

Traumatic Cervical Pneumorrhachis: A Case Report and Review of the Literature

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ABSTRACT

Background Data: Pneumorrhachis means the presence of air inside the spinal canal. It is considered one of the rare findings among trauma patients. Most patients with pneumorrhachis are diagnosed with one or more of the following diseases: pneumocephalus, pneumothorax, and pneumopericardium. Pneumorrhachis can be isolated in cases of penetrating spinal injuries or combined in cases of skull base fractures.

Purpose: To report a traumatic cervical pneumorrhachis case.

Study Design: A case report.

Patients and Methods: A 37-year-old male patient presenting with a disturbed level of consciousness and evidence of severe head injury. No history of any chronic illness. He had multiple abrasions on the forehead and bilateral racoons' eyes after a history of a road traffic accident. Computed tomography (CT) scans over the skull and spine revealed the presence of air in the skull (pneumocephalus) and the cervical spinal canal (pneumorrhachis).

Results: The neurosurgical team reported one patient with pneumorrhachis. Endotracheal tube and multiple intravenous lines were inserted and further measures for stabilizing the hemodynamics were done. The patient was admitted into the Intensive Care Unit and treated conservatively with full recovery after 6 weeks of outpatient follow-up.

Conclusion: Pneumorrhachis is a rare spinal condition affecting the cervical spine. It is considered as an important radiological sign as it indicates the severe traumatic insult. Conservative medical treatment is the main way of management. The prognosis is related to the general condition of the patient and associated insults. (2019ESJ205)

Keywords: Pneumorrhachis; Skull base trauma; Intraspinal air; Pneumocephalus.

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INTRODUCTION

Pneumorrhachis means the presence of intraspinal air and is known by other terms such as intraspinal pneumatocele, spinal emphysema, and spinal pneumatosis. Pneumorrhachis is considered to be a radiological sign of serious underlying insult related to the skull or spine or chest.¹⁶ It can affect all regions of the spinal canal but the affected region indicates the suspected region of trauma.¹⁶ When pneumorrhachis is detected in the cervical spinal canal, skull base fracture is suspected and the clinical and radiological data of the patient should be revised.¹¹ When pneumorrhachis is detected in the thoracic spinal canal, the presence of pneumothorax should be suspected and evaluated. Intradural type of the pneumorrhachis is associated with the presence of a dural tear.¹¹ Those dural tears mostly are associated with severe head trauma. Ucler et al.¹⁶ believed that loss of cerebrospinal fluid (CSF) from the fracture lines causes the entrance of air into the subarachnoid space. Moreover, when transferred, the position of the patient's head was below the horizontal plane in relation to the body causing the entrance of air from the intracranial space to the intraspinal one.¹⁶ Here, we present one case of cervical pneumorrhachis that was diagnosed in our hospital by the neurosurgery department and underwent conservative medical treatment. We also reviewed the literature for other similar reports.

CASE REPORT

In January 2020, at the Damanhour Medical National Institute (DMNI) Hospital, a 37-year-old male patient with average body weight presented with a disturbed level of consciousness and multiple abrasions on the forehead after the history of a road traffic accident (RTA). On clinical examination, Glasgow Coma Scale

was 5/11 excluding eye movement due to extensive bilateral raccoon's eyes and multiple forehead abrasions. His motor response was withdrawal from painful stimuli, while his pupils could not be assessed because of the extensively swollen eyelids. First-aid measures including endotracheal tube, intravenous lines, and urinary catheter were performed. Urgent abdominopelvic ultrasonography revealed no intra-abdominal collection.

After the ER physician ensured that the patient was hemodynamically stable, they moved the patient to complete the survey. Non-contrasted CT brain was conducted and revealed bilateral frontal epidural and subarachnoid pneumocephalus and scattered air entrapment in the prepontine and perimesencephalic cisterna. CT cervical spine was done (as a routine survey for comatose patients) and showed ventral subdural air lucency extending from the base of the skull down to the level of the sixth-cervical vertebra (Figure 1). All the results of the routinely requested laboratory tests were within normal ranges.

