



# Hemopneumothorax Associated with Pneumorrhachis Following Blunt Chest Trauma: A Case Report

Putu Eka Mardhika<sup>1\*</sup>, Tjokorda GB Mahadewa<sup>1</sup> and Citra Aryanti<sup>2</sup>

<sup>1</sup>Department of Neurosurgery, Udayana University, Indonesia

<sup>2</sup>Department of Surgery, Udayana University, Indonesia

## Abstract

**Introduction:** Pneumorrhachis is a condition that marked by presence of air in spinal canal. We present a rare case of pneumorrhachis of the cervical to thoracic canal associated with hemopneumothorax and flail chest with subcutaneous emphysema that recovered remarkably after shaft clipping surgery and chest tube insertion only. Pneumorrhachis can resolve by itself with conservative management.

**Case Presentation:** A 45-year-old woman suffered from chest pain and shortness of breath after fell at the hotel swimming pool. Further examination revealed rhonchi on left lung auscultation and asymmetry respiratory pattern. Computed tomography of the chest proved the presence of multiple rib fractures 4-9 left side, hemopneumothorax, subcutaneous emphysema. Accidentally, the CT showed intra spinal gas representing pneumorrhachis extending from C6-T3. No neurologic deficit was found. She was treated conservative by supplemental oxygen only, no further neurological deterioration was detected. Follow up examination was uneventful and the symptoms resolved completely.

**Conclusion:** Pneumorrhachis was mostly found accidentally with variety of underlying disease, especially in the case traumatic pneumothorax and fracture of skull base. Pneumorrhachis was managed conservatively and should be taken in attention in the presence of neurologic deficits.

**Keywords:** Ribs fracture; Pneumothorax; Pneumorrhachis

## Introduction

Pneumorrhachis is a condition that marked by presence of air in spinal canal. It was Gordon et al. [1] who stated clearly the term of Pneumorrhachis as the presence of intra spinal air [1]. It can be associated with trauma or non-trauma cases [2]. Usually, it is not associated with neurological deficit and not dangerous for the patient. It is usually found accidentally during radiological examination. There is no established guideline for its treatment yet [3].

Hemopneumothorax is relatively common complication of multiple ribs fracture because of blunt chest trauma. The fracture of ribs can tear several blood vessel and cause blood accumulation in intra thoracic cavity [4-5], however, blunt chest trauma associated with pneumorrhachis is a rare entity [1-3]. It is still unclear how free air can trap in the spinal canal because of chest injury [6-8]. In this article, we present a rare case of pneumorrhachis of the cervical to thoracic vertebra canal, associated with hemopneumothorax and flail chest. We will discuss the possible mechanism of how free air can be trapped inside the spinal canal after blunt chest trauma. This case report is arranged based on Surgical Case Report (SCARE) criteria.

## Case Presentation

A 45-year-old woman with a history of left side multiple ribs fracture with hemopneumothorax after fell at the hotel swimming pool. Vital sign examination found blood pressure 96/64 mmHg, respiratory rate 28 times/min, heart rate 92 times per min, O<sub>2</sub> saturation 98% on 10 liter/min on non-rebreathed mask. General physical examination revealed rhonchi on auscultation of left lung and asymmetry respiratory pattern or flail chest. Neurologic examination was normal. There was no sign of lateralization and perfect motoric and sensoric status.

Computed tomography of the chest showed multiple rib fractures of 4<sup>th</sup> to 9<sup>th</sup> costae of left side, hemopneumothorax, subcutaneous emphysema and pneumorrhachis extending from C6-

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### \*Correspondence:

Putu Eka Mardhika, Department of Neurosurgery, Udayana University, Sanglah Hospital, Bali, Indonesia, E-mail: ekamardhika@gmail.com

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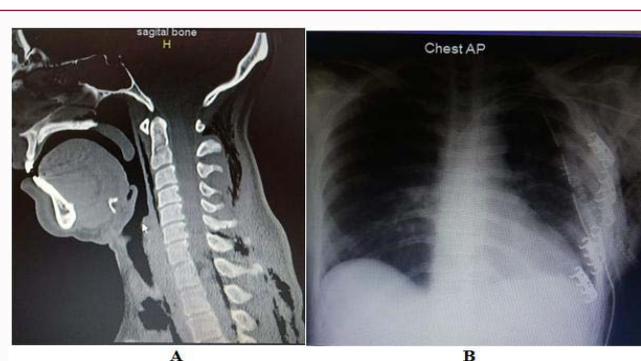
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**Figure 1A:** Cervical CT Scan (axial view).

