Archives of Anesthesiology and Critical Care (Autumn 2024); 10(Supplement 1): 515-522.

Available online at http://aacc.tums.ac.ir

Case Report

Traumatic Tension Pneumothorax with Extensive Subcutaneous Emphysema

Hojat Rastegari[1], Mehdi Heidari[2,3], Aliakbar Keykha[4,5]*

[1]Department of Emergency Medicine, Khatami AL Ambiance Hospital, Zahedan University of Medical Sciences, Zahedan, Iran.

[2]Department of Anesthesiology and Critical Care, School of Medicine, Zahedan University of Medical Sciences, Zahedan, Iran.

[3]Clinical Immunology Research Center, Ali IbneAbitaleb Hospital, Zahedan University of Medical Sciences, Zahedan, Iran.

[4]Community Nursing Research Center, Zahedan University of Medical Sciences, Zahedan, Iran.

[5]Department of Medical-Surgical Nursing, School of Nursing and Midwifery Zahedan University of Medical Sciences, Zahedan, Iran.

ARTICLE INFO

Article history:
Received 12 January 2024
Revised 15 February 2024
Accepted 29 February 2024

Keywords:
Multiple trauma;
Tension pneumothorax;
Subcutaneous emphysema

ABSTRACT

Tension pneumothorax (TPT) in trauma patients is an uncommon disorder caused by the progressive accumulation of air in the pleural cavity. In pre-hospital and emergencies, if it is not diagnosed and treated on time, it endangers the lives of patients. In this study, we report a patient who developed tension pneumothorax and extensive subcutaneous emphysema due to mild trauma and not going to the hospital in the early hours, which caused an anaphylactic appearance on the patient's face.

Introduction

Chest trauma causes a quarter of all trauma deaths. Two-thirds of the deaths of patients with chest trauma occur after the patient arrives at the hospital [1]. Pneumothorax (PTX) is defined as the presence of air in the pleural cavity and is classified into two categories: spontaneous and non-spontaneous (traumatic). Traumatic PTX can be classified into two categories: iatrogenic and non-iatrogenic [2]. Non-iatrogenic or traumatic pneumothorax is generally classified as penetrating and non-penetrating (blunt) chest injuries. In blunt trauma, rib fracture often causes visceral pleural rupture and pneumothorax, or sudden lung compression leads to alveolar rupture. Penetrating wounds also cause direct entry of air into the pleural cavity and cause PTX [3]. Theoretically, any type and size of PTX can develop into a tension pneumothorax [2]. In tension pneumothorax, the progressive accumulation of air in the chest cavity causes mediastinal shift and cardiovascular collapse. If tension pneumothorax is not diagnosed and treated on time, it leads to the rapid death of patients. Because this condition is rare and has potentially devastating effects, all healthcare personnel must know the signs and methods of chest decompression [1-2].

Case Report

The patient was a 32-year-old migrant worker who lived alone. After midnight, he had a minor accident with a car while collecting recyclables. The driver of the car had fled from the scene of the accident and the patient did not go to the hospital because he did not have an acute physical problem. At seven o'clock in the morning, the patient had gone to his employer's house to do cleaning. He suffered from severe dyspnea and was taken to Khatam Al-Anbia Hospital in Zahedan. On arrival, the patient had severe dyspnea. He was conscious, but due to

The authors declare no conflicts of interest.

