

Pneumorachis of the cervical spine with associated pneumocephalus and subcutaneous emphysema

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ABSTRACT

Pneumorachis, the presence of free intraspinal air, is an exceptional radiological finding. We present a case that sustained injury following an assault and was diagnosed to have diffuse pneumocephalus, pneumorachis and extensive surgical emphysema of the head and neck region secondary to the fracture of the cribriform plate of ethmoid bone. To the best of our knowledge pneumorachis due to fracture of the cribriform plate of ethmoid bone has not been reported before, in the English language literature.

Key words: Cervical spine, pneumocephalus, pneumorachis, surgical emphysema

INTRODUCTION

Pneumocephalus is relatively common but associated pneumorachis is a rare entity despite the intracranial compartment and spinal canal remaining in communication with each other.^{1,2} Gordon and Hardman (1977) were the first to describe the phenomenon of intraspinal air.³ Pneumorachis can also be secondary to pneumothorax, pneumomediastinum, pneumocephalus, subcutaneous emphysema, bowel perforation or as iatrogenic event of postdiskectomy.² Very few cases of pneumorachis associated with head injury are reported in literature [Table 1].¹⁻¹⁰ In a majority of the cases, pneumorachis is not associated with neurological symptoms. No definitive guidelines for its treatment exist because of its rareness and diverse etiologies. We present a rare case of pneumorachis of the cervical canal associated with pneumocephalus and surgical emphysema secondary to fracture of cribriform plate of ethmoid bone that made uneventful recovery with conservative management.

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CASE REPORT

A 24-year-old male presented to the accident and emergency department with history of assault and having sustained sharp cut injuries in the neck over the anterolateral aspect extending till the nape and occiput. There was presence of three lacerations (two over the anterolateral aspect of the neck and one over the lateral aspect of the neck extending till the nape) with active bleeding from the same region. The margins of the lacerations were well defined and minimal contamination was present. After sustaining the assault, the patient fell down and struck his head against bricks over the ground. The patient had a history of profuse bleeding during transportation. There was no apparent associated injury. On examination, the patient was unconscious (Glasgow coma score 12/15). The pulse rate was 100 per minute and the blood pressure was 100/58 mmHg.

An intravenous line was secured and fluid resuscitation was started. Lacerations were repaired under all aseptic precautions. The patient was shifted with cervical collar for urgent noncontrast computed tomography (NCCT) scan of the head with screening of cervical spine [Figure 1]. NCCT revealed fracture of the cribriform plate of ethmoid bone with evidence of moderate pneumocephalus in the subarachnoid spaces in the basifrontal, suprasellar cistern region. There was presence of pneumorachis in relation to the posterior arch of atlas and the body of the third cervical vertebra, and there was no evidence of fracture or subluxation in the cervical spine [Figures 2a]. Extensive surgical emphysema was also noted in the lateral and posterior aspects of the cervical region [Figure 1b]. Magnetic resonance imaging (MRI) and contrast angiogram of

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Quick Response Code:	Website: www.ijoonline.com
	DOI: 10.4103/0019-5413.82346