**Figure 1B:** Coronal view showing subcutaneous emphysema on the left side and pneumorrhachis intra canal of C7-T1.



**Figure 2A:** Sagittal view showing pneumorrhachis extending from C6 - T3.

**Figure 2B:** Post shaft clipping surgery of left 4-9 ribs and chest tube insertion.

T3 (Figures 1A, 1B, 2A). The patient undergone shaft clipped on 4<sup>th</sup> to 9<sup>th</sup> costae of left ribs and chest tube placement by thoracic surgeon (Figure 2B). Pneumorrhachis was treated conservatively by supplemental oxygen only, no further neurological deterioration was detected. The patient was discharged on day 14<sup>th</sup> with complete recovery by thoracic surgeon.

## Discussion

Pneumorrhachis is defined as free air in the spinal canal, resulting from chest trauma, head trauma, epidural injections, spinal surgery, ERCP and/or occurred iatrogenically. Pneumorrhachis had several definitions (pneumocele, pneumatosis, emphysema, aerorachia, pneumosaccus, and air myelogram) before Gordon and Hardman (1977) describe the fixed term “pneumorrhachis” [1]. About less than 80 case reports have been published in the worldwide, while many article are not available online and not all were caused by traumatic pneumothorax (Table 1).

Pneumorrhachis can be classified into internal and external. The internal pneumorachis is defined as the finding of air in the intradural space (subdural or subarachnoid), while the external pneumorachis is defined as the finding of air in the extradural space (intra spinal and epidural) [2,9-13]. In the extradural type, the absence of fascial barrier between the posterior mediastinum and neck causes migration of air from intervertebral foramina into the spinal canal [14-22]. In intradural type, air dissects the interstitial space which surrounding the nerves and vessels through neural foramina or neurovascular sheaths [23]. Specifically in pneumothorax, the marked increase in intraalveolar pressure could cause alveolar rupture, which allows the air to pass along the broncho vascular axis up to the mediastinum

[16]. The air the travelled along mediastinal pleura, then intervertebral foramina, and enter the dural space [24]. The leakage of gas to the spinal canal can result in the negative pressure intradiscal, which could lead to further recruitment of gas in the disc space [25]. Moreover, presented air in the spinal canal can move to the cranium, thus leading to pneumocephalus [26].

The most common location for pneumorrhachis to occur was at cervical, followed by thoracic, lumbar, then sacral [9]. However, the location of air accumulation in spinal canal depends on the site, rate, and volume of air dissection, also the positioning of the patient. If free air was found at intradural, the pathomechanism usually was more severe, while if the air was only located extradural, the patient was usually better preserved clinically, and was usually not associated with pneumocephalus. The extradural air was often reabsorbed to the deeper structure [27]. The symptomatic case could cause spinal cord compression, mostly in trauma cases.

Pneumorrhachis is primary a radiographic diagnosis since it usually provide no specific clinical symptoms. The standardized treatment guideline was not existed until now. Patients with pneumorrhachis are usually managed conservative with cervical collar and supplemental oxygen showed promising results, even in the case with complication [11]. Oxygen therapy was used with the concept that oxygen induces air absorption, as previously reported [28]. The presence of intracranial injuries was suggested to have antibiotics prescription to prevent secondary infection [2]. In fact, the treatment was primarily aimed at addressing the primary disease [2].

Based on our analysis, the presence of pneumorrhachis usually accompanied by calvaria or skull base fracture. As we can see in Table 1, all the reported pneumorrhachis case was accompany by pneumocephalus. The etiology of all case was calvaria, skull base, sinus fracture, or combination of them. The fracture line may provide entry point for free air and manifest as pneumocephalus. The pneumocephalus somehow make their way into the spinal canal and manifest as pneumorrhachis. However, in this case, the patient had blunt chest injury and accidentally we found pneumorrhachis from CT scan examination. Several authors have reported 6 similar cases of pneumorrhachis following blunt chest trauma but there is no further explanation about it [19]. There were others 5 cases about pneumorrhachis with pneumothorax as its underlying cause, however, no full text was available online. The intra spinal gas has the same low CT scan density with other gases must be clearly differentiated from gas due to infective, degenerative, malignancy, and inflammatory cause [29]. The management of this case was done conservatively while the treatment was focused on correcting the underlying or primary cause, thus the ribs fracture with shape clipping. Other studies also reported that pneumorrhachis could be managed conservatively. In concordance with this study, pneumorrhachis will resolve spontaneously by diffusion [30]. In most cases, air tends to reabsorbs completely into the blood without significant recurrence.