*Corresponding author.
E-mail address: aliakbar.keykha@gmail.com

severe dyspnea, he was unable to speak, communicate, and lie on the bed. The patient's head, face, and neck were completely swollen and inflamed so that due to the severity of the swelling, the patient's eyes were completely closed. There was no detectable jugular vein distention due to severe neck edema. Swelling and redness of the head and neck had created an anaphylactic appearance in the patient. The patient's companions did not know about the patient's accident at first. Therefore, the possibility of anaphylactic shock was given. The patient was immediately transferred to the resuscitation room and underwent cardiorespiratory monitoring. In the initial examination, the patient's blood pressure was 80/50 mmHg, heart rate was 156 beats per minute, respiratory rate was 57 breaths per minute, Spo2 was 65%, and the temperature was 37 degrees Celsius. Upon further examination, we noticed a small amount of dried blood on the hair of the patient's head. Upon examination, it was determined that there was a 3 cm wound with a regular border on the patient's scalp. By touching the edema of the head and neck, the cryptic sound caused by the infiltration of air underneath the dermal layers of skin was identified. Therefore, the diagnosis of trauma and tension pneumothorax was confirmed. First, the cervical collar was closed for the patient. Then the patient's clothes were removed and the whole body was examined for swelling, wounds, and deformities. On observation and palpation of the whole body, it was found that there was subcutaneous emphysema from the patient's head to the knees, the patient's scrotum was also completely swollen due to air infiltration (Figure 1). The patient's chest wall movement symmetrically on both sides. The patient had tachypnea and used the secondary breathing muscles, but due to chest swelling, the suprasternal and supraclavicular intercostal retraction was not clear. During respiratory sound auscultation, there was no decrease in sound and no abnormal sound on any side of the chest. Therefore, the patient was treated based on tension pneumothorax.

Investigation and treatment

After transferring the patient to the resuscitation room, oxygen was prescribed with a face mask of 15 liters/min, but the patient was unable to tolerate the mask on his face, he was restless, pulling the mask and monitoring equipment. He was also unable to lie down on the bed. Several attempts to get a peripheral vein were unsuccessful due to hypotension and patient restlessness. For this reason, two peripheral venous catheters size 14 were placed in the second intercostal space on both sides of the thorax in the midclavicular line, which led to the exit of a large amount of air from inside the chest, and the patient became a little calmer. At the same time, we prepared to insert the chest tube on both sides of the chest. After complete disinfection of both sides of the chest with betadine and local anesthesia, chest tube size 28 was inserted into the fifth intercostal space on both sides.

Then, an 18 G peripheral venous catheter was inserted in the right external jugular vein and 5 cc of blood sample was taken for blood tests. Fluid therapy was started with normal saline, and the patient was sedated by injecting 150 mg of propofol, 200 µg of fentanyl, 5 mg of midazolam, and 150 mg of lidocaine, and was intubated with a tracheal tube size 7.5 and under mechanical ventilation was done with PRVC mode. To control the pain and tolerate the mechanical ventilation, the patient was given an infusion of 25 µg of fentanyl and 1 mg of midazolam per hour. Then, one cc of arterial blood was taken from the radial artery for ABG. To facilitate fluid injection and improve the patient's hemodynamics, a three-line central venous catheter was also inserted in the left subclavian vein, and the injection of 3 liters of normal saline was continued until the patient's hemodynamic status stabilized. (BP=120/84, HR=74, RR=14, T=37)

After the stabilization of the patient's condition, the patient was log rolled with the help of 3 people. The back surface and body folds were examined for any injuries, but no injuries were found. For further evaluation, FAST was performed, and due to severe subcutaneous emphysema, only artifacts were seen and a clear image was not seen to detect tissue damage, intraperitoneal bleeding, pneumothorax, and hemothorax. An oral gastric tube and a foley tube were placed for the patient, and no trace of blood was observed in the output secretions. A chest x-ray was performed to confirm the diagnosis. The x-ray showed air leakage under the skin in the neck, chest, arms, and mediastinum, but the volume of air in the patient's chest cavity was not proportional to the severity of the patient's dyspnea (Figure 2).

Therefore, for a more detailed examination and assessment of possible accompanying injuries, a CT scan of the brain, chest, cervical spine, and abdomen with and without contrast was requested for the patient.

In the chest CT, the radiologist reported severe subcutaneous emphysema, bilateral mild pneumothorax, patchy ground glass opacity, and bilateral consolidation in the context of lung contusion or aspiration (Figure 3).

In the brain, neck, and abdomen CT scan, no other significant pathological disorder was reported except extensive subcutaneous emphysema (Figures 4,5,6).

