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Prescription of Brain CT in Traumatic Brain Injury: A Prospective Audit in a Senegalese Level-2 Hospital (2024 – 2025)

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ABSTRACT

Background: Head injuries represent a major public health concern and are a leading cause of morbidity and mortality among young adults. Computed tomography (CT), an imaging modality based on ionizing radiation, is the gold standard for evaluating traumatic brain injury (TBI). The objective of this study was to quantify the yield of abnormal brain CT findings and to test whether initial loss of consciousness (ILOC) predicts abnormal imaging results. **Methodology:** We conducted a prospective, descriptive, and analytical study from January 2, 2024, to July 31, 2025, at the Radiology Department of Abdoul Aziz Sy Hospital in Tivaouane, Senegal. All patients who underwent brain CT scans for recent TBI were included. **Results:** A total of 521 CT scans were analyzed. Seventy-one percent of patients were male, and 65% were older than 15 years, with a mean age of 25 ± 18 years. The mechanism of injury was reported in 45 cases (8.6%), dominated by road traffic accidents (34 cases). Clinical data concerning the Glasgow Coma Scale (GCS) and other neurological signs were available for only 10 (1.9%) and 107 (20.5%) patients, respectively. Initial loss of consciousness was absent in 60.6% of cases. Brain CT findings were normal in 345 (66.2 %) of patients. **Conclusion:** Nearly three-quarters of brain CT scans performed for TBI were normal, highlighting gaps in documentation of clinical criteria that determine imaging appropriateness. Strengthening clinical documentation and applying validated decision rules could improve CT utilization and reduce unnecessary radiation exposure.These findings highlight the need for evidence-based imaging stewardship in West African regional hospitals.

Keywords: Traumatic Brain Injury, CT scan, Clinical assessment, Recommendations, Senegal, RTA

INTRODUCTION

Traumatic brain injury (TBI) is defined as brain damage caused by an external mechanical force, potentially leading to temporary or permanent neurological deficits, or even death (1). It represents a major global public health issue, particularly among young adults (2). The worldwide annual incidence is estimated at approximately 69 million cases, with a steady increase reported over the past 25 years (3). In Senegal, TBI also constitutes a significant health burden due to its high frequency and associated morbidity and mortality (4).

Brain computed tomography (CT) remains the gold standard for evaluating traumatic brain injuries. However, systematic CT prescription is not recommended in mild head trauma (Glasgow Coma Scale ≥ 13), as life-threatening complications requiring neurosurgical intervention occur in less than 1% of cases (5,6). Over prescription contributes to unnecessary radiation

exposure and increased healthcare costs, particularly in resource-limited settings (7).

To address this, several clinical decision rules have been developed and validated, such as the Canadian CT Head Rule, the New Orleans Criteria, and for pediatric populations, PECARN, CATCH, and CHALICE (8–11). The NICE NG232 guideline (2023) provides integrated recommendations for both adults and children, incorporating these rules into a unified framework. These tools enable evidence-based imaging while minimizing unnecessary scans.

In Senegal, few studies have evaluated CT utilization in the management of TBI. Understanding current prescribing patterns is essential for developing local strategies that balance diagnostic accuracy with radiation safety.

The primary objective of this study was to determine whether the presence of initial loss of consciousness (ILOC) is associated with a higher likelihood of abnormal brain CT findings after adjusting for age group and sex.

The secondary objectives were to assess documentation completeness on CT request forms and to describe the mechanisms of injury among TBI patients.

MATERIALS AND METHODS

We conducted a prospective, descriptive, and analytical study including all patients who underwent brain CT for recent traumatic brain injury (TBI), defined as head trauma within the previous 48 hours, with or without initial loss of consciousness (ILOC).
Patients with polytrauma requiring whole-body CT and those with remote head trauma (head injury occurring more than three months earlier) were excluded.

The study was carried out at Abdoul Aziz Sy Hospital in Tivaouane, a level-2 regional hospital in Senegal. All data were anonymised, and the study protocol was approved by the hospital's Ethics and Scientific Committee.

CT examinations were performed using a 16-slice NEUSOFT® scanner, without intravenous contrast, with systematic cervical spine coverage and dose adjustments for pediatric patients to minimize radiation exposure.

Data were extracted from the electronic radiology database of the department, covering all patients included over a 19-month period. The data were entered and processed in Microsoft Excel, then analyzed using R Studio (version 2024.12.0).

The chi-square (χ^2) and Student's t-tests were used to compare qualitative and quantitative variables, respectively. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 521 brain CT scans were analysed. Among these, 71% of patients were male, and 65% were aged 15 years or older. The mean age was 25 ± 18 years.

