Case Report: Clinical Diagnosis of Pneumothorax–Loss of Syringe Plunger Recoil and Recommendation on Waiting For Spontaneous Closure of Broncho-Pleural Fistula

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ABSTRACT

Tension-type pneumothorax in particular is a life-threatening emergency that requires prompt diagnosis and treatment. Although imaging modalities—a chest CT scan being the gold standard—are frequently employed for confirmation, clinical diagnosis is essential in cases when imaging delays could be lethal. A bronchopleural fistula (BPF) complicated spontaneous pneumothorax in an obese patient with a body mass index of 43.6 kg/m². Before the chest tube was inserted, the diagnosis was verified by a straightforward and repeatable bedside diagnostic technique: loss of syringe plunger recoil following pleural entrance with a 16G trocar cannula. The patient experienced a persistent air leak that was consistent with BPF after tube thoracostomy, and this was meticulously watched. After three weeks of conservative treatment, the air leak eventually closed on its own, negating the need for surgery. This case demonstrates how the syringe plunger recoil test can be used as a simple and trustworthy bedside tool to support imaging in the quick diagnosis of pneumothorax, enabling prompt treatment to start. It also implies that a cautious conservative approach may allow for the spontaneous closure of a bronchopleural fistula with careful monitoring and the right safeguards, saving some patients from the hazards associated with major surgery.

Keywords: pneumothorax**,** bronchopleural fistula, thoracostomy**,** plunger

INTRODUCTION

Pneumothorax is still a serious medical illness that needs to be identified and treated with urgency to avoid potentially fatal consequences [1–3]. Even while imaging techniques like computed tomography and chest radiography are useful [4,5], bedside clinical indicators are still crucial for their early identification and intervention to avoid death especially in tension pneumothorax [6,7]. The disappearance of syringe plunger recoil during aspiration is one such underreported bedside clinical test that could be a useful diagnostic hint. Additionally, treating chronic air leaks—especially bronchopleural fistulae—often poses a therapeutic conundrum [8,9].

A simple bedside technique for identifying pneumothorax with a syringe and needle has been proposed over time per clinical observations. In these situations, loss of resistance during aspiration and lack of plunger recoil are reliably linked to pneumothorax, provided the needle is positioned correctly within the pleural cavity and well fitted to the plunger to avoid aspiration of external air. In every case, the diagnosis of pneumothorax was confirmed by subsequent chest tube placement.

This case study highlights the diagnostic use of syringe plunger recoil loss in pneumothorax and discusses the recommendation to wait for spontaneous closure of a bronchopleural fistula in specific patients.

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"If The Needle Is Well Fitted To The Syringe And The Needle Is In The Pleural Cavity, If There Is No Elastic Recoilof The Plunger Of The Syringe When It Is Pulled, There Is A Pneumothorax"

The following requirements must be fulfilled before using this method: the needle must be securely attached to the syringe; it must penetrate the pleural cavity instead of staying inside the intercostal muscles or subcutaneous tissue; in patients who are obese or have a thick chest wall, this can be ensured by first touching the rib with the needle and then adjusting to pass just above it into the pleural cavity; in these patients, a wide-bore needle from a cannula (16G or 18G) is advised.

Case Presentation

Mr. O.F., an Igbo man from Enugu State who is 66 years old and works as a minibus driver, came in with dyspnea and chest pain that started suddenly. At presentation, he was 1.68 m tall, weighed 123 kg, and had a BMI of 43.6 kg/m². He is a Roman Catholic. He woke up with severe chest tightness and breathing difficulties, although appearing to be well before bed. He was treated with unknown drugs at a local hospital, made a brief recovery, and was discharged the same day. A more serious recurrence struck nine days later, making it impossible for him to travel even short distances without stopping. Because he wasn't getting better, he was admitted for four days before being referred. An X-ray of the chest at the referring hospital showed a large right-sided pneumothorax. Since air was aspirated without plunger recoil, the diagnosis was verified by aspiration using a syringe attached to the trocar of a 16G cannula; recoil was noted when the needle lingered in soft tissue outside the pleural cavity. After being placed at the patient's bedside, a 30F thoracic catheter caused a huge air leak that instantly caused the attached urobag to bloat and bubble when it was later connected to an underwater-seal drainage system.