The results of the patient's initial tests were as follows.

WBC= 6/8×103 /mm, RBC= 3/8 mil/mm, HB= 10/2, HCT= 33/3, PLT= 142×1000, PT= 15/sec, PTT= 37/sec, INR= 1/3, BS= 79 mg/dl, BUN= 14 mg/dl, CR= 0/7 mg/dl, K= 3/9 meq/l, Na= 139 meq/l, ABG (PH= 7/41, PaCO2= 35/8, HCO3= 22/5, BE= -1/8, PaO2= 48/8, O2Sat= 84/8)

The only significant change in the patient's tests was the decrease in arterial oxygen pressure and oxygen saturation. Therefore, according to the evidence of chest CT and trauma, the patient was treated with 1 gr ceftriaxone every 12 hours, 600 mg clindamycin every 12 hours, 40 mg pantoprazole daily, and 1 gr NAC every 12 hours. Anesthesia and surgery consultations were done to transfer the patient to the intensive care unit, and the patient was transferred to the ICU unit under cardiorespiratory monitoring with a portable ventilator.

Follow-up and outcome

The patient was under mechanical ventilation in the intensive care unit for 48 hours. In the clinical examination, the amount of subcutaneous emphysema was reduced. also, chest X-ray was shown to reduce the amount of subcutaneous emphysema and the amount of pneumothorax and pneumomediastinum. Therefore, the sedation of the patient was stopped and after the patient was fully conscious, he was separated from mechanical ventilation. After 24 hours, the patient was transferred to the surgery department. 24 hours later, due to the good general condition, and the stability of respiratory and hemodynamic status, the surgeon removed the patient's bilateral chest tubes. 24 hours later, the patient was discharged with an oral antibiotic prescription (cephalexin 500 mg every 6 hours).

Figure 1- Picture of the patient showing severe emphysema in the face and scrotal sac (this picture was prepared after the insertion of a double-sided chest tube and intubation of the patient, and a large amount of emphysema has been reduced. It was much more, but due to the bad patient condition, time was not taken to prepare the image)

Figure 2- Chest X-ray in the supine position shows extensive subcutaneous emphysema in the neck and chest, pneumomediastinum, and severe expansion of the stomach due to air swallowing (X-ray after needle thoracotomy and chest tube placement was done, intrapleural and mediastinum air volume is reduced for this reason)