The mechanism of injury was missing from the CT request form for 476 patients (91.3%), reflecting incomplete documentation rather than absence of information in clinical records. Among the 45 documented cases, 34 were due to road traffic accidents, followed by falls (5 cases), domestic accidents (2), work-related accidents (1), knife injuries (1), and assaults (2) (Table 1).

Clinical information regarding consciousness level (GCS) and neurological signs was available in only 10 (1.9%) and 107 (20.5%) examination requests, respectively. Among the reported clinical signs, scalp haematoma (21 cases), headache (19 cases), drowsiness (7 cases), and coma (3 cases) were most common.

The presence or absence of initial loss of consciousness (ILOC) was systematically documented in all CT requests. Among the 316 patients without ILOC, 71 (22.5%) had abnormal findings, whereas among the 205 patients with ILOC, 67 (32.7%) had abnormal CT results. This difference was statistically significant ($p = 0.01$).

Six patients presented with traumatic cervical spine injuries, including fracture-dislocation. Secondary complications were identified in 12 patients (2.3%), primarily subfalcine cerebral herniation (1.5%), followed by cerebral edema in four patients, two of whom died.

Table 1. *Mechanisms of Injury*

Mechanism	n (%)
Road traffic accident	34 (6.5)
Fall	5 (1.0)
Work-related accident	1 (0.2)
Domestic accident	2 (0.4)
Knife injury	1 (0.2)
Assault	2 (0.4)
Not reported	476 (91.3)

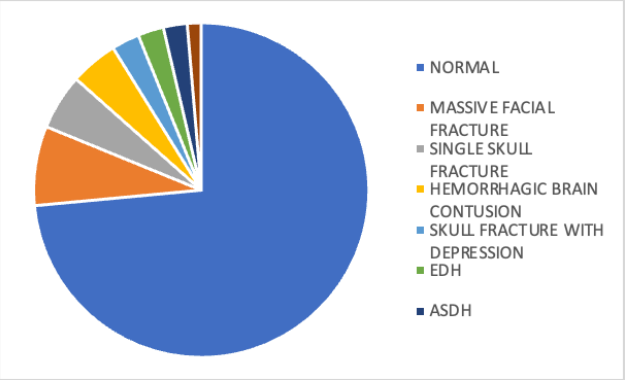

Figure 1*. Distribution of global brain CT findings. A normal brain CT was found in 345 patients (66.2%), while 176 (33.8%) showed abnormal findings, including intracranial hemorrhage, fractures, or cerebral edema.*

Table 2*. Clinical Information Reported on CT Request Forms*

Clinical Signs	n (%)
Vomiting	28 (5.4)
Hematoma	19 (3.6)
Headache	18 (3.4)
Seizures	8 (1.5)
Drowsiness	7 (1.3)
Open wound	7 (1.3)
Epistaxis	4 (0.8)
Otorrhagia	4 (0.8)
Agitation	3 (0.6)
Coma	3 (0.6)
Vertigo	2 (0.4)
Amnesia	1 (0.2)
Blurred vision	1 (0.2)
Rhinorrhagia	1 (0.2)
Neck swelling	1 (0.2)
Not reported	414 (79.5)

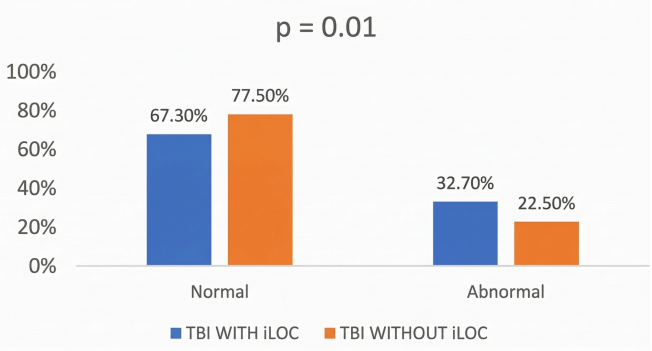

Figure 2*. Distribution of normal and abnormal brain CT findings according to the presence or absence of ILOC (Initial loss of consciousness).*

DISCUSSION

Head injuries are increasing worldwide, with an estimated global incidence of 100 to 300 cases per 100,000 inhabitants (3). In Senegal, several studies have examined CT findings in TBI patients across different hospitals, often as part of radiology theses (4,7). However, few have explored the relationship between normal CT findings and clinical data. For example, a study conducted in Ziguinchor in 2024 focused on pediatric TBI but included only pathological results (8).

In the present study, we evaluated not only the justification for brain CT prescriptions but also the relationship between initial loss of consciousness (ILOC) and CT outcomes. We also highlighted the insufficient clinical information provided in CT requests—such as Glasgow Coma Scale (GCS), mechanism of injury, and neurological signs—even though these parameters are essential for determining CT indications and timing (9).

