Original Article

Traumatic pneumomediastinum: A risk factor for the development of pneumopericardium

Farooq Ahmad Ganie, Hafeez Ulla Lone, Gh Nabi Lone, Shyam Singh, Abdual Majeed Dar, Mohd Akbar Bhat, Mohd Lateef Wanie, Syeed Wahid, Masaratul Gani[1]

Department of Cardiovascular and Thoracic Surgery, and [1]Department of Health Services, Sher-i-Kashmir Institute of Medical Sciences Medical College (SKIMS), Soura, Kashmir, India

ABSTRACT

OBJECTIVE: Patients of polytrauma due to road traffic accident, fall from height, sports injury with blunt chest trauma, as well as penetrating injury to chest were investigated for pneumomediastinum and pneumopericardium, which may prove life threatening.

MATERIAL AND METHODS: This study was retrospective for three years and prospective for three years and was conducted in the department of cardiovascular and thoracic surgery at the Sher-i-Kashmir Institute of Medical Sciences, Soura, Srinagar, Jammu and Kashmir for six years. All patients who reported to the hospital as polytrauma were investigated by noncontrast computed tomography (CT) scan of the chest. We did 1,350 CT scans of the chest for blunt and/or penetrating chest trauma in the last six years as a part of emergency investigations. All chest CT scans were investigated for pneumopericardium, simultaneous with other traumatic pathologies.

RESULTS: Of the 1,350 chest CT scans, 930 were normal. Twenty-one patients had pneumomediastinum in addition to other primary surgical pathology. Of these 21 patients with simultaneous pneumomediastinum, eight patients had associated pneumopericardium; five patients with pneumopericardium had blunt chest trauma as etiology and three patients had penetrating trauma as etiology for pneumopericardium.

CONCLUSION: To overcome the fatality of pneumopericardium, two important approaches need to be followed. The first is continuous monitoring of blood pressure and the second is the availability of an immediate facility for drainage of pneumopericardium. Pneumomediastinum is obligatory for pneumopericardium to occur.

Key words: Noncontrast chest CT scan, pneumomediastinum, pneumopericardium

Access this article online	
Quick Response Code:	Website: www.ijsronline.com
	DOI: 10.4103/2230-7095.113806

INTRODUCTION

Pneumopericardium, a collection of air or gas in the pericardium is a serious condition that may become life threatening. Pneumopericardium is a relatively rare consequence of a blunt or penetrating injury to the chest or due to iatrogenic injury.[1] Pneumomediastinum is the collection of air or gas in the mediastinum. Spontaneous pneumopericardium and pneumomediastinum, sometimes called pericardial-mediastinal emphysema, is a very rare condition with a multitude of causes: Parturition, pulmonary barotraumas, severe cough, asthma, inhalation of cocaine, exposure to chlorine gas, emesis, and athletics. Pneumopericardium and pneumomediastinum can occur spontaneously with unknown etiology, which usually resolve completely. Pneumopericardium characteristically presents with Hamman's sign best heard in the left lateral decubitus position. In some cases, tension pneumopericardium has been reported, which requires an urgent decompressive procedure.[2]

Although several hypotheses of the pathogenesis of pneumopericardium are described, it is not exactly known why and under what circumstances tamponade occurs.[3]

MATERIALS AND METHODS

This study was done in the department of cardiovascular and thoracic surgery at the Sher-i-Kashmir Institute of Medical Sciences, Soura, Srinagar, Jammu and Kashmir for six years. All patients who reported to the hospital as polytrauma due to road traffic accident, fall from height, sports injury with blunt chest trauma, as well as patients who had penetrating injury to the chest were investigated by noncontrast chest computed tomography (CT) scan. We did 1,350 CT scans of the chest for blunt and/or penetrating chest trauma in the last six years as a part of emergency investigations. All chest CT scans were studied for pneumopericardium, simultaneous to other traumatic pathologies. Different traumatic pathologies were treated

ADDRESS FOR CORRESPONDENCE:
Dr. Farooq Ahmad Ganie, Department of Cardiovascular and Thoracic Surgery, SKIMS, Soura Srinagar, Kashmir, India. E-mail: farooq.ganie@ymail.com

as per standard protocol. Patients who had traumatic pneumopericardium were observed for any complications due to pneumopericardium along with management for other primary surgical pathologies.