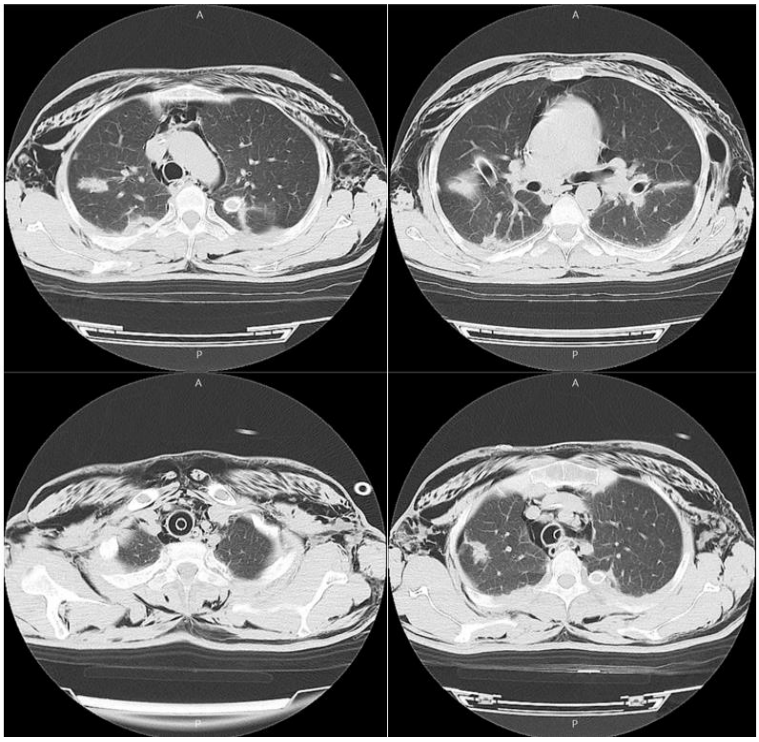

Figure 3- Spiral chest CT scan shows bilateral pneumothorax, pneumomediastinum, lung consolidation due to bilateral contusion, bilateral chest tube, and extensive subcutaneous emphysema (CT after needle thoracotomy and chest tube placement was done, the volume of air inside the pleura cavity and mediastinum are reduced for this reason)

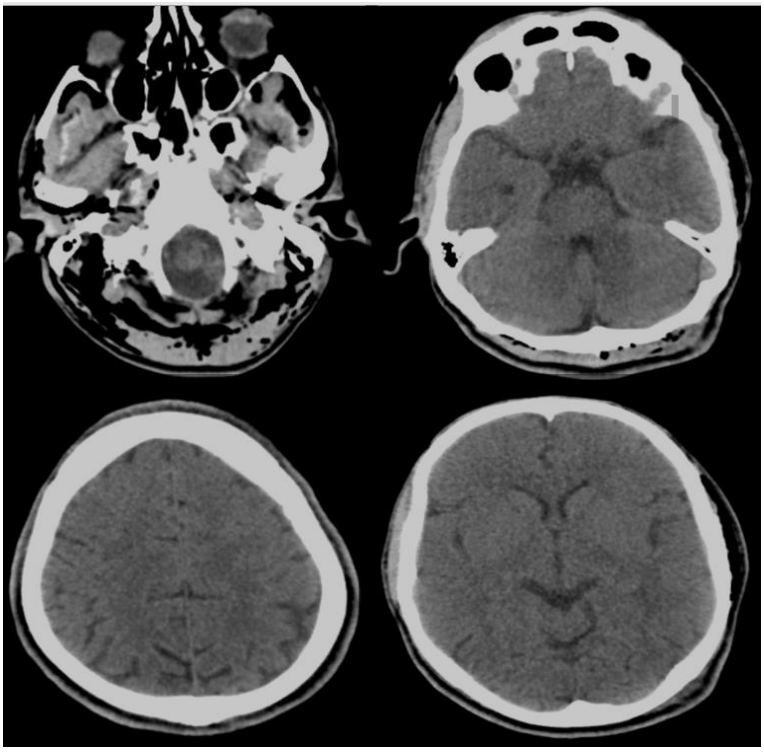

Figure 4- A Brain CT scan shows the normality of the ventricles and brain parenchyma, soft tissue swelling, subgaleal hematomas (SGHs), and diffuse subcutaneous emphysema.

