Some Peculiar Lesions of Traumatic Brain Injuries Encountered in our Practice with Brief Discussion-Imaging Manuscript

***Uduma FU[1], Itanyi UD[2], Akpan S[3], Eduwem DU[4], Emejulu JKC[5]**

ABSTRACT

The advent of neuroimaging like computed tomography and magnetic resonance imaging has facilitated the diagnosis of traumatic brain injuries. Emphasizing certain diagnostic features of some peculiar traumatic brain injuries. The following lesions of traumatic brain injuries were pictorially depicted, namely Tension pneumocephalus, Blow out orbit, Bilateral subacute subdural haematomata, Acute-on-chronic subdural haematoma, Middle cranial fossa acute epidural haematoma, Traumatic basal ganglial haematoma and Acute intra-ventricular haematoma. Mount Fuji sign is typical of tension pneumocephalus while herniation of extra-ocular muscles into the maxillary sinus is diagnostic of blow-out orbit. Rabbit ear appearance is observable in bilateral subacute subdural haematomata.

Keywords: Traumatic brain injury, Computed tomography, Magnetic resonance imaging, Pneumocephalus

INTRODUCTION

Traumatic brain injury (TBI) is a more specific terminology for head injury. TBI is an important public health problem worldwide, thus a potentially devastating clinical condition[1-4]. In Africa, the commonest etiologic factor is road traffic accident (RTA)[4,5]. RTA as an independent entity is of grievous concern to many developing nations with its untoward economic impacts[5,6]. TBI is known to be accompanied by significant morbidity and mortality[4]. This essentially calls for expedited and non-invasive detection of any brain injury and its sequelae. The advent of neuro-imaging like computed tomography (CT) and magnetic resonance imaging (MRI) has facilitated the elucidation of variable traumatic intracranial lesions. This informs our opting for few salient cases shown pictorially to highlight lesion peculiarities and localizations that may be inimical to the patients using neuro-images.

Department of Radiology[1], Faculty of Clinical Sciences, University of Uyo, Uyo, Nigeria.
Department of Radiology[2], University of Abuja Teaching Hospital, Abuja Nigeria.
Department of Opthamology[3], Faculty of Clinical Sciences, University of Uyo, Uyo, Nigeria.
Department of Radiology[4], University of Calabar Teaching Hospital, Calabar, Nigeria.
Neurosurgical Unit, Department of Surgery[5], Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria.

*Corresponding author: felixuduma@yahoo.com

IMAGE PRESENTATIONS

Case A

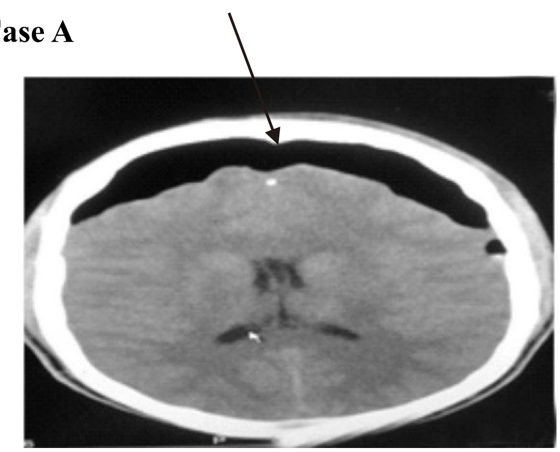

Figure 1: Axial brain CT at the level of lateral ventricles showing frontal intracranial, extra-axial (sub-dural) air density lesion overlying and compressing posteriorly both frontal lobes with air dipping into the interhemispheric fissure and separation of the frontal lobes to a peak like configuration (black arrow) characteristic of Mount Fuji sign of Tension pneumocephalus.

Case B

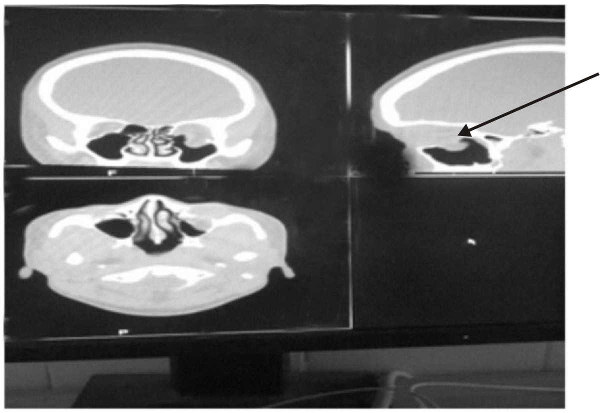

Figure 2: Bone window images of cranial CT (coronal, sagital and axial) showing bony defect (black arrow) of floor of the left orbit (25×20 mm in size) complicated by herniation of left extra-ocular muscle and intra-orbital fat into the left maxillary sinus giving a tear drop sign (Blow-out orbit).