RESULTS

Of 1350 chest CT scans, 930 were normal with no pneumothorax or hemothorax, 45 patients had minimal pneumothorax, and 130 had a significant amount of pneumothorax. Fifty-five patients had minimal hemopneumothorax and 50 patients had mild hemothorax; 85 patients had significant hemothorax and 54 patients had significant hemopneumothorax. Twenty-one patients had pneumomediastinum in addition to other primary surgical pathology. Of these 21 patients with simultaneous pneumomediastinum, eight patients had associated pneumopericardium; five patients with pneumopericardium had blunt chest trauma as etiology and three patients had penetrating trauma as etiology for pneumopericardium. Two patients with penetrating trauma were mauled by a bear and had 60 to 70% of the tracheal lumen avulsed. One 13-year-old child with pneumopericardium was mauled by a group of stray dogs. One patient with blunt trauma as etiology had pneumopericardium with isolated pneumomediastinum and no other surgical pathology.

Management

All patients who were admitted for chest trauma, blunt or penetrating, were managed for their primary surgical pathology by intercostal chest tube drainage. There were three patients with penetrating injury to the neck, with pneumopericardium needing tracheal repair in one patient, emergency tracheostomy tube placement and subsequent repair in the second patient, and bilateral intercostal tube drains in the third patient. One patient with pneumopericardium and isolated pneumomediastinum after blunt trauma needed only observation and simultaneous analgesics. All patients who had developed pneumopericardium were investigated for troponin T at the time of admission and two to three electrocardiographic readings during admission in the hospital. All patients who developed pneumopericardium needed observation in a high-dependency unit till they were discharged. Their invasive blood pressure was continuously monitored.

DISCUSSION

All patients who developed pneumopericardium with other primary surgical pathologies also had pneumomediastinum at the same time. All of them had either pneumothorax or hemopneumothorax except one patient who had only pneumomediastinum. Patients with penetrating chest and/or neck injury with simultaneous pneumomediastinum and pneumopericardium had no direct injury of the pericardium. Patients of either blunt trauma or penetrating trauma who developed pneumomediastinum with or without pneumopericardium usually had small bullea in the lungs toward the mediastinal pleura.

Pneumopericardium was first described by Bricketeau in 1844, who called the classical pericardial sound associated with this disorder *bruit de moulin* (water-wheel sound).[1] Spontaneous pneumomediastinum and pneumopericardium are almost always self-limiting. Treatment may not be required unless a large amount of air is present or if there is tension pneumopericardium.[2] Most patients recover spontaneously within one or two weeks.[3] None of our patients needed any invasive procedure, but they needed close observation, analgesics, and frequent electrocardiographic study to look for myocardial damage. Pneumopericardium was treated conservatively with placement of thoracic drains and observation of the patient.[4] Most of our patients had simultaneous intercostal tube drains for other surgical pathologies like pneumothorax, hemothorax, or hemopneumothorax. It was observed in our study that tube drains in the pleural cavity or suction drains in the retrosternal space for pneumomediastinum augment the clearance of pneumopericardium. One of our patients who was managed conservatively and needed no drain for simultaneous pneumomediastinum and pneumopericardium was seen to take a longer time for clearance of pneumopericardium. Usually, pneumomediastinum and pneumopericardium are self-limiting, requiring no specific therapy; however, vigilance and a continuous monitoring of the vital signs is necessary.[5] Subxiphoid pericardial window and pericardial drainage treat this condition successfully. Diagnosis of this rare form of tamponade depends on clinical examination supported by radiographic findings of the chest.[6] In our study, none of the patients needed invasive drainage of pneumopericardium, but continuous monitoring of invasive blood pressure was required particularly in patients who had a combination of significant pneumomediastinum and pneumopericardium. Possible causes of the pneumopericardium such as tracheobronchial or oesophageal tears had to be excluded by bronchoscopy or esophagogastroduodenoscopy. Usually, pneumopericardium is self-limiting requiring no specific therapy. However, a continuous monitoring of electrocardiography and blood pressure are necessary at an intermediate care unit. Tension pneumopericardium causing a life-threatening cardiac tamponade requires an immediate pericardial aspiration, subsequent pericardial drainage via a pericardial window or emergent open subxyphoid approach to the pericardium.[7] We observed that the immediate facility for drainage of pneumopericardium in case of temponade should be available. Moreover, it was observed that in patients with significant pneumomediastinum, there was a greater tendency to increase the pneumopericardium. It was also noted that