The patient recovered, and the SPO2 on intranasal oxygen (INO2) increased from 85% to 91%. On the second post-tube thoracostomy day, the air bubble stopped, but the patient's dyspnea deteriorated as saturation decreased. Even though the thoracicic catheter was in place, a huge pneumothorax was still seen on a chest CT scan, confirming that there was no pulmonary embolism, as suspected by pulmonary angiography. The CT scan of the chest also showed lung collapse and bullae. Just beneath the original tube thoracostomy site, a second Closed Tube Thoracostomy Drainage (CTTD) was performed using size 24F. Once more, a huge air leak occurred, but the patient recovered and was weaned off of INO2 that same day. Within 10 hours of the second chest tube, SP02 increased to 94% without oxygen (O2). Prior to the repeat thoracostomy, it was 88% without 02 and 90% with O2. When the initial chest tube was withdrawn during surgery, blood clots were observed to be clogging it. Although the patient was stable and not on oxygen, the air leak continued, and a bronchopleural fistula (BPF) was diagnosed. After that, he was prepared for a thoracotomy and fistula closure.

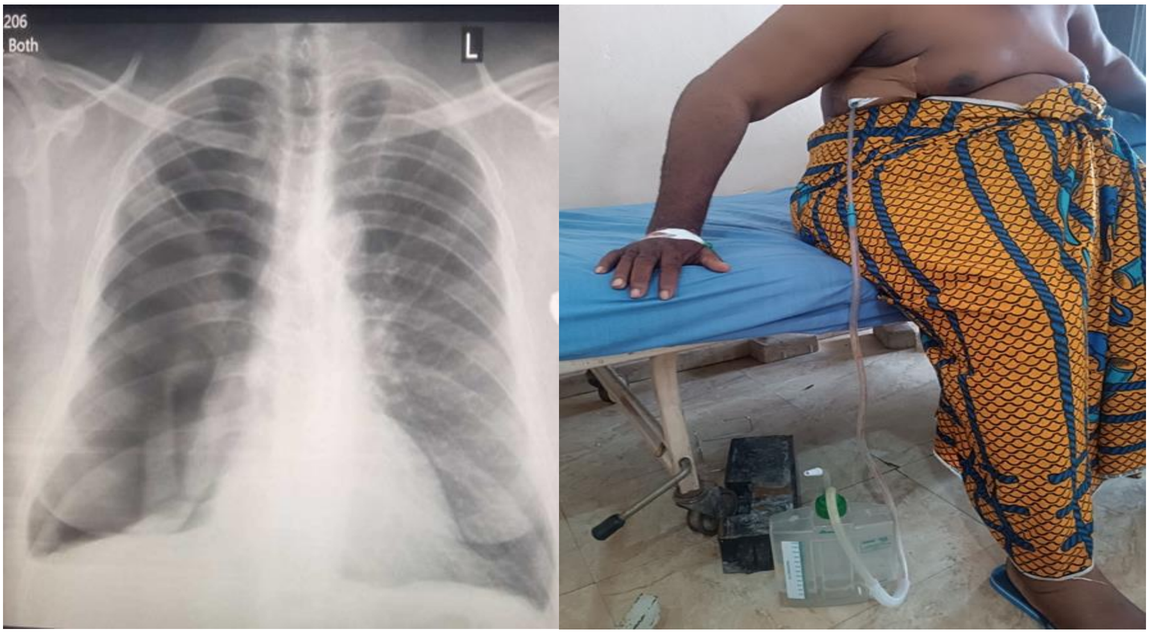

Fig 1:Initial chest x-ray showing pneumothorax and the patient after 2nd chest tube insertion