Table 1: Published case reports of pneumorachis

Authors (year)	Cause	Etiology	Location of air	Symptoms	Treatment	Outcome
Gordon and Hardman (1977) ³	Motor vehicle accident	Open skull fracture	Pneumocephalus and pneumorachis of the cervical region	Decerebrate	Details not available	Death
Newbold <i>et al.</i> (1987) ⁴	Motor vehicle accident	Sphenoid sinus, basioccipital and bilateral temporoparietal fractures with CSF rhinorrhea	Pneumocephalus and pneumorachis of the cervical region	Details not available	Incision and drainage of left parietal fracture and transsphenoidal patch repair	Alive (details not available)
Yip <i>et al.</i> (1990) ⁵	Blunt trauma head	Bifrontal and fontal sinus fractures	Pneumocephalus and pneumorachis of the cervical region	None	Antibiotics	Resolution
Sinha and Mantle (2000) ⁶	Motor vehicle accident	Multiple skull base fractures, intracerebral hemorrhage, otorrhea	Pneumocephalus and pneumorachis of the cervical region	Coma	Ventilatory support	Death
Inamasu <i>et al.</i> (2002) ⁷	Motor vehicle accident	Temporal bone fracture and dural tear	Pneumocephalus and pneumorachis of the cervical region	None	Lumbar drainage (for CSF leak)	Resolution
Çayli <i>et al.</i> (2003) ⁸	Case 1: history of fall Case 2: trauma	Mastoid fracture with otorrhea Skull base fracture with otorrhea	Pneumocephalus and pneumorachis of the cervical region	None	Antibiotics and lumbar drainage (case 2)	Resolution
Yousaf <i>et al.</i> (2003) ⁹	Blunt trauma head following fall	Temporal bone fracture, extradural haemorrhage, otorrhea	Pneumocephalus and pneumocele of the cervical spine	Radicular symptoms	Cervical collar, supplemental oxygen	Resolution
Chibbaro <i>et al.</i> (2005) ¹⁰	Motor vehicle accident	? Mastoid cavity fracture	Pneumorachis of the cervical region (C7-L1)	None	None	Resolution
Oertel <i>et al.</i> (2006) ¹	Motor vehicle accident	Occipital skull fracture, sphenoid sinus fracture	Pneumocephalus and pneumorachis of the cervical spine	Coma	None	Death
Chaichana <i>et al.</i> (2010) ²	Motor vehicle accident	Bilateral mastoid and sphenoid wing fractures	Pneumocephalus and pneumorachis of the cervical region (C2-C7)	None	Antibiotics and oxygen therapy	Resolution
Present case	Assault	Fracture of the cribriform plate of ethmoid bone	Pneumocephalus, pneumorachis of the cervical region (craniovertebral junction and C3) and surgical emphysema of the cervical region	None	Antibiotics and oxygen therapy	Resolution

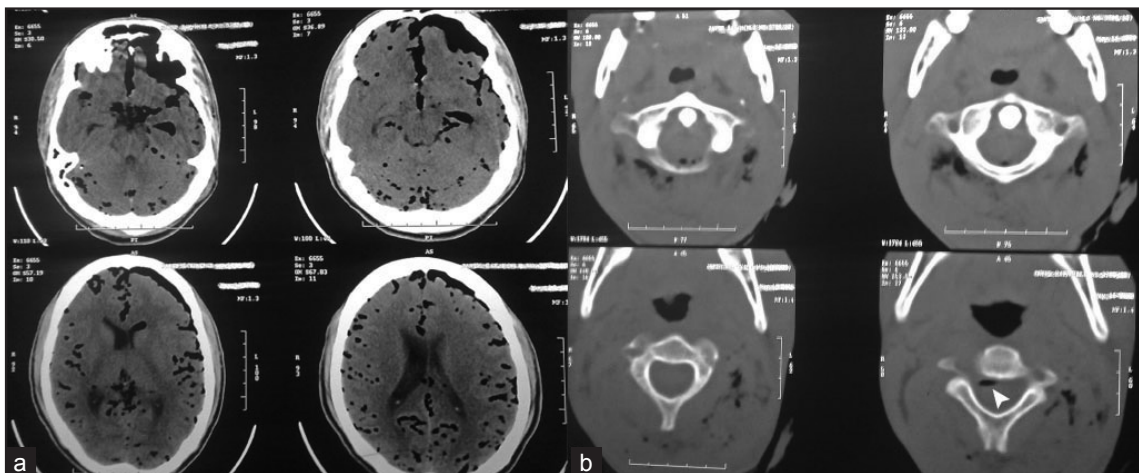


Figure 1: (a) Noncontrast CT scan of the head showing diffuse pneumocephalus in the brain parenchyma and moderate pneumocephalus in the subarachnoid spaces in the basifrontal region. (b) Axial view; noncontrast computed tomography cervical spine showing pneumorachis at the craniovertebral junction and C3 level (arrow head). Surgical emphysema may also be noted in the lateral aspect of the neck

cervical spine, NCCT chest and abdomen revealed normal study. The patient was started on injectable analgesics and antibiotics. He was also kept on 100% oxygen

for 6 h to facilitate resolution of pneumocephalus and pneumorachis. There was no neurological deficit. A repeat NCCT of the head and cervical spine after 72 h revealed



Figure 2: (a) Sagittal view; noncontrast computed tomography cervical spine showing presence of pneumorrhachis (solid arrow) in relation to the posterior arch of atlas and the body of the third cervical vertebra without an evidence of fracture or subluxation. (b) Sagittal view; noncontrast computed tomography cervical spine and head showing resolution of pneumorrhachis and pneumocephalus after 72 hours

complete resolution of pneumocephalus and pneumorrhachis [Figure 2b]. The patient was discharged 4 days after the admission. There was no incidence of delayed cerebrospinal fluid rhinorrhoea and he was completely asymptomatic at the 1 year follow up.