vigorous coughing increases pneumomediastinum, which may subsequently increase pneumopericardium. Early diagnosis is possible on initial radiographs of the chest. CT is also an effective method for evaluating the presence of air in the pericardial space and may assist in establishing the diagnosis. We observed that chest X-rays had no role in diagnosing pneumopericardium. It was seen that pneumopericardium in most of the patients is an accidental finding after CT of the chest for other traumatic pathologies of the chest. Tension pneumopericardium requires immediate recognition and decompression to prevent cardiac tamponade with a fatal collapse of circulation.[8] To overcome the fatality of pneumopericardium, two important approaches need to be followed. The first is continuous monitoring of blood pressure and the second is the availability of an immediate facility for invasive drainage of pneumopericardium.

The Macklin effect is the major cause of pneumopericardium. Higher intrathoracic pressures are required for pneumopericardium, which is also accompanied by pneumomediastinum. It is most likely that air enters the pericardial sac along the venous sheaths, where the collagenous support of the pericardial reflections is weaker.[9,10] In three patients, penetrating injury as the cause of pneumopericardium and pneumomediastinum with no evident direct injury to the pericardium indicated that pneumopericardium was due to lifting of the pericardium from the vessels due to increase in pressure by air in the mediastinum. It was seen that patients who develop pneumomediastinum usually have small bullea in the lung parenchyma, which rupture into the mediastinum. Pneumopericardium is usually self-limiting and resolves spontaneously, but may require intervention such as drainage of the accompanying pneumothorax. Notably, complications such as tension pneumopericardium are described in up to 37% of the reported cases. In this situation, a pressurized compartment is created by the one-way valve principle, and possibly worsened by mechanical ventilation. This in turn may lead to a life-threatening cardiac tamponade, requiring emergency pericardiocentesis or surgery.[11] It was observed that placing either a pleural drain or subcutaneous drain in the suprasternal notch augments drainage of pneumomediastinum as well as pneumopericardium. A rise in the intra-alveolar pressure above atmospheric pressure is important in the pathophysiology of pneumopericardium and pneumomediastinum. The alveoli rupture and air moves to the hilar area, mediastinum, and through the pericardial reflection on the pulmonary vessels into the pericardial cavity. The parietal pericardium is reflected on the visceral pericardium near the ostia of the pulmonary veins, the weakest histological area.[12] We observed that pneumopericardium occurred due to lifting of the pericardium by increased pressure in the mediastinum due to air in the mediastinum, as those patients who had minimal pneumomediastinum did not develop pneumopericardium. Pneumopericardium was seen only in patients who had significant pneumomediastinum. Treatment may not be required unless a large amount of air is present or if there is tension pneumopericardium.[2] We observed that all patients with pneumopericardium have pneumomediastinum, but all patients who have pneumopericardium did not have pneumothorax. Neonatal pneumopericardium is a rare clinical condition that usually occurs in association with other air leak syndromes (pneumomediastinum, pneumothorax, pneumoperitoneum, and subcutaneous and interstitial emphysema) especially when there is severe lung pathology, post vigorous resuscitation, or in the presence of assisted ventilation.[13-15] There is a direct relation between pneumomediastinum and pneumopericardium, but not between pneumothorax and pneumopericardium.