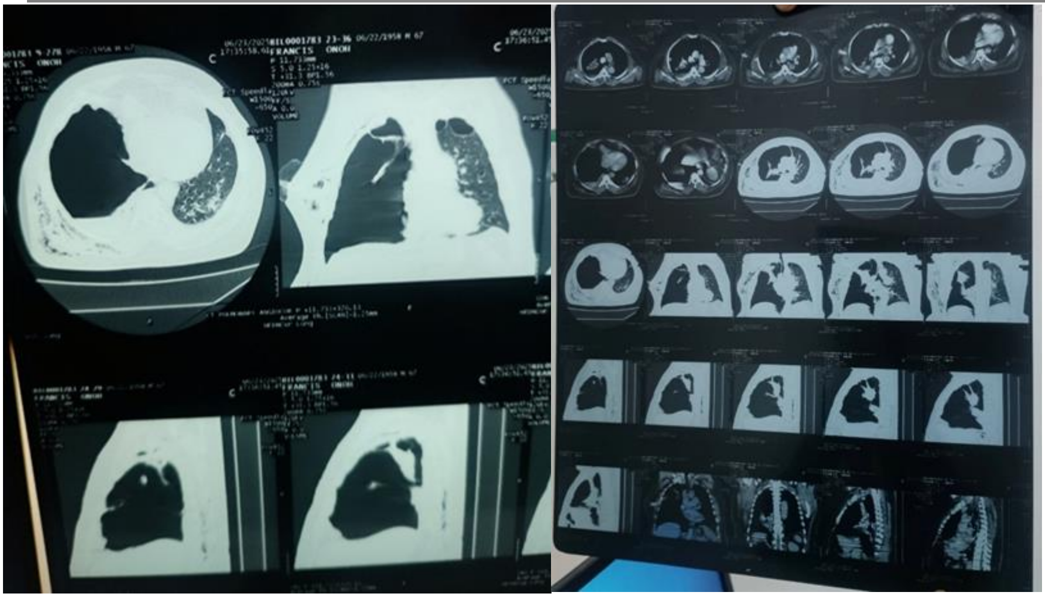

Fig 2 : Chest CT-scan showing right pneumothorax with 1st chest tube in-situ but blocked before 2nd tube was inserted.

The patient, an elderly man with class III obesity, was a high-risk surgical candidate. Furthermore, the procedure could not be performed on the originally scheduled date due to logistical limitations. When the second chest tube got clogged, a third was placed. Chest physiotherapy was continued and within 4-5 days before the next operation date, the fistula closed spontaneously and air bubble stopped in the underwater-seal bottle. Chest physiotherapy was carried out using a balloon exercise, in which the patient repeatedly inflated a balloon several times a day. The improvised balloon device was made by securing a hand glove over the tip of a syringe (with the needle removed) using adhesive tape, leaving a small portion of the syringe barrel at the opposite end as a mouthpiece after removing the plunger completely. The patient was instructed to take a deep breath and exhale forcefully into the glove in a single continuous blow until he could no longer sustain the effort, thereby promoting deeper subsequent breathing. This exercise was performed multiple times daily. In addition, the patient was mobilized out of bed and encouraged to ambulate while carrying the chest drainage bottle.

Following the insertion of the second chest tube (CTTD), he received intravenous ceftriaxone and metronidazole for 48 hours, after which he continued with oral amoxicillin/clavulanic acid 1 g every 12 hours and metronidazole 400 mg every 8 hours, but when the bronchopleural fistula (BPF) persisted for more than one week, the antibiotics was escalated to intravenous ceftriaxone 1 g every 12 hours, levofloxacin 500 mg once daily and metronidazole 500 mg every 8 hours which he received for six days. The regimen was then converted to oral amoxicillin/clavulanic acid 1 g every 12 hours and metronidazole 400 mg every 8 hours for five days.

Analgesic management initially consisted of intramuscular paracetamol 600 mg every 8 hours for 24 hours, followed by oral paracetamol and arthrotec. However, with the insertion of another chest tube and persistence of the BPF, he was commenced on intramuscular tramadol 100 mg every 8 hours and diclofenac 75 mg every 12 hours for 72 hours, after which he was switched to oral co-codamol (paracetamol 500 mg/codeine 8 mg) two tablets every 8 hours and arthrotec (diclofenac 75 mg/misoprostol 200 µg) one tablet every 12 hours for five days. For gastroprotection, intravenous omeprazole 40 mg daily was administered for 72 hours. Deep vein thrombosis prophylaxis consisted of subcutaneous enoxaparin 40 mg daily for two weeks, with oral rivaroxaban 15 mg every 12 hours (stopped after six days), and subsequently dabigatran 150 mg daily was given as well.

Repeat CXR was done when the air bubble stopped. There was still lower lobe collapse but the saturation was satisfactory. The two chest tubes (both patent and the blocked one) were clamped with two forceps in each tube for more than 36hrs and there was no respiratory distress. SPO2 was 96-97% on the extubation date and remained so after the chest tubes were removed. He was still observered in the hospital untill the next day and then discharged home to be followed up in the clinic. SPO2 still 96-97% on the day of discharge. Durration on chest tube was 22days (approx 3weeks)

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Fig 3 : Improvised balloon used for chest physiotherapy--deflated and inflated

Fig 4-CXR after 3rd CTTD showing lung expansion.Air bubble has stopped

Past Medical and Surgical History

He had a ventral abdominal hernia repaired and a bilateral inguinal herniorrhaphy, both of which resulted from carrying a big object in Belgium. He has no known history of diabetes or hypertension, is married, has three kids, does not smoke, drinks alcohol in moderation, and has no known medication allergies.

