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# Outcome of traumatic brain injury in children by using rotterdam score on computed tomography

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## SHORT COMMUNICATION

## OUTCOME OF TRAUMATIC BRAIN INJURY IN CHILDREN BY USING ROTTERDAM SCORE ON COMPUTED TOMOGRAPHY

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**Background:** The Rotterdam Score (RS) on CT head is a new evolving clinical tool as a predictor of mortality in Traumatic Brain Injury (TBI). The objective of this study is to assess the outcome of children with TBI admitted in paediatric intensive care unit (PICU) of a tertiary-care, university hospital by using RS. **Methods:** This was a prospective observational study conducted on children (age: 1mo -16yr) with TBI admitted in PICU of Aga Khan University Hospital from 2013 to 2016. RS on CT was calculated by a radiologist. All patients were managed according to according to Paediatric Brain Trauma Foundation Guidelines 2012. Demographic data, clinical variables and outcomes were recorded. Logistic regression analysis was applied to assess the association between outcome and R. **Results:** Ninety-two cases were enrolled during four years. The median age was 77 months (3 months to 16 years) and 73 (79%) were male. The main cause of injury was RTA (60.9%) followed by fall (39.1%). Sixty-two patients (67%) had a post-resuscitation GCS of 8 or less. 54% (51) patients were managed conservatively. The RS of 1, 2, 3, 4 and 5 were present in 19, 36, 19, 15 and 3 patients. The mean RS was 2.4. The higher mortality rate was observed in high RS. The RS was significantly associated with mortality (OR 1.75, 95% CI 1.03-2.95;  $p < 0.04$ ). **Conclusion:** Rotterdam Score on CT head can be used to predict mortality in paediatric patients with TBI.

**Keywords:** Children; TBI; Rotterdam score; CT scan; Mortality

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## INTRODUCTION

Early non-contrast cranial computed tomography (CT) is the choice of neuroimaging in acute management of traumatic brain injury (TBI). CT of brain is not only helpful in the management of patient as well as in predicting the prognosis of patients with TBI.<sup>1</sup> Several reports are available on individual CT findings like midline shift, subarachnoid bleed, basal cistern and presence of intracranial mass.<sup>2,3</sup> The Rotterdam Score (RS) on CT of brain is the more recently emerged as a prediction model for prognosis.<sup>4</sup> The RS has demonstrated prognostic value in adult patients with TBI.<sup>5,6</sup> There is a paucity of data related to RSSC in paediatric TBI.<sup>7</sup> The objective of this study is to evaluate the use of RS in predicting outcome of children with TBI admitted in paediatric intensive care unit of a tertiary-care hospital.

## MATERIAL AND METHODS

This was a prospective observational study conducted in the paediatric intensive care unit (PICU) of the Aga Khan University Hospital from January 2013 to December 2016. The Aga Khan University Hospital is equipped and staffed which is necessary for a level 1 trauma centre. This study was approved by

institutional ethical committee (3178-Ped-ERC-2013). All children aged 1mo -16 years admitted to the PICU with TBI were included in this study. Patients with a history of head trauma for more than 24 hours prior to presentation and patients with a diagnosis of polytrauma were excluded from this study. Patients were also excluded if they expired before the initial non-contrast CT head could be obtained, if no imaging was done, or if the images were not available.

All patients were appropriately managed according to guidelines on acute management of traumatic brain injury in infant, children and adolescent published in 2012.<sup>1</sup> The following data including demographics, mechanism of injury, post-resuscitation GCS, CT scan characteristics, neurosurgical interventions and outcome as hospital discharge as alive or dead on structured *pro-forma*. All images of CT scan were reviewed through picture archiving and communication system (PACS) by radiologist (BS) who was blinded to the outcome. Each CT scan characteristics were classified based on R S as described by Mass *et al* (Box 1).<sup>4</sup> The primary outcome was hospital mortality. Data were entered and analysed using SPSS IBM version 20 (Armonk, NY). Binary logistic regression analysis

was performed to assess the relationship between RS and outcome as mortality.