Written, informed consent was obtained from the patient authorizing treatment, radiological examination and photographic documentation. He also consented that data concerning the case would be submitted for publication.

DISCUSSION

Pneumorrhachis is an exceptional but eminent radiological finding, accompanied by different etiologies and possible pathways of air entry into the spinal canal. The phenomenon of intraspinal air has been described with various terms such as intraspinal pneumocele, spinal epidural and subarachnoid pneumatosis, aerorrhachis, pneumosaccus or traumatic pneumomyelogram.^{1-5,9} The term pneumorrhachis was first coined by Newbold *et al.* (1987).⁴ It is sparsely described in the literature and is usually asymptomatic and underdiagnosed entity with associated injuries. With the advent of advanced imaging techniques like acute phase multidetector computed tomography, such cases are now detected more easily.

Various causes of pneumorrhachis are now known, which include trauma (pneumothorax, pneumomediastinum, pneumocephalus, subcutaneous emphysema, bowel perforation), various respiratory conditions causing high intrathoracic pressure and barotraumas, surgical or diagnostic procedures, malignancy, infections with gas-forming organisms or even idiopathic.^{1,2} In our patient a fracture of the cribriform plate of ethmoid bone might have lead to escape of air in various planes giving rise to subcutaneous emphysema apart from pneumocephalus and pneumorrhachis.

Goh *et al.* (2005) paid special attention to differentiate between air in the subarachnoid space versus air in the epidural space, as both the conditions have different clinical implications. Epidural emphysema, by itself, is usually innocuous, whereas subarachnoid pneumorrhachis is a marker of severe injury and is commonly associated with pneumocephalus.¹¹ A traumatic subarachnoid pneumorrhachis is developed secondary to pneumocephalus. The occurrence of either a fracture of an air-containing cavity on the cranium or an open skull fracture with a dural tear allows free communication of air into the subarachnoid space, resulting in pneumocephalus.¹² The air can then travel to the cervical subarachnoid space or even more distal as the intracranial compartment and spinal canal are in communication. This communication was valiantly shown by Dandy (1919) with the use of air as a negative contrast medium into the lumbar subarachnoid space for diagnostic pneumoencephalogram.¹³

Because pneumorrhachis is usually asymptomatic, it is primarily a radiographic and not a clinical diagnosis.¹ CT scan is considered as the diagnostic modality of choice for a reliable and prompt detection of pneumorrhachis. Nevertheless, it may be difficult to differentiate epidural emphysema and subarachnoid pneumorrhachis on CT.¹¹ Even MRI or contrast CT may be required for differentiation. Traumatic pneumorrhachis is a marker of severe injury, and its presence should alarm the treating physician to carry out diagnostic workup for the associated injury.

Owing to its rareness and diverse etiologies, no definitive guidelines for its treatment exist and it largely based upon individual case reports [Table 1]. Cervical pneumorrhachis with head injury has not been reported to be associated with neurological deficit. Yousaf *et al.* reported a case of pneumorrhachis with associated radicular symptoms and treated him successfully with cervical collar and supplemental oxygen.⁹ The presence of traumatic subarachnoid pneumorrhachis implies an open injury with an accompanying 25% risk of meningitis.¹⁴ Injectable antibiotics may be instituted to prevent this potential complication. Association of significant or persistent cerebrospinal fluid leakage have been treated with neurosurgical patch repair or temporary lumbar drainage.^{4,7,8} If general anesthesia is required in such patients, the attending anesthetist should not use inhalational nitrous oxide as it causes an increase in the intracranial pressure after diffusing into the air-filled spaces.¹⁵ Few workers have used supplemental oxygen therapy to facilitate air absorption.^{2,9}

The present report intends to increase awareness about pneumorrhachis among orthopedic surgeons. It is usually

asymptomatic and self-limiting, but its presence should alert the attending trauma physician to carry out diagnostic workup for associated injury and treat the underlying cause.

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How to cite this article: Arora S, Aggarwal P, Cheema GS, Singla J. Pneumorrhachis of the cervical spine with associated pneumocephalus and subcutaneous emphysema. *Indian J Orthop* 2011;45:372-5.

Source of Support: Nil, **Conflict of Interest:** None.