were synthesized qualitatively due to the heterogeneity in study design and patient populations.

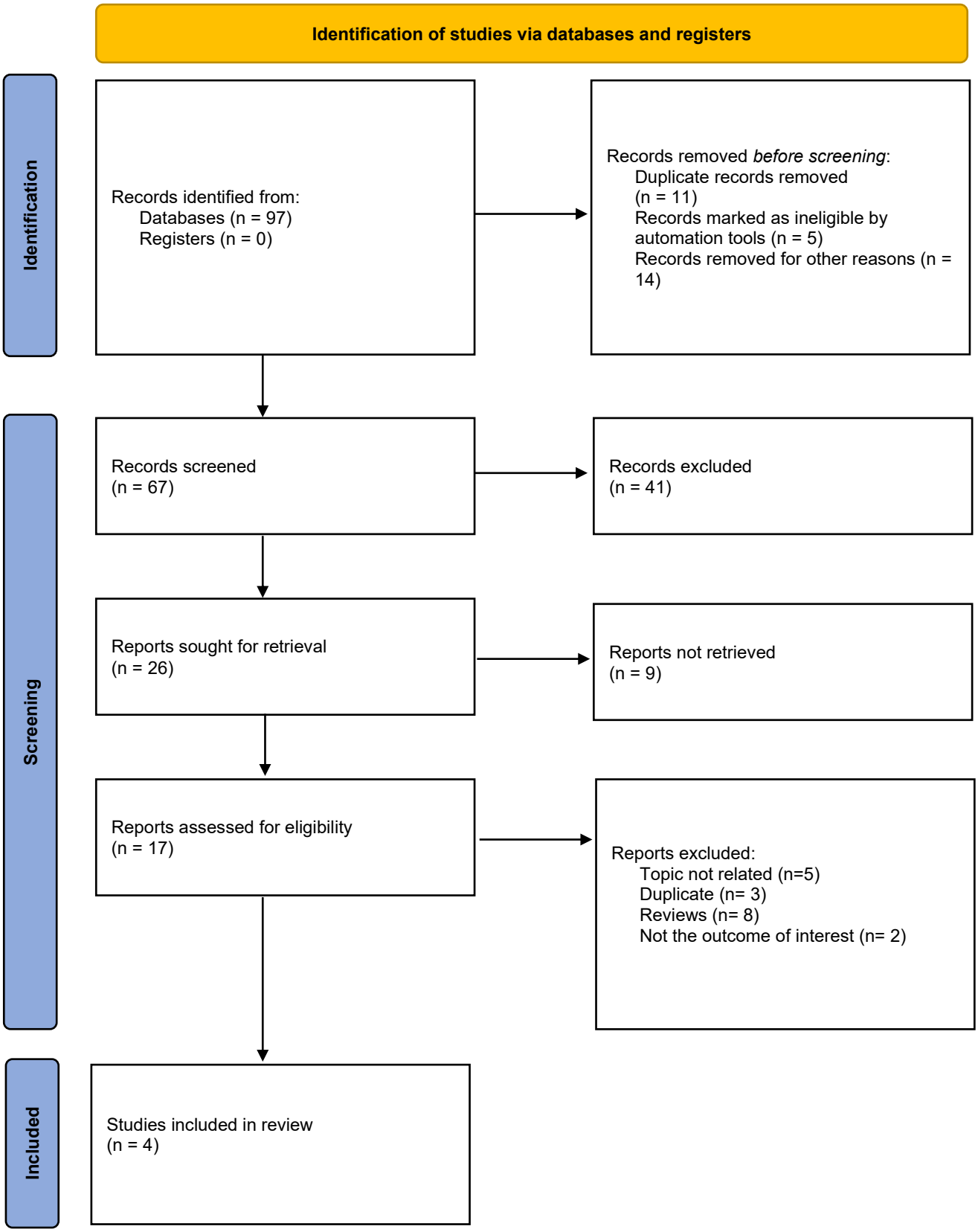

Fig 1: PRISMA consort chart of selected studies

3. RESULTS

Four original studies were included to compare the effectiveness of conservative versus interventional treatment for spontaneous PTX. We include prospective randomized trials, observational studies, and retrospective cohort studies, discussing both primary and secondary spontaneous PTX and traumatic cases. Conservative management was shown to be a good and preferable alternative to invasive approaches in most cases (Table 1).