CONCLUSION

Pneumomediastinum is obligatory for pneumopericardium to occur due to lifting of the pericardium from the vessels. Patients with significant pneumomediastinum have a greater tendency to increase the pneumopericardium; vigorous coughing increases pneumomediastinum, which may subsequently increase pneumopericardium. To overcome the fatality of pneumopericardium, two important approaches need to be followed. The first is continuous monitoring of blood pressure and the second is the availability of an immediate facility for invasive drainage of pneumopericardium.

REFERENCES

1. Bricketeau M. Observation d'hydropneumopéricarde accompagné d'un bruit de fluctuation perceptile á l'oreille. Arch Gén Méd 1844;4:334.
2. Abdalla M, Gould L, Bharathan T. Spontaneous pneumopericardium: A case report. Angiology 1994;45:81-3.
3. Bartal N, Zaarura S, Marvan H. Spontaneous pneumopericardium and pneumomediastinum. Ann Otol Rhinol Laryngol 1990;99:1005-6.
4. Lonsky V, Mandák J, Harrer J, Tuna M, Dvorak P, Dedek T, *et al*. Posttraumatic pneumopericardium: A sign of severe injury or radiodiagnostic rarity. Acta Medica (Hradec Kralove) 2006;49:129-32.
5. Baharudin A, Sayuti RM, Shahid H. The Macklin effect-pneumomediastinum and pneumopericardium following blunt chest trauma. Med J Malaysia 2006;61:371-3.
6. Capizzi PJ, Martin M, Bannon MP. Tension pneumopericardium following blunt injury. J Trauma 1995;39:775-80.
7. Ladurner R, Qvick LM, Hohenbleicher F, Hallfeldt KK, Mutschler W, Mussack T. Pneumopericardium in blunt chest trauma after high-speed motor vehicle accidents. Am J Emerg Med 2005;23:83-6.
8. Markarian MK, MacIntyre DA, Cousins BJ, Fildes JJ, Malone A. Adolescent pneumopericardium and pneumomediastinum after motor vehicle crash and ejection. Am J Emerg Med 2008;26:515.e1-2.
9. Macklin CC. Transport of air along sheaths of pulmonic blood vessels from alveoli to mediastinum. Clinical implications. *Arch Intern Med* 1939;64:913-26.

10. Mansfield PB, Graham CB, Beckwith JB, Hall DG, Sauvage LR. Pneumopericardium and pneumomediastinum in infants and children. *J Pediatr Surg* 1973;**8:**691-9.
11. Haan JM, Scalea TM. Tension pneumopericardium: A case report and a review of the literature. *Am Surg* 2006;72:330-1.
12. Katzir D, Klinovsky E, Kent V, Shucri A, Gilboa Y. Spontaneous pneumopericardium: A case report and review of the literature. Cardiology 1989;76:305-8.
13. Fellous L, Tourneux P, Brule-Pepin R, Goissen C, Krim G. Pneumopericardium: A rare complication of meconium aspiration syndrome. Arch Pediatr 2005;12:83.
14. Rucker J. Pneumopericardium in hyaline membrane syndrome in premature infants. Padiatr Padol 1987;22:51-8.
15. Kumar A, Bhatnagar V. Respiratory distress in neonates. Indian J Pediatr 2005;72:425-8.

Cite this article as: Ganie FA, Lone HU, Lone GN, Singh S, Dar AM, Bhat MA, *et al*. Traumatic pneumomediastinum: A risk factor for the development of pneumopericardium. Int J Stud Res 2013;3:7-10.

Source of Support: Nil, **Conflict of Interest:** No.