Due to the unavailability of emergency department notes and the absence of an electronic medical record system, the clinical evaluation of each patient could only be inferred from information provided on CT request forms. This major limitation prevents a full assessment of clinical appropriateness.

Our work also faced other constraints, including the lack of clinical follow-up data and the limited number of patients undergoing radiological monitoring, partly due to the absence of a

neurosurgery department in our hospital, which is a level-2 regional facility.

Globally, millions of brain CT scans are performed each year, yet a considerable proportion may be unnecessary. It is estimated that up to one-third of CT scans in adults with TBI could be avoided (10). In children—where TBI is frequent but usually benign—the initial clinical examination remains crucial to determining the need for imaging (11).

A statistically significant difference ($p = 0.01$) was found between patients without ILOC and those with ILOC in terms of abnormal CT findings. The absence of ILOC was strongly correlated with normal imaging, emphasizing the importance of a thorough clinical evaluation before requesting CT. This finding aligns with international data: in the United States, the proportion of brain CT scans performed without a history of loss of consciousness ranges between 30% and 60% (12,13).

In our study, the lack of clinical information in CT requests and the absence of documentation prevented retrospective calculation of GCS scores or objective evaluation of adherence to clinical guidelines. Thus, the data suggest that brain CT prescriptions were not guided by evidence-based decision rules, but rather by incomplete documentation. However, our results point to a documentation gap, particularly regarding GCS (reported in only 1.9% of cases), rather than truly inappropriate imaging.

The non-use of clinical decision guidelines does not necessarily imply inadequate management. Future multicenter studies are warranted to evaluate the appropriateness of brain CT prescriptions in TBI across Senegal.

The issue is especially important in pediatric practice. In our series, 183 children were examined; 71.5% had normal CT scans, and only 1% showed serious complications (e.g., cerebral herniation). These figures are consistent with studies showing that potentially life-threatening complications requiring neurosurgery occur in less than 1% of cases (5,6). Because clinical assessment in infants and young children is challenging, CT is frequently used (14). Nevertheless, CT has low sensitivity for certain lesions—such as diffuse axonal injury or early edema—for which MRI is more appropriate (15).

Another major concern is radiation exposure. In children, developing tissues are particularly radiosensitive, necessitating strict dose optimization. Several studies have demonstrated an increased risk of leukemia or brain tumors following repeated CT exposure (16–18). As early as 2009, Kuppermann et al. estimated a radiation-induced cancer risk of 18 per 10,000 brain CTs (19). More recently, Wang et al. (2023) confirmed that although the risk remains low for a single scan, it becomes significant after four or more examinations, especially in young children (20).

Given these findings, clinical decision rules are essential to guide CT prescription. The French Society of Emergency Medicine (SFMU) and the Francophone Group for Pediatric Rehabilitation (GFRUP), as well as the Centers for Disease Control and Prevention (CDC) in the United States, recommend the Pediatric Emergency Care Applied Research Network (PECARN) criteria for mild pediatric TBI (9,19). Other validated rules—such as CATCH, CHALICE, the Canadian CT Head Rule, and the New Orleans Criteria—have proven effective in reducing unnecessary imaging (21,22). Klang et al. also demonstrated a 15.3% overuse rate of brain CT in mild TBI (23).

In our study, 71% of patients were male, consistent with findings from other studies (24,25). In contrast, only 1.9% of requests mentioned the Glasgow Coma Scale, a key component in assessing and classifying head injury severity (26). The majority of TBIs are mild (GCS ≥ 13), representing over 95% of pediatric cases, with fewer than 10% showing intracranial lesions and fewer than 1% requiring surgery (27,28).

Given these results, our study underscores the need for a rational use of brain CT, based on comprehensive clinical assessment and validated decision-making tools. Current overuse leads not only to unnecessary radiation exposure but also to a financial burden for patients and the national healthcare system, especially in the absence of universal medical coverage.

Through this study, we aim to raise clinician awareness—particularly in emergency settings—of the importance of documenting the mechanism of injury, GCS, and neurological signs when ordering a CT scan. We also encourage national multicenter studies on CT utilization in TBI, especially pediatric cases, to establish locally adapted imaging protocols similar to those developed in the United States (18), France (9), and Canada (29). All six patients with cervical spine fracture-dislocation required neurosurgical follow-up.

CONCLUSION

Brain computed tomography remains an indispensable tool in the management of traumatic brain injury (TBI). However, its

systematic prescription without adequate clinical documentation (particularly in mild cases and among pediatric patients) results in unnecessary radiation exposure and additional costs for an already fragile healthcare system. In this prospective study, nearly three-quarters of brain CT scans were normal, and key clinical information (especially the Glasgow Coma Scale) was often missing from request forms. A thorough clinical assessment, guided by the NICE and PECARN criteria, together with pediatric dose optimization, is essential to rationalize imaging use and improve the quality of practice in our setting.

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