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POST TRAUMATIC PNEUMOCEPHALUS: A TERTIARY INSTITUTE EXPERIENCE

Avinash Sharma*	Associate professor, Department of Neurosurgery, Gajra Raja Medical College, Gwalior *Corresponding Author
Anand Sharma	MCH Neurosurgery, Assistant Professor, Gajra Raja Medical College
RLS Sengar	Professor, Department of Neurosurgery, Gajra Raja Medical College, Gwalior
S N Iyengar	Professor & Head of Department, Department of Neurosurgery, Gajra Raja Medical College, Gwalior

ABSTRACT Pneumocephalus (Intracranial aerocele), defined as intracranial air, is an uncommon complication in head injury patients. It can present immediately following head trauma or be delayed for many days before clinical symptoms occur. The diagnosis made by computed tomography (CT) in all cases. 91% cases were managed conservatively, 9% cases managed by surgery for tension pneumocephalus and depressed fracture. We presented prospective study of 100 cases of traumatic pneumocephalus with review of literature.

KEYWORDS : Pneumocephalus, Head injury

Introduction:

The terms pneumocephalus (PNC) and tension pneumocephalus (TP) were created by Wolff [1] and Ectors, [2] respectively, even though TP has been described in the early literature. PNC is the presence of air within the intracranial cavity. When this circumstance causes increased intracranial pressure that leads to neurological deterioration, it is known as TP. PNC can exist in several compartments: extradural, subdural, subcrachnoid, intraventricular (pneumoventricle), intracerebral pneumatocoele and mixed . In the past, plain radiography had an important role in making the diagnosis. Computed tomography (CT) is currently the best modality for visualizing pneumocephalus. We are reporting a study of 100 cases of traumatic pneumocephalus with review of literature.

2 Materials and Method

The present study was a prospective study conducted at department of neurosurgery, GR Medical College and JA group of hospitals (GRMC) over a period of 7 year from December 2010 to April 2017. GRMC is a tertiary care super specialty treatment Centre. Being the largest medical institute in the region of Gwalior, it caters the health needs of entire region as well as neighboring states. All patients of head injury with evidence of pneumocephalus on CT scan were included in this study. In addition to CT finding, patient age, sex and GCS were also recorded at the time of admission. Initial NCCT scan head was looked for -1) type and size of pneumocephalus 2) Associated fracture –cranial vault / basal sinuses 3) other associated parenchymal injury. Patients with parenchymal injury/ hematoma associated with pneumocephalus were excluded from study. Patients were looked for any CSF leak or features of meningitis daily. Repeat CT scan was done after between 7^{th} to 10^{th} day of injury and looked for above mentioned finding again. Complication were noted and treated accordingly. Patient outcome was noted according to Glasgow Outcome Scale at the of discharge. Thus, with-all above considerations we had a cohort of 100 patients with pneumocephalus. The data was compiled, summarized and analyzed using frequency distribution and percentage proportion.

Results

Total 100 patients of traumatic pneumocephalus were included in study, mean age of patients were 33.34 (SD12.89) year. 90 percent were males (n=90) and 10 percent (n=10) were female. Motor vehicle accidents were the most common cause (50.00%, n=50) of TBI, followed by falls and penetrating brain injury, each accounted for 33.00 %(n=33) and 10% (n=10) respectively. Mild head injury was the most common presentation, present in 70% of patients (Table 1).

Table 1 Demographic profile of traumatic pneumocephalus patients

Age	No. Of patients	Percentage
0-20	32	32.00%
21-40	46	46.00%
41-60	15	15.00%
>60	6	6.00%
SEX Ratio		
Total No of case	Male	Female
100	90%	10%
Glasgow coma scale		
Mild	70	70.00%
Moderate	20	20%
Severe	10	10%
Assessment of mode of injury		
Fall from height	33	33%
Road traffic accident	50	50%
Penetrating brain injury	10	10%
Blunt injury	7	7%

It was evident from table 2 that the most common site for pneumocephalus were subdural space, present in 39% of patients followed by mixed area of involvement (29%). Presence of air in extradural space and intraparenchymal region were present in 15% and 3 % of cases.

Table 2: Anatomical distribution of traumatic pneumocephalus

Anatomical Location	No of Patients	Percentage
Extradural	15	15.00%
Subdural (SD)	39	39.00%
Subarachnoid (SA)	14	14.00%
Intraparenchymal (IP)	3	3.00%
Intraventricular (IV)	0	0.00%
Mixed		
SD +SA	15	51.70%
SD+SA+IP	3	10.34%
SD+IP	3	10.34%
SD+IP+IV	2	6.80%
SD+SA+ED	2	6.80%
SA+IV	1	3.40%
SD+SA+IV+IP	1	3.40%
SD+SA+IV	1	3.40%
SA+IP	1	3.40%
Total	29	29.00%

Study also revealed that the most common site of fracture in traumatic pneumocephalus were para-nasal sinuses (50.00%) specially fracture of frontal (39.00%) and ethmoid bone (11.00%) (Table 3). Small multiple droplets were the most common presentation (48%) followed by pneumatocele presented in 23% of patients (table 4). 18% patients developed CSF leak while 4 % patients develop meningitis (Table 5). Mostly patient (91%) were treated conservatively while 9% patients managed surgically for tension pneumocephalus and depressed fracture (Table 6).

