Radiographic Predictors of Intracranial Hypertension

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Introduction

It is well established that traumatic brain injury (TBI) is a process not limited to the injury sustained at the time of trauma. Hence, post-traumatic management of the trauma patient is critical, and may include placement of an intracranial pressure (ICP) monitor.

Guidelines set by the Brain Trauma Foundation (BTF) (Fig. 1) outline the parameters for ICP monitor placement. The goal of this study is to determine if findings on head (computed tomography) CT could positively predict the presence of increased ICP.

Brain Trauma Foundation Guidelines

Indications for the placement of intracranial pressure monitoring devices:

1. Severe traumatic brain injury (TBI) and a Glasgow Coma Scale (GCS) score of 3 - 8 with an abnormal computed tomography (CT) scan

2. Severe TBI with a normal head CT, and two of the following criteria:
   - Age over 40
   - Unilateral or bilateral posturing
   - Systolic blood pressure < 90 mmHg

Hypothesis

Certain radiographic findings (presence of hemorrhage, cisternal effacement, sulcal effacement, hydrocephalus, midline shift and herniation) on head CT can be used to determine the presence or absence of intracranial hypertension.

Methods

The institutional review board at Boston Medical Center (BMC) approved a retrospective study, reviewing all patients that had an ICP monitor (external ventricular drain (EVD), Camino ICP monitoring kits or Licox) placed for severe TBI over the past five years. Data points obtained included:

- Sex
- Age
- GCS Score
- Intial ICP

Findings on head CT that were recorded included:

- Midline shift
- Herniation
- Intracranial hemorrage
- Sulcal effacement
- Cisternal effacement
- Hydrocephalus

All head CTs were read by a neuroradiologist. These reports were reviewed and the number of findings on head CT were summed. The Spearman correlation coefficient was used to test for significance.

Fig. 1

Finding	Occurrence
Sulcal Effacement	55.8%
Cisternal Effacement	34.8%
Midline Shift	32.5%
Bleed	13.9%
Herniation	6.9%
Hydrocephalus	4.6%

Results

Our study included 43 patients, of which 33 were male (76.7%) and 10 were female (23.3%). The average GCS score was 5. Only 14 patients (32.6%) demonstrated increased ICP. The most common finding was sulcal effacement, which was present in 24 patients (55.8%), (Fig. 1).

There was no statistically significant correlation ($p > 0.05$) between ICP values and the number of findings on head CT nor between GCS before ICP monitor placement and either the ICP or the number of findings on the radiology report.

Presence of sulcal effacement, the most common finding, had a positive predictive value of 41%, and a negative predictive value of 68% (Fig. 2). Cisternal effacement, the second most common finding was found to have a positive predictive value of 50%, and a negative predictive value of 69% (Fig. 3).

Fig. 2

Sulcal Effacement	Initial ICP < 20	Initial ICP > 20	Total
No	13	6	19
Yes	14	10	24
Total	27	16	43

Fig. 3

Cisternal Effacement	Initial ICP < 20	Initial ICP > 20	Total
No	20	9	29
Yes	7	7	14
Total	27	16	43

Conclusions

In our study, we did not find a statistically significant correlation between ICP values and findings suggestive of intracranial hypertension on head CT. Future steps include a larger retrospective study or a prospective study to determine if ICP and head CT scan findings correlate.

References

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