

## **Research Article**

### **Grading of Brain Contusions by Modified Method: An Autopsy Study**

**Dr. Garudadhri GV<sup>\*1</sup>, Dr. Vedashree MK<sup>2</sup>, Dr PC Dikshit<sup>3</sup>, Dr Nita Khurana<sup>4</sup>**

<sup>1</sup>Resident, Department of Forensic Medicine, Mandya Institute of Medical Sciences, Mandya-571402.

<sup>2</sup>Assistant Professor, Department of Pathology, MVJ Medical College, Hoskote, Bangalore.

<sup>3</sup>Director Professor & Head, Department of Forensic Medicine, Maulana Azad Medical College, New Delhi-110002.

<sup>4</sup>Professor, Department of Pathology, Maulana Azad Medical College, New Delhi-110002.

#### **\*Corresponding author**

Dr. Garudadhri GV

**Email:** [garudagv2@gmail.com](mailto:garudagv2@gmail.com)

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**Abstract:** Quantification and analysis of brain contusion was initially done in 1970's followed by 2005. They derived brain contusion index based on parenchymal depth and surface distribution of contusion over brain. We conducted this study with the objectives of whether severity of contusion index determines Post trauma survival, is there a region specific contusion which determines Post trauma survival and finally, is there any region specific contusion in cases according to their mode of occurrence. The study was conducted in Department of Forensic Medicine, Maulana Azad Medical College, New Delhi. It was a prospective study conducted on the brains of twenty eight cases of fatal brain trauma having contusions which were received for medicolegal autopsy at the mortuary. We conclude that Contusion severity scale does not bare any relation with the Post trauma survival. In comparison to the mode of injury, there is no relation with the distribution of contusions over the brain. Post Trauma Survival is variable with contusions over cerebral and cerebellar hemispheres, but, in cases with contusions over brainstem, the Post trauma survival was less than 72 hours.

**Keywords:** Contusion, Brain, Grading, Modified method

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#### **INTRODUCTION**

Initial quantification and analysis of brain contusion was done by Adams JH *et al.* [1] in 1970s. They derived brain contusion index based on parenchymal depth and surface distribution of contusion over brain. But this index had few applied anatomical limitations, so Bennet I Omalu *et al.* [2] in 2005 proposed a two tier system based on the Adams' system with a re-definition of the lobar distinctions and classifications of the brain. This system may be applied to routine forensic reporting, as evidence in the Court and research analysis of traumatic head conditions.

We conducted this study with the objectives of whether severity of contusion index determines Post trauma survival, is there a region specific contusion which determines Post trauma survival and finally, is there any region specific contusion in cases according to their mode of occurrence.

#### **MATERIALS AND METHODS**

The study was conducted in Department of Forensic Medicine, Maulana Azad Medical College, New Delhi. It was a prospective study conducted on the brains of twenty eight cases of fatal brain trauma having contusions which were received for medicolegal autopsy at the mortuary of Department of Forensic

Medicine, Maulana Azad Medical College. The cases included were with head injury sustained due to motor vehicle accidents, railway accidents, fall from height and other blunt impact injuries having known survival period. Decomposed bodies were excluded from the study.

At autopsy brains were removed. After thorough external examination, the whole brain was fixed in 10% neutral buffered formalin for 3 weeks before dissecting. For each brain, 10 Liters 10% neutral buffered formalin was used and was stored in plastic containers by suspension method. Gross examination and grading of contusion was done by Modified Adam's method. Then they were dissected in a standard fashion using a brain-cutting knife. The cerebrum was sectioned coronally at 10-mm width, sometimes further sectioned for narrower widths. The brainstem was sectioned horizontally and cerebellum at right angles to folia at 5-mm width [3]. Grading of contusion on its depth was done by Modified Adam's method.

For the determination of the degree of spread of contusions on the surfaces of the cerebral hemispheres, brain was divided into 10 anatomic regions. It included the four lobes of each cerebral

hemisphere, brain stem and cerebellum. Grading of lobes of each hemisphere was done using table 1.

**Table 1: Grading of Cerebral contusion**

<b>Spread on the surface of the brain</b>	<b>Grade</b>
Absent	0
Localized to one gyrus or two adjacent gyri	1
Involving greater part of one surface of a lobe	2
Involving more than one surface of a lobe	3
<b>Maximal parenchymal depth</b>	
Absent	0
Extending through full thickness of cortex	1
Extending through full thickness of cortex	2
Extending into digitate white matter	3
Extending into deep white matter	4

Lobar contusion index was determined by multiplying spread of contusion with its depth.

$$\text{Lobar/Regional contusion index} = \text{Depth} \times \text{Spread}$$

Right Cerebral Contusion Index (RCCI) = Summation of all the lobar/regional indices for the right hemisphere

Left Cerebral Contusion Index (LCCI) = Summation of all the lobar/regional indices for the left cerebral hemispheres

The brainstem is divided into six regions namely, caudal and rostral medulla, caudal and rostral pons, and caudal and rostral midbrain.

**Table 2: Grading of contusions of Brainstem**

<b>Spread on the surface of the Brain stem</b>	<b>Grade</b>
Absent	0
Involving a single region	1
Involving two contiguous regions	2
Involving two noncontiguous regions or greater than two contiguous regions	3
<b>Maximal parenchymal depth</b>	
Absent	0
Involving < 25% of the brainstem diameter	2
Involving >25% of the brainstem diameter	4

For grading the surface spread of contusions of the cerebellum, three lobes (anterior, posterior, and flocculonodular) and three zones (vermis, paravermis or intermediate zone, and the lateral zone) are designated.