Case C

Figure 3: Axial brain CT at the level of lateral ventricles showing bilateral intracranial extra-axial concavo-convex isodense collection (black arrows) of subdural haematomata in the fronto-parietal calvarium. Note associated compression of both ventricles medially leading to narrow, slit-like elongated ventricles (rabbit ear sign) and slight sub-falcine herniation to the left. (Bilateral subacute subdural haematomata).

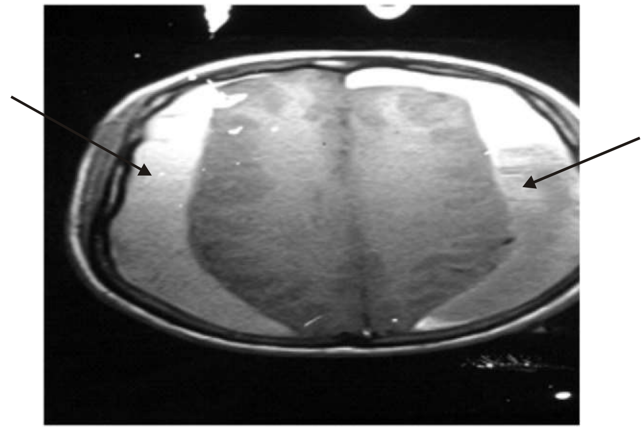

Figure 4: Axial T1 weighted MR image in another patient with MRI more eloquently showing bilateral hyperintense cresentric shaped collection (black arrows) extending from frontal to occipital region-(Bilateral subacute subdural haematomata).

Case D

Figure 5: Axial brain CT showing right fronto-parietal extracranial cresenteric bleed with fluid-fluid level and dependent hyperdense component (white arrow). Note associated significant subfalcine herniation (black arrow) to contralateral side. (Acute-on-chronic subdural haematoma).

Case E

Figure 6: Unenhanced axial brain CT at the base of the skull showing localized biconvex hyperdense bleed in the anterior part of left middle cranial fossa (black oblique arrow) beneath the left greater wing of sphenoid. This is associated with an aerocele. Both lesions are compressing on the left temporal cerebral lobe. Note another aerocele (black curved arrow) in the contralateral right middle cranial fossa. (Anterior temporal acute epidural haematoma and pneumocephalus in middle cranial fossa).

Case F

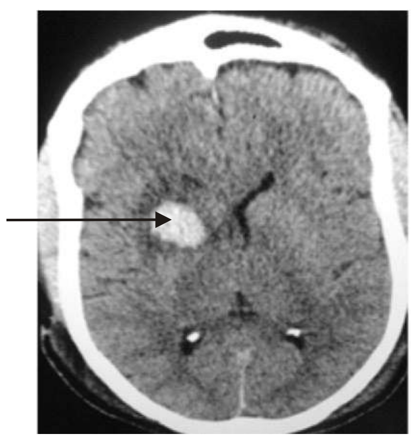

Figure 7:Unenhanced axial brain CT at the level of lateral ventricle showing hyperdense intra-parenchymal ovoid bleed (black arrow) located in the vicinity of right globus pallidius and putamen. Note compression of right lateral ventricle. (Acute traumatic basal ganglial haematoma).

Case G

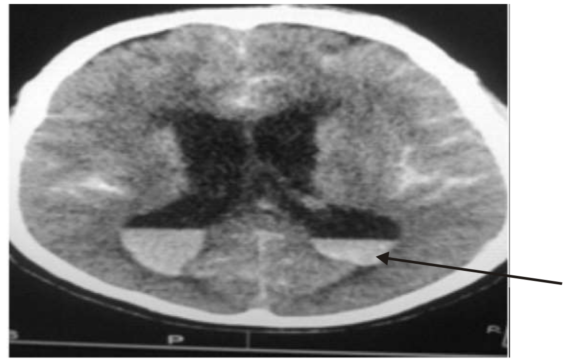

Figure 8: Axial brain CT at the level of lateral ventricle showing fluid- fluid level with hyperdense (black arrow) collection in the occipital horns of the lateral ventricles (Bilateral acute intraventricular haematomata).