The diagnosis of severe traumatic brain injury with a fracture of the skull base and extensive pneumocephalus was established (Figure 2). The treatment started immediately after complete evaluation and investigations. The management was conservative medical treatment and admission into the Intensive Care Unit (ICU) with close clinical observation. The patient was ventilated and received medical treatment in the form of antibiotics, antiepileptics, and intravenous fluids with regular ICU clinical radiological and laboratory follow-up. Serial follow-up CT scans showed gradual reabsorption of the intraspinal as well as the intraspinal air. The patient was extubated and discharged from the ICU to the neurosurgery ward after one week, then discharged from the hospital to the outpatient clinic for follow-up after another week. The patient fully recovered after 4 weeks of outpatient follow-up.

Table 1. Published studies of traumatic pneumorrhachis.

Study/year	Study design	Patients	Age/year	Trauma	Clinical data	Level	Management	GOS
Newbold et al. ¹¹ , 1987	Case report	1	24	RTA	Extensive facial trauma, GCS 15/15	Cervical	Conservative	5
Gelalis et al. ⁴ , 2011	Systematic review	44/37 reports	NA	RTA	NA	Cervicothoracolumbar	Conservative	5
Gill et al. ⁶ , 2011	Case report	1	18	RTA	Seizures, bleeding from the nose and right ear, GCS 7/15	Cervical	Conservative	5
Aroara et al. ¹ , 2011	Case report	1	24	Assault	Bleeding from nose and ear, GCS 12/15	Cervical	Conservative	5
Ucler et al. ¹⁶ , 2012	Case report	1	NA	RTA	NA	Cervicothoracic	Conservative	5
Germino et al. ⁵ , 2013	Case report	1	NA	RTA	NA	Cranio-cervical	Conservative	5
Zolnourian et al. ¹⁷ , 2013	Case report	1	25	RTA	Bleeding from the right ear, GCS 12/15	Cervical	Conservative	5
Kara et al. ⁹ , 2015	Case report	2	NA	RTA	NA	Cervical	Conservative	5
Hadjigeorgiou et al. ⁸ , 2016	Case report	2	NA	RTA	NA	Cervical	Conservative	5
Rashidi et al. ¹⁴ , 2018	Case report	2	43	RTA	Left brachial plexus injury	Cervical	Conservative	5
Pfeifle et al. ¹³ , 2019	Case report	8	NA	RTA	NA	Cervical	Conservative	5
Supit et al. ¹⁵ , 2020	Case report	1	18	Stabbed in the neck	Quadriplegia	Cervical	Surgical intervention for posterior decompression	5
Present case, 2020	Case report	1	37	RTA	Raccoon's eyes, forehead abrasions, GCS 5/11	Cervical	Conservative	5

GCS: Glasgow Coma Scale; GOS: Glasgow Outcome Scale; RTA: road traffic accident; NA: not available.