The vermis is the most medial zone on the midline and the paravermis is the zone adjacent to the vermis, whereas the lateral zone is the more lateral cerebellar hemisphere.

**Table 3: Grading the contusions of the cerebellum.**

<b>Based on spread on the surface of the brain</b>	<b>Grade</b>
Absent	0
Localized to one lobe and one cerebellar zone	1
Localized to either two lobes and one zone or one lobe	2
Affecting 2 zones and 2 lobes or greater.	3
<b>Based on maximal parenchymal depth</b>	
Absent	0
Localized to the arachnoid mater and traumatic subarachnoid extravasation of erythrocytes	1
Extending into the molecular layer of the cerebellar cortex	2
Extending into the Purkinje cell layer and internal granule cell layer	3
Extending into the cerebellar white matter and/ or deep cerebellar nuclei	4

Global/Total Contusion Index or TCI = Summation of all the lobar/regional indices for the right cerebral and left cerebral hemispheres, brainstem, and cerebellum.

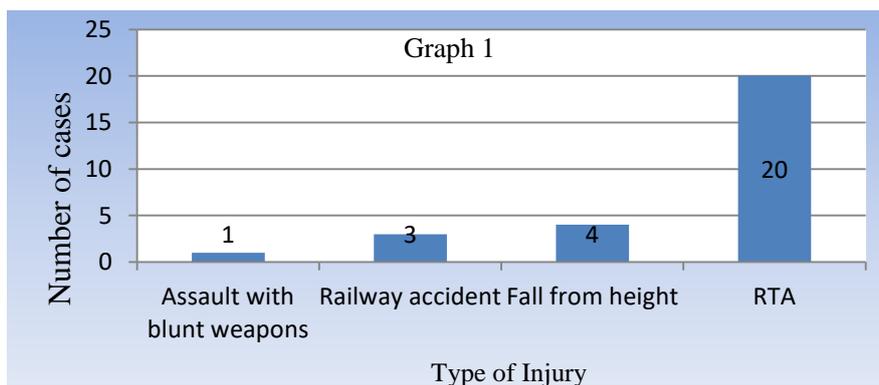
Severity in each case was classified obtained Brain contusion severity scale.

**RESULTS**

Most of the cases, i.e., 20 are of RTA followed by fall from height, railway accident and one case with assault by blunt weapons.

**Table 4: Severity scale**

**Severity	TCI
Mild	≤ 30
Moderate	31-60
Severe	61-90
Marked	91-120

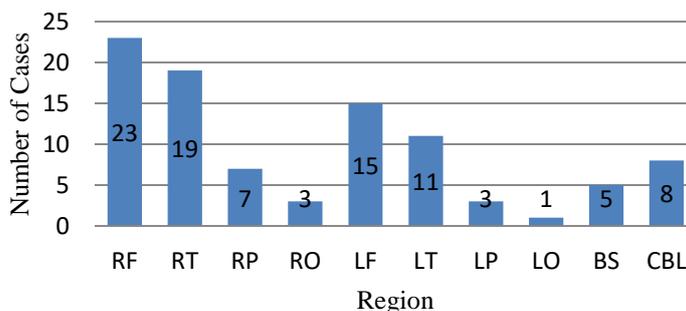


**Fig. 1: Distribution of cases based on mode of occurrence**

**Distribution of Contusions**

In most of the cases the contusions were distributed over frontal region followed by temporal region, more frequently on right side. Survival in cases with contusions is variable with contusions over cerebral and cerebellar hemispheres, ranging from spot death to 3

months survival. But, in all 5 cases with contusions over brainstem the Post trauma survival is less than 72 hours. In comparison to the mode of injury, we observed no relation with the distribution of contusions over the brain.



**Fig. 2: Distribution of contusions after formalin fixation**

Majority of the cases had moderate degree of Contusion severity, i.e., in 21 cases followed by mild degree in 7 cases. The post trauma survival is variable

in all the cases in relation to the Contusion severity scale.

**Table 6: Distribution of cases based on Contusion severity scale**

Contusion Severity Scale (CSS)	Cases
Mild	7
Moderate	21
Severe	0
Markedly severe	0

## DISCUSSION

Grading of brain contusion was initially done in 1970's followed by 2005. Hardly any studies regarding grading of brain contusions by any method were found in Pubmed and Medline while writing this article. In this study, majority of the cases were from road traffic accidents. In majority of the cases, the brain contusions were distributed over frontal region followed by temporal region. With respect to the side, it was more frequent on right side followed by the other. Survival in cases with contusions is variable with contusions over cerebral and cerebellar hemispheres, ranging from spot death to 3 months survival. But, in all 5 cases with contusions over brainstem, the Post trauma survival is less than 72 hours. In comparison to the mode of injury, there is no relation with the distribution of contusions over the brain. Majority of the cases had moderate degree of Contusion severity, i.e., in 21 cases followed by mild degree in 7 cases. The post trauma survival is variable in all the cases in relation to the Contusion severity scale. Hence, we conclude that Contusion severity scale does not bare any relation with the Post trauma survival.

## CONCLUSION

Finally, we conclude that Contusion severity scale does not bare any relation with the Post trauma survival. In comparison to the mode of injury, there is no relation with the distribution of contusions over the brain. Post Trauma Survival is variable with contusions over cerebral and cerebellar hemispheres, but, in cases with contusions over brainstem, the Post trauma survival was less than 72 hours.

## REFERENCES

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