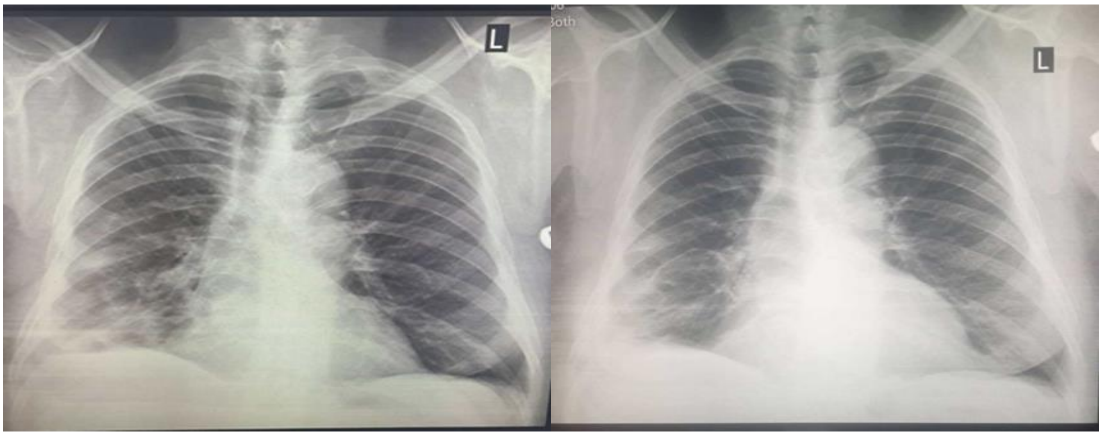

Fig 5: CXR 5 days and 1month after discharge respectively.

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DISCUSSION

The buildup of air in the pleural cavity, known as a pneumothorax, can occur spontaneously or as a result of trauma [10,11]. As the name implies, traumatic pneumothorax happens after a blunt or penetrating chest injury [7]. It can also be iatrogenic following medical procedures such intermittent positive pressure breathing or central line insertion [11,12]. Conversely, spontaneous pneumothorax occurs without any known trauma [13,14]. It can be categorized as secondary when linked to illnesses like emphysema or cancer, or primary when no underlying lung disease is found [15,16], but there is a challenge of this definition among those who feel it is a continumm with secondary pneumothorax [17]. Older persons are more likely to get secondary pneumothorax; the maximum prevalence has been documented between the ages of 60 and 64yrs [13,18]. Primary spontaneous pneumothorax is more common in children and young adults [13,15], frequently due to burst bullae [17,19], even if the underlying lung disease is not usually diagnosed and may be connected to congenital abnormalities. Any type of pneumothorax can be categorized as tension pneumothorax if there is cardiovascular compromise and mediastinal shift [7], or as simple if there is neither. In the former case, intrapleural pressure rises above atmospheric pressure for the majority of the respiratory cycle [7,10,20]. Tension pneumothorax is a surgical emergency, and the patient's life depends on a timely diagnosis and treatment[6]. Since chest X-rays are used to discover the majority of cases, it is currently less usual to identify tension pneumothorax based solely on clinical indicators [21]. However, in this situation, an efficient, dependable, and readily repeatable clinical diagnosis is essential, especially in underdeveloped nations and environments with limited resources, where delays in acquiring imaging may arise from a lack of facilities or financial limitations. Some patients may die in these circumstances while undergoing diagnostic testing.

Reduced tactile fremitus, a hyperresonant percussion note, decreased or missing breath sounds on the affected side, and decreased chest excursion are clinical indicators of pneumothorax on chest examination [7,22,23]. The diagnosis is further supported by evidence of respiratory discomfort and tracheal deviation to the opposite side. Disorientation, cyanosis, and hypotension might happen, especially when tension pneumothorax occurs [6,19,24]. Acute chest pain and dyspnea are the hallmark symptoms of spontaneous pneumothorax, occurring in as many as 95% of patients [19,22]. However, a lack of clinical acumen, patient instability in emergency situations, or difficulty with examination might make clinical diagnosis difficult, particularly in obese people or those with a thick, muscular chest wall (like our index patient) [18]. Variability in interpretation also exists since results might vary depending on how each person interprets what they hear or feel. Therefore, a more objective and repeatable clinical evaluation is very beneficial—indeed, revolutionary and incredibly fulfilling. A well-described clinical test is the presence of a hissing sound when a needle is inserted into the pleura in pneumothorax, or the deflection of light paper or cotton wool when air escapes [25–27]. These symptoms, however, could not always be present or might not be fully recognized, which could lead to a lack of assurance regarding the diagnosis and a propensity to request imaging, which has dangers and delays for the patient. Both the hissing sound and the cotton wool deflection signs are highly subjective, difficult to demonstrate, and often leave uncertainty as to whether they actually occurred. They are also not easily reproducible and require a large volume of air under pressure for demonstration. In contrast, the loss of plunger recoil is far superior—it is objective, easy to demonstrate and understand, and consistently reproducible.