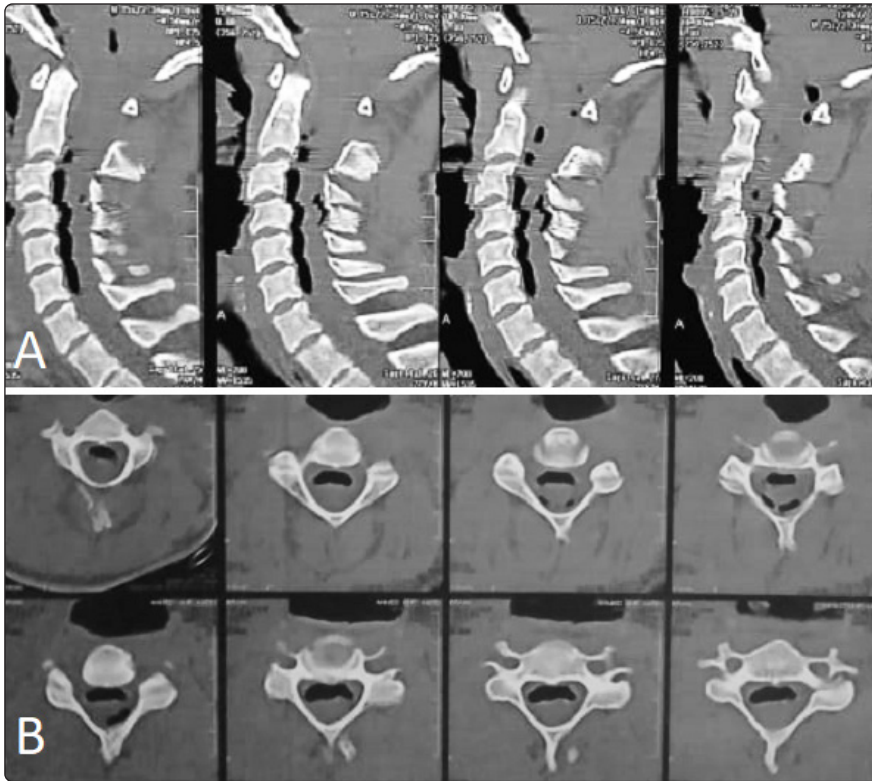


Figure 1. CT scan of cervical spine: sagittal (A) and axial images (B) revealing intraspinal air mainly anterior to the spinal cord.

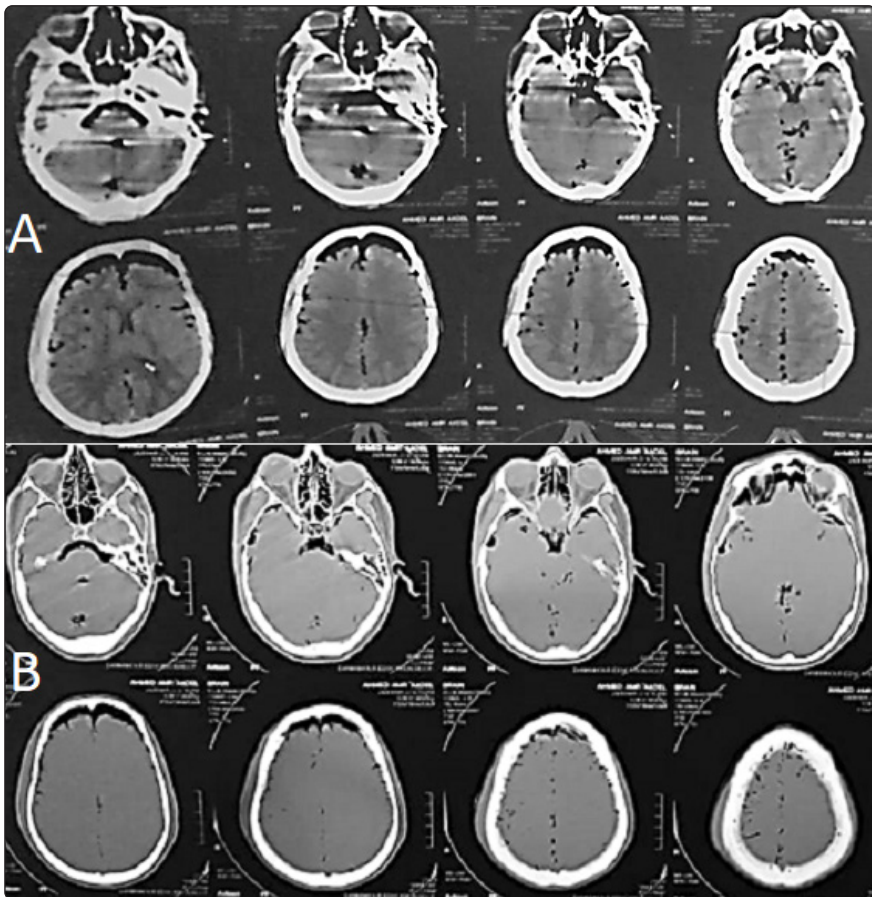


Figure 2. CT scan of the brain: (A) soft tissue axial cuts and (B) bone window revealing the extensive epidural, subarachnoid pneumocephalus located bifrontal, prepontine, perimesencephalic, and within the fourth ventricular.