In the largest randomized controlled trial involving 316 patients aged 14 to 50 with moderate to large primary spontaneous pneumothorax (PTX), conservative management resulted in a 94.4% rate of lung re-expansion within 8 weeks, as determined by complete-case analysis. The median time to radiographic resolution was longer in the conservative group (30 days vs. 16 days), but patients in this group had shorter hospital stays, fewer adverse events, and lower recurrence rates over 12 months (Brown et al., 2020). A retrospective cohort study of 127 episodes in 116 adults compared conservative and invasive management in clinically stable patients with quantified PTX sizes. The study found no significant difference in recurrence rates between the two groups. The conservative group had a significantly shorter mean hospital stay (0.6 days vs. 6.5 days) and fewer complications, indicating the viability of conservative treatment in stable cases, regardless of PTX size (Chew et al., 2014).

A multicenter randomized controlled trial on occult PTX in ventilated trauma patients compared immediate pleural drainage with observation. Among the 90 patients included, there was no significant difference in respiratory distress, ICU stay, or mortality between the groups. 20% of the observed group required drainage, and the complication rate for initial drainage was 15% (Kirkpatrick et al., 2013). An observational study of 602 patients with traumatic PTX found that 46% were initially treated conservatively, and 90% of them did not require further intervention. The failure rate of conservative management is low among those receiving positive pressure ventilation. The presence of a large hemothorax is significantly associated with failure of conservative management (Walker et al., 2017) (Table 2).

Table 1: Main findings of the included studies

Study	Study Design	Study Duration	Participants Characteristics	Study Aim	Methodology
Brown et al., (2020)	Multicenter, prospective, randomized, open-label, noninferiority trial	July 2011 - March 2017	316 patients (14-50 years) with unilateral primary spontaneous PTX; mostly healthy individuals without underlying lung disease	To evaluate whether conservative management is noninferior to interventional management for moderate-to-large primary spontaneous PTX	Patients randomized to interventional (chest tube) or conservative management, followed up with radiographs and clinical interviews for 8 weeks
Chew et al., (2014)	Retrospective cohort study	2006 - 2011	127 episodes from 116 clinically stable adults; 75% male, median age 37, 82% ever-smokers	To assess feasibility of conservative treatment in clinically stable patients with quantified PTX sizes	Review of case notes and radiographs; outcomes compared between conservative and invasive (chest tube) groups, PTX size quantified by Collins method
Kirkpatrick et al., (2013)	Prospective, multicenter, randomized controlled trial	October 2006 - February 2012	90 trauma patients with occult PTX requiring positive pressure ventilation; mean Injury Severity Score 33	To compare outcomes of pleural drainage versus observation in mechanically ventilated trauma patients with occult PTX	Patients randomized to pleural drainage or observation; monitored for respiratory distress, adverse events, and need for drainage
Walker et al., (2017)	Observational study using trauma database	April 2012-December 2016	602 trauma patients with traumatic PTX; 73% male, mean age 48, mean ISS 26	To assess treatment approaches and outcomes for traumatic PTX, including conservative	Data extracted from trauma registry; demographics, interventions, and outcomes analyzed to determine success of