Table 3 Site of fracture in case of traumatic pneumocephalus

Site of Fracture	No of cases
Para-nasal Sinus	50
· Frontal	39
· Ethmoid	11
Basal Fracture	28
· Temporal Bone (Middle cranial fossa)	18
· Frontal Bone with roof of orbit (Anterior cranial fossa)	10
Cranial Vault	20
Compound depressed fracture	5
Compound elevated fracture	1
Compound linear fracture	9
Fracture not detected	05

Table 4: Size of pneumocephalus in traumatic pneumocephalus

Size	Number	Percentage
Droplets	58	58.00%
· Multiple	48	48.00%
· Single	10	10.00%
Pneumatocele	23	23.00%
Air droplet + Pneumatocele	19	19.00%

Table 5: shows complication in traumatic pneumocephalus patients

Complication	Number	Percentage
CSF Leak	18	18.00%
· Otorrhea	8	8.00%
· Rhinorrhea	10	10.00%
Meningitis	4	4%

Table 6: Management in case of traumatic pneumocephalus patients

Treatment	Total	Percentage
Conservative	91	91.00%
Surgery	9	9.00%

Discussion

Pneumocephalus is defined as an intracranial air collection. It may be caused by head trauma, infection, barotrauma following scuba diving and surgery involving the sinuses, orbit, nasal passages or intracranial space [3,4]. Erosion from extracranial infections or tumours may also lead to pneumocephalus. Some cases are idiopathic. The majority of cases are due to either trauma (75-90%) or surgery. Only 0.5% to 1% of all episodes of head trauma result in pneumocephalus [[3]. The presence of intracranial gas in a patient with recent head trauma is a sign suggestive of basal skull fracture.

Trauma is the most common cause of epidural air collection and a frequent cause of air in the other intracranial spaces [3]. Air entering the epidural space as a result of basal skull fracture comes from the sinuses in the floor of the anterior or middle cranial fossa, or the orbit. If the dura is breached, air will reach the subdural space; this occurs in about 28% of cases of pneumocephalus. Tearing of the arachnoid will allow air to enter the subarachnoid space. Distinction of subdural and subarachnoid air can be difficult if the two coexist.

At least two possible mechanisms for the development of PNC are described [5]. One is the effect of ball valve, where the air enters from the extracranial space through CSF leakage, which allows input but not output. When the intracranial pressure increases, the brain, and the dura plug the fistula tract and prevent air from going out. Another theory is known as the ``inverted soda bottle effect``. Loss occurs when the CSF for a fistula or external drainage causes negative intracranial pressure. Air enters as bubbles, replacing the CSF as the pressure in the two cavities balance. A more unusual mechanism is the production of gas *in situ* due to infection by germs forming gas [6].

The diagnosis of pneumocephalus is usually established radiographically. CT has replaced plain radiography as the modality of choice for delineation of the location, extent and etiology of intracranial air. CT scan is extremely sensitive, and can identify as little as 0.5 cc of air in the intracranial spaces [7]. Air in the epidural space appears as biconvex collection of gas not changing with movement. Subdural air tends to outline the contour of the skull and moves with a change in position of the head, although usually confined by the falx and tentorium. Subarachnoid pneumocephalus appears on CT as non-confluent gas pockets conforming to the sulci and cisternal spaces, or in the ventricular system. Air collections within the brain (pneumatocoele) appear as round or oval intra-axial gas collections surrounded entirely by parenchyma.

The therapeutic approach to traumatic pneumocephalus is usually conservative, including nursing in head-up position, avoidance of maneuvers that might increase intra sinus pressure and antibiotics if there is evidence of meningsm Surgical treatment is indicated when there is recurrent pneumocephalus, or sign of increasing intracranial pressure suggesting development of tension pneumocephalus. Treatment includes the drilling of burr holes, needle aspiration, and closure of dural defect.

Conclusion:

Pneumocephalus in head injury is uncommon finding, usually associated with paranasal sinus fracture. Subdural space was most common space for air collection followed by mixed variety. Multiple air droplets were the most common pattern seen on CT scan. CSF leak was common complication presented in 18% cases, although rhinorrhea was more common than Otorrhea. Treatment includes conservative measure in mostly cases except in tension pneumocephalus and depressed fracture.

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