DISCUSSION

Pneumorrhachis defined as is the presence of air inside the vertebral spinal canal. Newbold et al.¹¹, in 1987, was the first to describe pneumorrhachis. Pneumorrhachis is a rare condition and its diagnosis is difficult or even impossible clinically, so it is usually diagnosed radiologically. It can be primary or secondary; epidural or subarachnoid; iatrogenic, traumatic, or nontraumatic in terms of the source, location, and etiology, respectively.^{7,10} Newbold et al.¹¹ considered pneumorrhachis as a marker of fracture of the skull base and reported one case of traumatic cervical pneumorrhachis in 1987. Since 1987, many cases have been reported in the literature (Table 1).

In 2002, Cayli et al.² reported one patient presenting with traumatic cervical and lumbar pneumorrhachis. The precise mechanisms are unknown, but Newbold et al.¹¹ believed that traumatic pneumorrhachis was caused by the occurrence of dural tear at the base of the skull. Dural tear creates a communication pathway for air into the subarachnoid space from the extracalvarial or extra-spinal air.^{10,11} In 2010, Chaichana et al.³ reported traumatic pneumorrhachis in a 35-year-old male patient after RTA: he was fully conscious and GCS was 15 but had otorrhea from the left side, left facial deficit, and decreasing hearing on the left side. Thus, the authors concluded that the evidence of severe trauma is the leading risk factor in the occurrence of pneumorrhachis. In 2011, Gelalis et al.⁴ reported traumatic pneumorrhachis that extended from the skull base to the midthoracic vertebra. In 2012, Ucler et al.¹⁶ reported a 56-year-old male patient with extensive cervical and thoracic pneumorrhachis after major multiple traumas with marked cerebrospinal fluid (CSF) leak and bilateral open depressed skull fractures. In 2013, Germino et al.⁵ reported pneumorrhachis in a patient who had craniocervical hyperpneumatization and claimed that, for a long time, the patient used to do the Valsalva maneuver. In 2015, Kara et al.⁹ reported

2 patients of traumatic pneumorrhachis and concluded that early diagnosis is important in the evaluation of the patients. In 2016, Hadjigeorgiou GF et al.⁸ conducted a comprehensive literature search in PubMed database for English-language published articles up to October 2015 for the term “traumatic pneumorrhachis”, the search yielded 11 cases, and their paper reported another two patients. In 2019, Pfeifle et al.¹² reported 8 patients of traumatic pneumorrhachis over the period of 12 years.¹³ In 2020, Supit et al. reported a patient with traumatic cervical pneumorrhachis after a history of penetrating neck injury. The patient had quadriplegia and CT cervical spine showed cervical intradural pneumorrhachis. Surgical intervention for posterior decompression and laminectomy was done.¹⁵ Most of the published literature claims that the diagnosis of pneumorrhachis may be more reported if a complete radiological scan of the spine was performed.

The site and distribution of the pneumorrhachis can be determined by the site of air dissection, rate and volume of intraspinal air spreading, the capacity of intraspinal space, and position of the patient.¹² Patients who are diagnosed with pneumorrhachis mostly have one or more of these signs: pneumocephalus, pneumothorax, and pneumopericardium.^{9,12} Pneumorrhachis can be isolated in the penetrating spinal injuries, but it is mostly associated with pneumocephalus if a fracture in the skull base is present.^{7,12}

Recently, CT scan of the spine is the gold standard method of diagnosing pneumorrhachis. A brain and cervical spine CT scan in addition to cervical, thoracic, and lumbosacral spine X-rays are the routine images in the neurosurgical investigation in trauma patients. More detailed radiological images can be required if positive data were revealed in the routine study.^{3,9,13}

Pneumorrhachis must be assessed according to the general condition and presentation of the patient taking into consideration the following causes that may mimic pneumorrhachis in radiological scans. These include vacuum disc phenomenon, degenerative gas collection,

malignant gas collection, inflammatory gas collection, and infectious diseases by gas-forming organisms, although this gas is different from air in composition.¹²