				management effectiveness	conservative management

Table 2: Main findings of included studies

Study	Demographic Characteristics	Hospital Stay	Main Findings	Outcome
Brown et al., 2020	316 patients, aged 14-50, unilateral PSP, mostly healthy	Median 2.8 days (conservative) vs 6.1 days (intervention)	Conservative management noninferior to intervention for PSP with fewer adverse events	94.4% lung re-expansion in conservative group (complete cases), fewer recurrences
Chew et al., 2014)	127 episodes in 116 adults, median age 37, 75% male, 82% smokers	Mean 0.6 days (conservative) vs 6.5 days (invasive)	Conservative approach feasible for PSP; no added complications; reduced hospital stay	No difference in recurrence; shorter stay and fewer complications conservatively
Kirkpatrick et al., 2013	90 trauma patients, mean ISS 33, mixed ages, requiring PPV	No significant difference in ICU, ventilator, or hospital days	Observation for OPTX under PPV is safe in selected cases; some needed delayed drainage	20% required delayed drainage; 15% complication rate with immediate drainage
Walker et al., 2017	602 trauma patients, mean age 48, 73% male, mean ISS 26	Not directly compared, but most conservatively managed patients avoided admission	Conservative management effective in 90% of traumatic PTX cases, even on PPV	90% conservatively managed did not need chest tube; safe even with positive pressure ventilation

4. DISCUSSION

The management of spontaneous PTX has developed significantly, with growing interest in conservative methods across different subtypes, including primary, secondary, and traumatic cases. Evidence suggests that, in some patients, conservative management leads to outcomes comparable to invasive interventions, mainly in terms of safety, complication rates, and healthcare resource utilization.

Findings from a large randomized trial show that conservative management of primary spontaneous Pneumothorax (PSP) is the same as interventional methods such as chest tube insertion. The study shows a high rate of lung re-expansion at eight weeks and lower adverse event rates in the conservatively managed group (Brown et al., 2020). A retrospective cohort study advised for conservative treatment, because of its shorter hospital stays and comparable recurrence rates to invasive treatment (Chew et al., 2014).

In trauma settings, the debate about the management of occult Pneumothorax (OPTX) remains active. A multicenter, randomized controlled trial found no difference in respiratory distress or mortality between patients who received immediate tube thoracostomy and those who underwent observation. (Kirkpatrick et al., 2013). These findings were the same as an observational study involving over 600 trauma patients, in which 90% of conservatively managed individuals did not require escalation of care (Walker et al., 2017).

A previous study on blunt chest trauma cases shows that most patients with OPTX were successfully treated conservatively, and tube thoracostomy is a good option for those with larger pneumothoraces or additional complications (lung contusion or pneumonia). Patients who failed conservative management had higher injury severity scores and required more ventilation support, which indicates the need for careful patient selection (Mahmood et al., 2020). Another trauma registry study found that observation was associated with shorter hospital stays and same mortality rates in comparison to those receiving chest tubes, with no incidence of tension Pneumothorax in the observation group (Wilson et al., 2009).

A long-term outcome study compared conservative treatment, video-assisted thoracoscopic surgery (VATS), and open thoracotomy, showing a higher recurrence rate with conservative management, more than 50% after the first episode and up to 60% following recurrence. Surgical groups showed lower recurrence rates, and VATS had similar benefits to open surgery but with less morbidity and shorter hospital stays (Sawada et al., 2005).

Management of recurrent PTX, and SSP, is controversial. In patients with a long recurrence-free interval (RFI), conservative treatment was shown to be useful, mainly for SSP cases where surgery is riskier due to comorbidities. Surgical intervention had better recurrence-free survival overall (Kim et al., 2020). Data from large hospital samples show that half of iatrogenic pneumothoraces

followed central venous catheter placement, and most could be avoided with real-time ultrasound guidance (Sadeghi et al., 2010). Awareness of these preventable causes is important in modern clinical practice.

Rare but serious cases of PTX following cosmetic procedures like liposuction underscore the need for vigilance. Though infrequent, these complications require prompt recognition and appropriate intervention, with observation being sufficient in select cases (Mentz etal., 2020). Guidelines recommend intervention in symptomatic patients or those at high risk of complications, but conservative strategies are recognized as safe and effective for select patients, in younger, hemodynamically stable individuals with small or moderate pneumothoraces (Baumann and Noppen, 2004; Klopp et al., 2007).

5. CONCLUSIONS

Our study found that conservative management is a safe and effective option for selected patients with spontaneous pneumothorax. It shows benefits including fewer complications, reduced hospital stays, and similar or superior long-term outcomes compared to interventional treatment.

Informed consent

Not applicable.

Ethical approval

Not applicable.

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This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interest.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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