A visible pleural line [28–30] and the lack of lung markings are used to diagnose pneumothorax on a chest X-ray (CXR). However, interpretation is dependent on the experience of the doctor, and it is easy to overlook data. This limitation is especially more noticeable in emergency situations involving unstable patients, when low diagnostic accuracy [31] may nevertheless be achieved by combining clinical evaluation with an anteroposterior (A-P) CXR. The diagnostic yield [32] can be enhanced by using oblique CXR. The aspiration and loss of plunger recoil approach will be highly useful in ambiguous situations. Although the gold standard for detecting pneumothorax, a chest CT scan is simpler to interpret [33,34], it is costly, necessitates patient transportation, and is frequently inaccessible, especially in areas with limited resources where even basic CXR machines might not be available or functional, requiring referral for imaging outside of the hospital.

When it is accessible, ultrasonography can also be used to diagnose pneumothorax at the patient's bedside. The presence of a lung point, a particular spot where pneumothorax starts, is one of the sonographic findings. It is characterized by lung sliding that is apparent on one side and absent on the other, which is just air. The absence of lung pulse, which indicates the regular movement of the lung against the chest wall with each heartbeat [35–37], and horizontal hypoechoic B-lines (comet-tail artifacts) are other diagnostic indicators. With reported sensitivities of 78.6–88.0% for ultrasound against 39.8–52.0% for CXR, the sensitivity of chest ultrasonography in diagnosing pneumothorax is comparable to that of chest CT scan [35] and substantially greater than that of CXR. With a specificity range of 98.4–99.0% for ultrasonography and 99.3–100% for CXR [38,39], both modalities are comparably high.

As far as we are aware, aspiration and loss of plunger recoil have not been documented in the literature as a means of clinically diagnosing pneumothorax. In order to facilitate early diagnosis and prompt initiation of appropriate intervention for pneumothorax, we present this report with the hope that it will improve clinical practice. This is especially important in emergency situations and resource-constrained settings where imaging is not easily accessible. Additionally, we propose that aspiration with lack of plunger recoil, as previously mentioned, offers a trustworthy supportive diagnostic tool[32] in situations where CXR results are unclear.

If the border depth from the chest wall to the pleural line is less than 2 cm or the apical length is reduced by less than 3 cm, the pneumothorax is considered minor; if it is more than 2 cm [19,40,41], it is considered large. Small pneumothoraces can go away on their own without medical intervention [4]. On the other hand, severe pneumothorax frequently necessitates intervention such as aspiration [42,43] or tube thoracostomy [42,43]. To close BPF and treat the underlying cause of persistent or recurrent pneumothorax, however, thoracoscopy or thoracotomy may be required in certain cases [44–47].

There is disagreement over the best time to wait for a bronchopleural fistula (BPF) to potentially close on its own with CTTD alone before undergoing a major surgical procedure such a thoracotomy, and there is a lack of documentation on this topic [44,48]. The American College of Chest Physicians recommends 4days [49], Matthur and colleages [50] recommended 7-9days waiting for closure of BPF from primary spontaneous pneumothorax and Chee et al [51] noted in ther study that 100% of BPF from primary spontaneous pneumothorax closed within 15 days on CTTD and 79% for those from secondary. The risks and expenses of major surgery are avoided with watchful waiting on CTTD, but there is a chance of developing empyema[41] with extended surveillance. Even though surgical closure has been demonstrated to yield excellent results [44], our experience with the index patient, albeit an isolated case, indicates that BPF may spontaneously close with CTTD alone after waiting up to 21 days with proper analgesia, antibiotic coverage, and adequate chest physiotherapy, especially in high-risk surgical candidates. However, a multicenter observational study or formal clinical trial is required to confirm the effectiveness of this long-term conservative management strategy and potentially develop recommendations for its application, particularly in high-risk patients.

CONCLUSION

Loss of syringe plunger recoil during aspiration is a helpful adjunct to CXR for confirmation and is a consistent and repeatable clinical indicator of pneumothorax. In addition, individuals who are at high surgical risk may benefit from a 21-day period of attentive waiting for the bronchopleural fistula to spontaneously close on CTTD while taking appropriate measures.

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