Kim KY et al.¹⁰ claimed that pneumorrhachis does not tend to migrate and get spontaneously reabsorbed into the bloodstream over several days. Usually, the pneumorrhachis is managed conservatively with consideration of the associated findings according to the diagnosis. Symptoms and signs of intracranial and intraspinal pressure disturbance can be detected and explained by the presence of air instead of the CSF within the skull and vertebral canal. If a CSF leak occurs, the pressure will be decreased.^{5,13}

Most of the patients in the articles of pneumorrhachis were asymptomatic, while some case reports reported motor deficits and sensory deficits among those patients.⁵ Pneumorrhachis is believed to be associated with increased mortality and morbidity as it is mostly associated with severe multiple trauma patients. Up till now, no specific guideline is present for treatment of pneumorrhachis.⁹

In the presence of marked CSF leak, the following steps must be considered: medical treatment (maybe prophylactic antibiotics) and supine position, temporary lumbar spinal catheter, and surgical repair.^{10,16} If a tract (fistula) was found, surgical intervention is the choice.^{13,16} Furthermore, multidisciplinary consultation with cardiothoracic, radiology, intensive care, and internal medicine physicians must take place.^{4,16} If the general condition of the patient necessitated being under general anesthesia, some rules should be followed: avoiding inhalation of nitrous oxide and pressurization of the oro- and nasopharynx.¹²

CONCLUSION

Pneumorrhachis is a rare spinal condition affecting the cervical spine. It is considered an important radiological sign as it indicates the severity of the traumatic insult. Conservative medical treatment

is the main way of management. The prognosis is related to the general condition of the patient and associated insults.

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الملخص العربي

استرواح هوائى بالقناة الشوكية العنقية ناتج عن الأصابات: تقرير حالة

البيانات الخلفية: الاسترواح الهوائى منتشر الحدوث فى الجمجمة ولكنه نادر الحدوث فى القناة الشوكية. ولكن الاسترواح الناجم عن الاصابات أكثر ندرة، وتم ملاحظة ان اغلبية حدوث ذلك الاسترواح مصاحبة لكسور قاع الجمجمة سواء كانت بسبب اصابات مباشرة للرأس او حوادث مروية. وتم رصد أن معظم مرضى ذلك الاسترواح لا يعانون من اعراض عصبية محددة وأن معظمهم يتم اكتشافه عن طريق الفحص الرتينى بالاشعة المقطعية او الاشعة السينية.

تصميم الدراسة: عرض حالة وتقريرها.

الغرض: هدفت الدراسة الى اقرار حالة فريدة ونادرة عن حدوث استرواح هوائى بالقناة الشوكية العنقية ما بعد اصابات متعددة بالجسم.

المرضى والطرق: حالة لمريض يبلغ من العمر 37 عام ويعانى من غيبوبة (فقدان للوعى) وأعراض وعلامات إصابة شديدة بالرأس وكسر بقاع الجمجمة، وتم توقيع الكشف الطبى عليه بالطوارئء واجراء الاسعافات الأولية ثم الفحوصات الطبية والتي أظهرت وجود استرواح هوائى بالقناة الشوكية العنقية.

النتائج: تم استكمال البروتوكول العلاجى للمريض حيث تم اتخاذ طريقة العلاج الدوائى التحفظى. تم وضع انبوبة جنجيرية للمريض ونقل المريض الى العناية المركزة بمستشفى اخرى لاستكمال البروتوكول العلاجى.

الاستنتاج: يعد الاسترواح الهوائى بالقناة الشوكية علامة نادرة الحدوث، ويتم اتشخيصها عن طريق الفحص بالاشعة وخصوصا بالاشعة المقطعية. وجود تلك العلامة دليل على وجود اصابة وعلة بالغة بالرأس أو العمود الفقرى او الصدر ويجب البحث عن ذلك. علاج الحالة هو علاج تحفظى بالمقام الأول ويتم التعامل مع الأصابات المصاحبة بصفة أساسية. ونصح الأطباء باستكمال فحص العمود الفقرى بالاشعة المقطعية فى حالة وجود دليل لوجود اصابة بالغة بالرأس او وجود كسر بقاع الجمجمة لاتاحة اكتشاف حدوث الاسترواح الهوائى بالقناة الشوكية بالعمود الفقرى.