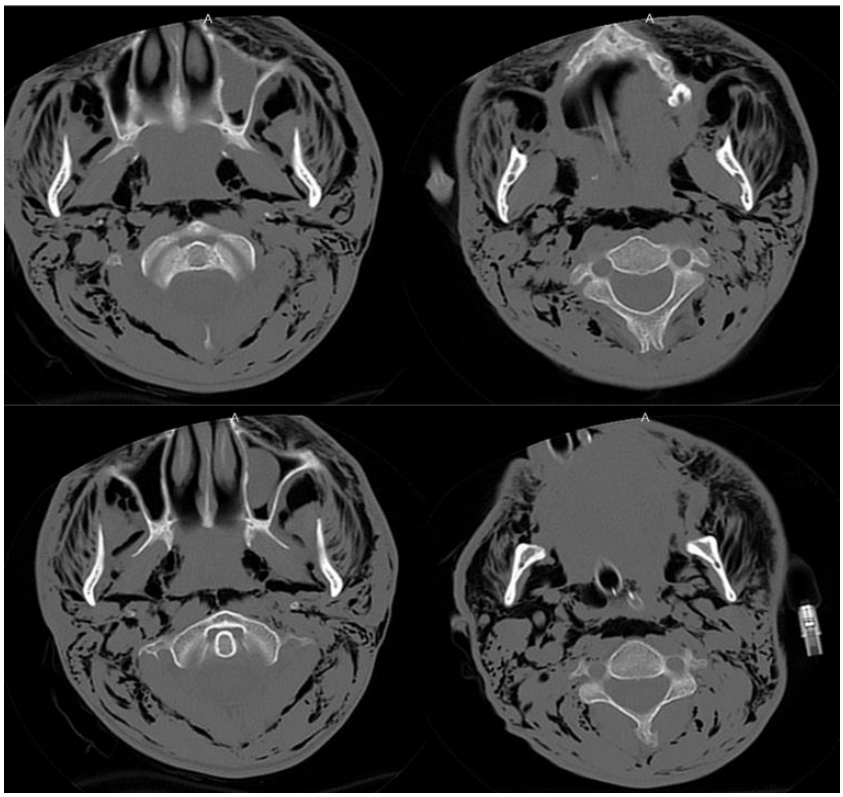

Figure 5- A neck CT scan shows the normal structure, height, and density of the cervical vertebrae, severe diffuse subcutaneous and deep tissue emphysema of the neck, and a left maxillary sinus cyst.

Figure 6- Abdominal CT scan shows the normality of the abdominal organs and diffuse subcutaneous emphysema.

Discussion

This case shows that in all cases of trauma (penetrating and non-penetrating), even mild traumas, tension pneumothorax should be considered as one of the possible diagnoses, and its symptoms such as chest pain, dyspnea, tachypnea, subcutaneous emphysema, and hemodynamic disturbance be examined.

According to what was stated in the patient's history, the patient did not have breathing problems until about 6 hours after the accident. Therefore, it is important to note that in many trauma patients immediately after the injury may not have symptoms of tension pneumothorax, and these symptoms may develop delayed. Therefore, it is very important to observe patients with a history of chest trauma in the emergency department for 3 to 6 hours and re-examine them before deciding on their discharge [4]. Therefore, all healthcare providers must be aware of the signs and symptoms of pneumothorax so that they can make a clinical judgment about the presence or absence of pneumothorax in the patient. Acute pleuritic chest pain radiating to the ipsilateral arm and shoulder and dyspnea at rest are common symptoms found in 64–85% of patients with PTX. Classic symptoms include decreased breath sounds, palpable fremitus, and hypoxia [3]. However, it is important to note that if the PTX is small, the physical examination and vital signs may be normal [2]. The most specific physical examination symptoms occur in tension pneumothorax. Accumulation of progressive air causes an increase in intrathoracic pressure and displacement of the mediastinum. It compresses the superior vena cava and leads to obstructive shock. Jugular vein dilatation, tachycardia, cyanosis, hypoxia, and hypotension are warning signs. Patients may have diaphoresis, chest pain, and severe dyspnea. If there is a hemodynamic disturbance with chest pain and dyspnea at rest, we should suspect tension pneumothorax. Immediate needle thoracotomy is necessary. Because it prevents cardiovascular collapse. Although signs and symptoms of hemodynamic instability must be present in the clinical diagnosis of TPT, the absence of these signs does not rule out the presence of tension pneumothorax [5]. A mediastinal shift is one of the most important symptoms. If a mediastinal shift is observed on CXR, even if there are no clinical signs of tension pneumothorax, treatment should be done preventively. Because in many cases, clinical symptoms develop when pneumothorax reaches more than 57% of lung capacity [6]. In many cases, a "silent lung" may be observed. In these cases, they need needle thoracotomy before being transferred to the hospital at the scene of the accident. In these cases, the needle should be inserted by an emergency medical technician or other trained professional. The needle or cannula should remain in place until the patient has a chest tube. If tension pneumothorax leads to cardiac arrest, needle decompression should be performed as part of resuscitation. Because it may lead to the return of cardiac output [7]. Intercostal space 2 in the midclavicular line (ICS2-MCL) and intercostal space 4/5 in the anterior and midaxillary line (ICS 4/5-AAL, ICS-MCL) are suitable sites for needle decompression (ND) in tension pneumothorax [8-9]. However recent studies show that needle decompression is more favorable in the fourth or fifth ICS-AAL. Because the heart and thymus are located in the vicinity of the second intercostal space (ICS-MCL) and may be damaged. Additionally, ultrasound is recommended to measure chest wall thickness and examine underlying structures before needle decompression if time permits [10]. Because in obese people, the chance of success of needle decompression in the 4th and 5th intercostal space decreases [9]. In the present case, due to severe chest edema and severe dyspnea, needle decompression was performed in the second intercostal space in the midclavicular line(ICS2-MCL).