The present report aimed to increase awareness about the possibility of pneumorrhachis occurrence, especially in traumatic pneumothorax. Although it was asymptomatic and self-limiting, the presence should alert the attending physician to pay more attention, by treating the underlying cause before it leads to neurologic deficits.

## Conclusion

Pneumorrhachis was mostly found accidentally with variety of underlying disease, especially in the case traumatic pneumothorax

**Table 1:** Published case reports of pneumorrhachis occurred due to traumatic fracture of brain skull and traumatic pneumothorax.

Author	MOI	Etiology	Location	Symptoms	Treatment	Outcome
<b>Associated with traumatic fracture of brain skull</b>						
Gordon et al. [1]	Motor vehicle accident	Open skull fracture	Pneumocephalus and c= pneumorrhachis of the cervical region	Decerebrate	Details not available	Death
Yip et al. [7]	Motor vehicle accident	Bifrontal and frontal sinus fractures	Pneumocephalus and pneumorrhachis of the cervical	None	Antibiotics	Resolution
Sinha et al. [8]	Motor vehicle accident	Multiple skull base fractures, intracerebral hemorrhage, otorrhea	Pneumocephalus and pneumorrhachis of the cervical	Coma	Ventilator support	Death
Inamasu et al. [9]	Motor vehicle accident	Temporal bone fracture and dural tear	Pneumocephalus and pneumorrhachis of the cervical	None	CSF lumbar drainage	Resolution
Yousaf et al. [11]	Fall	Temporal bone fracture and epidural hematoma	Pneumocephalus and pneumorrhachis of the cervical	Radicular pain	Collar brace	Resolution
Çavli et al. [10]	Fall/Trauma	Mastoid fracture with otorrhea	Pneumocephalus and pneumorrhachis of the cervical	None	Antibiotics and lumbar drainage	Resolution
Chibbaro et al. [12]	Motor vehicle accident	Mastoid cavity fracture	Pneumocephalus and pneumorrhachis of the cervical	None	None	Resolution
Chaichana et al. [3]	Motor vehicle accident	Bilateral mastoid and sphenoid wing fractures	Pneumocephalus and pneumorrhachis of the cervical region (C2-7)	None	Antibiotics and oxygen	Resolution
Arora et al. [13]	Assault	Fracture of the cribriform plate of ethmoid bone	Pneumocephalus and pneumorrhachis of the cervical region and emphysema	None	Antibiotics and oxygen	Resolution
<b>Associated with pneumothorax</b>						
Yanagawa et al. [14]	Automobile accident	Ribs fracture, extremities bone fractures, cervical root avulsion injury, pneumomediastinum	Pneumorrhachis of C5-T1	Loss of consciousness	Artificial ventilation (intubation)	Resolution
Pangtey et al. [15]	Barotrauma	Spontaneous pneumothorax and pneumomediastinum	Pneumocephalus and pneumorrhachis of the lumbal (L2-3)	Chest tightness and shortness of breath	None	Resolution
Ould-Slimane et al. [16]	Motor vehicle accident	Pneumothorax, pneumomediastinum, T7-8 transverse process fracture	Pneumocephalus and pneumorrhachis of the thoracal region T7-8	Vertebral pain, neurological deficits	Spinal osteosynthesis and oxygen	Resolution
Botchu et al. [17]	Automobile accident	Pneumothorax	Pneumorrhachis of the cervicothoracal region	None	None	Resolution
Ghafarzad et al. [18]	Motor vehicle accident	Ribs fracture, hemothorax, pneumothorax, lumbal vertebra fracture in L2-4	Pneumocephalus and pneumorrhachis of the lumbal region L2-L4	Low back pain and dysopena	Laminectomy and cord compression Oxygen	Resolution
Kaloregrakos et al. [19]	Motor vehicle accident	Ribs fracture, hematopneumothorax, T10 vertebral body fracture	Pneumorrhachis of the thoracolumbal region	Right-sided chest pain	Test tube insertion	Resolution
Present case	Fall	Rib fractures 4-9 left side	Subcutaneous Emphysema and Pneumorrhachis C6-T3	None	Shaft Clipping and chest tube	Resolution

and fracture of skull base. Pneumorrhachis was managed conservatively and should be taken in attention in the presence of neurologic deficits.

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