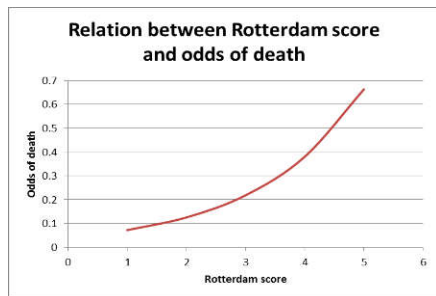
**RESULTS**

Of total 1546 PICU's admission, 92 (6%) were enrolled in study. The mean age with SD was 7±5 years and 79.3% (73) were male. The mechanisms of injury were road traffic accidents (60.9%) and falls (39.1%). The mean post-resuscitation GSC was 6.9±3.7. About half Of those (44.5%) required some form of neurosurgical interventions like placement of external ventricular drain, decompressive craniotomy, and evacuation of hematoma. The case-specific mortality was 15.2%.

The mean RS was 2.4±1 in our cohort. The most common RS was 2 (39.1%) in our study. The number and percentages of patients with RS 1,2,3,4 and 5 were 19 (20.6%), 36 (39.1%), 19 (20.6%), 15 (16.3%) and 3 (3.76%) respectively. The mortality rate was associated with rising RS as shown in figure-1. 100% mortality was seen in patients with RS of 5. Univariate analysis revealed that the RS was significantly associated with mortality (odds ratio 1.75, 95% confidence interval 1.03-2.95; *p*<0.04). The case-specific mortality rate was 14 (15.2%).

**Box-1: Rotterdam computed tomography score**

Rotterdam Score Element	Score
<b>Basal Cisterns</b>	
Normal	0
Compressed	1
Absent	2
<b>Midline Shift</b>	
No Shift or shift ≤ 5-mm	0
Shift > 5-mm	1
<b>Epidural Mass Lesion</b>	
Present	0
Absent	1
<b>Intraventricular Blood or tSAH</b>	
Absent	0
Present	1
Sum Score	+1



**Figure-1: Relationship between Rotterdam score and mortality**

**DISCUSSION**

We found that the RS on CT is directly correlated with outcome of children admitted with TBI in our PICU. Several clinical parameters have been described in predicting outcome of patients with TBI; including age, mechanism of injury, initial Glasgow coma scale, hypoxia, hypotension, and abnormal pupillary response.<sup>8</sup> Recently, the brain lesion analysis based on initial CT scan in emergency room is increasingly used in determining outcome of patients with TBI and identified as a priority to include in risk estimation.<sup>9,10</sup> However, Hirsch et al described the variable prognosis in 248 children with severe TBI on initial CT of head over 9-year period.<sup>2</sup> Teruel *et al* found that the unfavourable outcome based on initial worst CT findings in their 156 children with severe TBI during 8 year period.<sup>3</sup>

There is a strong evidence available in the literature of adult TBI that RS is an independent prognostic indicator of outcome. RS is one such measure that incorporates CT scan findings to account for heterogeneity of lesion and its associated prognosis.<sup>4,11</sup> Waqas *et al* reported recently from the same institution that RS is an independent predictor of unfavourable outcome and mortality in adult TBI after emergency decompressive craniectomy.<sup>6</sup> There is a dearth of information regarding utility of RS in paediatric TBI. Liesemer *et al* was also found that the RS had a direct relationship with mortality in a large paediatric cohort (>600 children with moderate to severe TBI).<sup>7</sup> It is a major public health problem worldwide despite all preventive efforts and is associated with high morbidity and mortality. This new composite score may help both physicians as well as family in determining prognosis and the effective utilization of expensive resources.

The most common mechanism of injury in our study cohort was from RTA and males were mostly involved like other paediatric reports on TBI.<sup>2,3</sup> We found a mortality rate of 15.2% in our study cohort. This is similar to the finding of a large multicentre trial in paediatric patients with TBI, whose mortality was reported to be 16%.<sup>12</sup>

Being a single centre study is a first limitation. Small sample size and focused only on one parameter are our limitations. The strength of this study is the first report on RS in paediatric TBI from a developing country.

**CONCLUSION**

Based on the findings of our study, we conclude that the Rotterdam scoring is a reliable measure to predict patient mortality in paediatric patients with TBI.

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