A similar case was reported by Tritsch et al. A 16-year-old patient presented to the emergency room due to a car hitting a tree at an unknown speed with right-sided chest pain, dyspnea, sweating, and tachycardia. In the examination, the patient was conscious, had a decrease in breathing sound on the right side, tenderness on the right and upper side of the abdomen, a small tear in the scalp and ear, decreased arterial blood oxygen saturation (93%), and normal hemodynamics. A portable chest X-ray revealed that the patient had a large pneumothorax on the right side, which led to a sharp shift of the mediastinum to the left [11]. As discussed earlier, the symptoms of tension pneumothorax can be very diverse. Comparing the two cases, we find that there was no subcutaneous emphysema in this case, hemodynamics was stable, but in the case reported in the present study, there was no decrease in breathing sound, but the patient's hemodynamics was disturbed. But in both cases, tension pneumothorax was created. Although the pneumothorax volume is small in the present study's chest X-ray and chest CT, we do not see the mediastinal shift. This is because needle thoracotomy and chest tube were inserted before radiological studies due to the severity of dyspnea. But in the mentioned study, a chest x-ray was performed first, and then a needle thoracotomy and chest tube were inserted.

Of course, if pneumothorax cannot be diagnosed clinically and the patient is relatively stable, Chest X-ray and bedside ultrasound can be used to diagnose pneumothorax [12]. Ultrasound has better sensitivity and specificity than Chest X-ray to diagnose pneumothorax [13]. This case questions the sensitivity of ultrasound to diagnose pneumothorax. Because the artifacts caused by severe subcutaneous emphysema prevented the diagnosis of pneumothorax by bedside ultrasound [13].

In another case, after falling from a height, a patient came to the emergency room complaining of left-side chest pain. Due to the hemodynamic stability and absence of dyspnea and O2 saturation drop, the patient will first have a Chest X-ray taken. In Chest X-ray, a large pneumothorax of about 30% of the left hemithorax (about 600 ml of air) with multiple left rib fractures (2nd to 6th ribs) is identified. However, the patient refuses to insert the chest tube. For this reason, the patient is transferred to the surgery department and monitored. They prescribe oxygen and painkillers. The size of the pneumothorax is monitored with serial chest X-ray and ultrasound. Serial chest radiographs show a slight decrease in the size of the pneumothorax. The patient is discharged on the sixth day of hospitalization. Then the patient, who has been symptomatic for some time, is followed up in the surgery clinic. However, the chest CT scan after 3 months showed that the pneumothorax was completely resolved. Therefore, they concluded that a large blunt traumatic pneumothorax in a clinically stable patient can be managed conservatively. Therefore, current recommendations for chest tube placement may need to be reevaluated [14].

This variation in clinical symptoms and response to treatment seen in tension pneumothorax shows that every patient with a history of chest trauma should be carefully considered for the occurrence of clinical symptoms. Also, decide to prioritize treatment or perform diagnostic tests based on the patient's condition.

Conclusion

In patients with dyspnea, subcutaneous emphysema, drop in O2 saturation, and hemodynamic disturbance with a history of chest trauma, a needle decompression and chest tube should be placed immediately. If the patient is symptomatic, we should not spend time doing chest x-rays, bedside ultrasounds, or chest CT to confirm the diagnosis.