DISCUSSION

A cursory look at some of the pertinent radiological features of selected neuro-radiological images in traumatic brain injuries may be relevant to underscore the need to avert neurological sequlae. Top on our list is Mount Fuji sign of tension pneumocephalus. Pneumocephalus denotes the availability of air inside the cranial cavity as a consequence of pathological communication with - ambient air[7-9]. Up to 75% of cases of pneumocephalus are caused by trauma[7-8]. Other known causes are craniotomies, infections, tumors, brain and spine surgeries as well as surgeries involving paranasal sinuses. In terms of localization, pneumocephalus can be in the epidural, subarachnoid, intra-ventricular, intra-cerebral, or subdural spaces. The most frequent localization is subdural and frontal[9-17]. This is seen in our index patient shown in figure 1.

Tension pneumocephalus is regarded as neurosurgical emergency. It occurs when extra-axial air is in sufficient volume to exert a pressure effect on the brain, with attendant intracranial hypertension and brain herniation.[7,9,11-16] The consequent clinical presentations manifest as generalized weakness, headache, vomiting and seizures. This therefore warrants immediate intervention in the form of cranial decompression using burr hole or needle aspiration to avert fatality.

As little as 25ml of air is sufficient to cause tension pneumocephalus[8-9]. CT is the golden standard for diagnosis of pneumocephalus since it can detects as small as 0.55mL of air whereas a conventional skull radiograph requires at least 2ml[8] . Two specific signs have been proposed for the diagnosis of subdural pneumocephalus on brain CT namely (1) Peaking sign (2) Mount Fuji sign[9-12]. Peaking sign is characterized by large collection of air over the anterior and lateral portions of bilateral frontal lobes causing its compression. The air does not cause any separation of the tips of the frontal lobe, thereby leading to an appearnce of a single peak in the midline[9,12,17]. The “Mount Fuji sign,” differentiates tension pneumocephalus from non-tension pneumocephalus[7,10-12]. Characteristically, this sign involves extension of air in between the tips of the frontal lobes suggesting that the pressure of the subdural air exceeds the surface tension of cerebrospinal fluid between the frontal lobes[8,16]. (see figure 1). This sign was first described by Ishiwata *et al*.[1,2] and named after the highest mountain in Japan.[8,12,13,16] The Mount Fuji sign indicates more severe pneumocephalus than the peaking sign and calls for need of emergent decompression[8-10]. Nevertheless, its absence does not essentially rule out subdural tension pneumocephalus[9].

The second lesion in our presentation is blow-out orbit (blow-up orbit or orbital blow-out fracture). This occurs when there is a fracture of one of the orbital walls with intact orbital rim and any bone fragment must be displaced outside the orbit [18-22]. In children, it is called trap door fracture as the fracture may spring back into place[18,21]. Blow out orbit results from direct blow to the central orbit from a fist or ball (an object with a diameter exceeding the bony margins of the orbit)[18,21]. This could result from assault, motor vehicle accident, barotrauma and violent sports like soccer, boxing, wrestling, basketball and rugby. The fracture site of predilection is inferior orbital wall that is posterior and medial to the infra-orbital groove[21]. Others sites in descending order are medial orbital wall (lamina papyracea), superior and lateral walls[18]. Inferior and medial walls are affected simultaneously in 50% of cases[21]. In inferior blow-out fractures, orbital fat alone or in combination with inferior rectus muscle will prolapse into the maxillary sinus. Consequences of this prolapse will be enophthalmos (due to increased orbital volume), diplopia: (due to extra-ocular muscle entrapment), orbital emphysema and malar region numbness (infraorbital nerve anaesthesia).[18,21,22] Other presentations are exophthalmos, up-gaze restriction of the eye, periocular ecchymosis and painful eye movement, especially with adduction and infraduction[18, 23]

CT is the best modality for evaluating blow out orbit. CT features of blow out orbit include:herniation of orbital fat inferiorly into the maxillary sinus giving a "tear drop" sign.[21,22,24] (see figure 2) .Other CT features are presence of intra-orbital bleed resulting in stretching or compression of the optic nerve, globe injury or rupture. Extraocular muscle entrapment is suspected if there is an acute change in angle of the muscle[21]. Surgical indications are herniation of the orbital contents into the maxillary sinus, muscle entrapment, enophthalmos of greater than 2 mm, significant diplopia in the primary position or oculo-cardiac reflex[23].