Consent

After he became conscious and removed the endotracheal tube, informed consent was obtained from him regarding permission to publish the patient's photo and disease report.

Ethical Considerations

The Zahedan University of Medical Sciences research ethics committee approved the present case report with the ethics code of IR.ZAUMS.REC.1402.467.

Abbreviations

TPT: Tension Pneumothorax, PTX: Pneumothorax, ABG: Arterial Blood Gas Analysis, NAC: N-acetyl cysteine, CT: Computed Tomography, FAST: Focused Assessment with Sonography in Trauma, G: Gauge, Spo2: Peripheral Capillary Oxygen Saturation, ICS: Intercostal space, MCL: Midclavicular line, AAL: Anterior Axillary Line, ND: Needle Decompression

References

[1] Sharma A, Jindal P. Principles of diagnosis and management of traumatic pneumothorax. J Emerg Trauma Shock. 2008;1(1):34-41.

[2] Tran J, Haussner W, Shah K. Traumatic Pneumothorax: A Review of Current Diagnostic Practices and Evolving Management. J Emerg Med. 2021; 61(5):517-28.

[3] Liman ST, Kuzucu A, Tastepe AI, Ulasan GN, Topcu S. Chest injury due to blunt trauma. Eur J Cardiothorac Surg. 2003; 23(3):374-8.

[4] Otten EJ. Rosen.'s Emergency Medicine: Concepts and Clinical Practice: 2-volume set, by Ron M. Walls, Robert S. Hockberger, Marianne Gausche-Hill, et al. Philadelphia, Elsevier Inc, 2022. 2756 pages. Elsevier; 2022.

[5] Leigh-Smith S, Harris T. Tension pneumothorax--time for a re-think? Emerg Med J. 2005; 22(1):8-16.

[6] Barton ED, Rhee P, Hutton KC, Rosen P. The pathophysiology of tension pneumothorax in ventilated swine. J Emerg Med. 1997; 15(2):147-53.

[7] Zarogoulidis P, Kioumis I, Pitsiou G, Porpodis K, Lampaki S, Papaiwannou A, et al. Pneumothorax: from definition to diagnosis and treatment. J Thorac Dis. 2014; 6(Suppl 4):S372-6.

[8] Laan DV, Vu TDN, Thiels CA, Pandian TK, Schiller HJ, Murad MH, et al. Chest wall thickness and decompression failure: A systematic review and meta-analysis comparing anatomic locations in needle thoracostomy. Injury. 2016; 47(4):797-804.

[9] Azizi N, ter Avest E, Hoek AE, Admiraal-van de Pas Y, Buizert PJ, Peijs DR, et al. Optimal anatomical location for needle chest decompression for tension pneumothorax: A multicenter prospective cohort study. Injury. 2021; 52(2):213-8.

[10] Leonhard G, Overhoff D, Wessel L, Viergutz T, Rudolph M, Schöler M, et al. Determining optimal needle size for decompression of tension pneumothorax in children – a CT-based study. Scand J Trauma Resusc Emerg Med. 2019; 27(1):90.

[11] Tritsch Z, Galan G, Oates G, Thomas J. Case Report: Traumatic Tension Pneumothorax in a Pediatric Patient. J Educ Teach Emerg Med. 2021; 6(1):V26-v8.

[12] Tintinalli JE, Stapczynski JS, Ma O, Yealy D, Meckler G, Cline D. Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 8e: McGraw Hill Education; 2016.

[13] Gentry Wilkerson R, Stone MB. Sensitivity of bedside ultrasound and supine anteroposterior chest radiographs for the identification of pneumothorax after blunt trauma. Acad Emerg Med. 2010; 17(1):11-7.

[14] Idris BM, Hefny AF. Large pneumothorax in blunt

chest trauma: Is a chest drain always necessary in stable patients? A case report. Int J Surg Case Rep. 2016; 24:88-90.