Subdural hematomas are relatively common, seen in about 10-20% of head injured patients and has a mortality as high as 50-85%[25]. It is mainly the consequences of inertial forces arising from acceleration and deceleration of the brain within the skull with resultant rupturing of veins via a shearing mechanism[25]. Subdural hematomas are not restricted by dural tethering at the cranial sutures but do not cross the midline because of the meningeal reflections[25-27]. Subdural haematomas can be bilateral. Such bilateral haematomas may cause medial compression of both ventricles leading to narrow, slit-like elongated ventricles. This corresponds to “squeezed ventricle” or “rabbit's ears” appearance as shown in figure 3[25].

Epidural haematoma (EDH) in contrast, is the result of direct impact to the skull with greater than 75% of cases resulting from disruption of the middle meningeal artery[26]. It is seen in 0.2% - 12% of all head trauma patients with fracture detected in more than 90% of cases[26-28]. It is particularly worrisome when epidural haemtoma is located in the middle cranial fossa as seen in our patient (figures 6). This is because it has a potential for rapid enlargement with subsequent temporal lobe herniation (uncal herniation), brainstem compression and poor outcome[26]. CT poor prognostic findings in such patients are pterional location of a skull fracture, EDH thickness greater than 1.5 cm, EDH volume greater than 30 ml, location within the lateral aspect of the middle cranial fossa, associated midline shift greater than 5 mm, and presence of a swirl sign within the hematoma (suggesting active bleeding and expansion of the collection)[26]. However, the anterior location of EDH in our patient (figures 6) rather than laterally to the temporal lobe will predispose to posterior as opposed to medial displacement of the temporal lobe

Traumatic basal ganglion hematoma (TBGH) is defined as intra-cerebral hematoma located in basal ganglion (caudate nucleus, putamen and globus pallidus) (see figure 7) and sometimes in neighboring structures like thalamus and internal capsule[28-32]. This contrasts with spontaneous hemorrhages that are solitary and located in the region of thalamus and internal capsule[29]. TBGH is thought to be due to shearing of lenticulostriate or anterior choroidal blood vessels caused by rapid acceleration and deceleration forces[29]. TBGH occurs mainly in young patients and it is a rare entity having been reported in only 3% of closed head injuries[29]. However, a higher incidence of 10%-12% is seen in autopsy series[29,30].

TBGH is an evidence of significant primary brain injury and carries worse morbidity. Poor prognosis is seen when it is bilateral, large (>2cm in diameter) or accompanied by diffuse axonal injury, intra-ventricular hemorrhages, contusions, and extra axial hematomas[29-33]. It rarely needs surgical evacuation but surgery is considered in increasing size of hematoma and deteriorating neurological condition[20]. Intra-ventricular hemorrhages may be the complications of parenchymal intracerebral bleed or subarachnoid bleed[34]. However, spontaneous primary intra-ventricular hemorrhage without a recognizable parenchymal component in unenhanced CT or MRI studies is extremely rare as seen in our patient (figure 8)[34]. Although primary intra-ventricular hemorrhage is uncommon, it is a serious clinical condition with a high early mortality[34].

CONCLUSION

Mount Fuji sign is typical of tension pneumocephalus while herniation of extra-ocular muscles into the maxillary sinus giving a tear drop sign is diagnostic of blow-out orbit. Rabbit ear appearance is observable in bilateral subacute subdural haematomata. Haematoma in the middle cranial fossa may provoke uncal herniation. While traumatic basal ganglia haematoma and primary acute intra-ventricular haematoma may separately be an evidence of significant primary brain injury. These heterogenous subtypes of traumatic brain injuries were selected to spot light their salient neuro-radiological features to facilitate prompt Radiological diagnosis and subsequent clinical management.

DISCLOSURE: The authors have no conflict of interests to declare in relation to this paper.

CONSENT: The consent of the patients were sought for usage of their neuro-radiological images for this study.

AUTHORS CONTRIBUTIONS: UFU conceived the study. UFU, IUD, EDU, EJKC and AS contributed images and searched the literatures. UFU, IUD contributed to text writing and all authors proof read text.

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