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Optimization Of Radiation Dose For Ct Head In Trauma Population

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Abstract

Aim: The aim of this study is the reduction of effective dose for CT scan of brain on traumatic patients in NIMS Hospital, Jaipur, Rajasthan.

Methods: It was an observational descriptive study. A total of 384 patients from the department of Radio-diagnosis and Imaging, NIMS Hospital, Jaipur, were selected and scan was taken at different technical factors.

Result: Out of 384 patients selected for the study, 275 (71.61%) were males and 109 (28.38%) were females. The outcome shows that out of all three groups, males are the most affected traumatic patients when compared to females. Out of the result obtained based on image quality, Group A (with 120 kVp and 450 mAs) and Group B (with 120 kVp and 400 mAs) serves 100% excellent quality images whereas Group C (with 100 kVp and 350 mAs) serves 98.44% average quality images.

Conclusion: Although better image quality needs to be maintained on contradict to this, radiation dose to the patients cannot be compromised for better image quality. Thereby according to cardinal principles for radiation protection, ALARA principles1 need to be implemented at all times. Optimization of technical factors yielded a difference is image quality and Group-B gave the best image quality.

Keywords: CT dose index-volume, ALARA, Dose Length Product, kVp, mAs

INTRODUCTION

A computed tomography, generally alluded to as a CT, is a radiological imaging study. The machine was created by physicist Allan MacLeod Cormack and electrical architect Godfrey Hounsfield [1].
The utilization of CT checks expands the doctor's capacity to precisely analyse a patient's sickness. Low-quantity CT scans are demonstrating helpful in protection medication and malignant growth screening [2].

Traumatic Brain Injury (TBI) may result from anyplace between a basic hit to the head to an entering injury to the brain. It is assessed that almost 1.5 to 2 million people are harmed and 1 million surrenders to death consistently in India. Street traffic wounds are the main source (60%) of TBIs followed by falls (20%-25%) and viciousness (10%). Liquor contribution is known to be available among 15%-20% of TBIs at the hour of injury [3].

CT is the imaging methodology of decision for assessment of the intense head-harmed patient. It is fast, harmless, and generally accessible and has not many contraindications. CT benefits for appraisal of TBI incorporate its awareness for showing intense intra-hub and extra-hub drain, mass impact, ventricular size, and bone breaks. Impediments remember low awareness for distinguishing little non-haemorrhagic sores like cortical wounds and diffuse axonal wounds (DAIs), as well as in early exhibit of hypoxic-ischemic encephalopathy [4].

Ensuing to the presentation of helical CT strategy in the last part of the 1980s and the approach of multidetector-line innovation in the last part of the 1990s, the number and effect of clinical utilizations of CT have kept on developing]. Ensuing to the presentation of helical CT strategy in the last part of the 1980s and the approach of multidetector-line innovation in the last part of the 1990s, the number and effect of clinical utilizations of CT have kept on developing [5].

Notwithstanding, despite the obvious proof that CT gives priceless data to the findings and patient administration, an expected risk of radiation-prompted harm exists. CT alone contributes close to half of the all-out radiation exposure from clinical use [6].

In any case, since the disease risk related with the radiation portion in CT isn't zero, obviously lessening radiation portion in CT should keep on being one of the first concerns of the CT practice. CT assessments should be suitably legitimate for every individual patient. For every CT assessment, all specialized parts of the assessment should be advanced, to such an extent that the expected degree of image quality can be available while keeping the dosages as low as could be expected [7].

Radiation portion in CT can be measured in various ways. Scanner radiation output, organ dose and effective dose are a few of the more normal portion measurements. The scanner radiation output is presently addressed by the volume CT dose index (CTDIvol), which depicts the radiation result of the scanner in an exceptionally normalized manner. Organ doses were prescribed to measure the radiation hazard to that organ for patients going through CT assessments. Effective dose, regularly communicated in the units of mSv, is an amount addressing an 'entire body comparable' 2 portion that would have a comparative risk of wellbeing drawback as that because of a fractional body light [8][9][10].

Radiation portion is one of the main elements deciding CT image quality and, in this way, the symptomatic precision and the result of a CT assessment. Radiation dose ought to just be diminished under the condition that the analytic image quality is not forfeited. Subsequently, to comprehend how the radiation portion in CT can be diminished, it is important to be know all about the connection between image quality and radiation dose. Keeping radiation portion as low as reasonably achievable (ALARA) is the core value for a medicinally demonstrated CT assessment. Numerous procedures and methodologies are accessible for radiation dose reduction. The fitting utilization of these systems is basic to achieve the objective of ALARA. Notwithstanding endeavors to decrease the radiation dose from every CT scan, justification of the CT assessment addresses the other basic part of dose reduction. At the point when the radiation portion per every assessment is decreased, the related risk is likewise diminished, bringing about additional improvement of the advantage/risk proportion.

METHOD AND MATERIAL:

STUDY TYPE: An observational descriptive study was carried out in Department of Radio-diagnosis & Imaging NIMS Hospital, Jaipur, Rajasthan. This study was based on optimization of radiation dose for CT head in trauma population.

STUDY DESIGN: This study was designed to check the amount of radiation doses encountered by the patients suggested for a CT brain at NIMS Hospital, Jaipur, Rajasthan.

STUDY AREA: CT scan room 5, Department of Radio- diagnosis & Imaging, NIMS Hospital, Jaipur, Rajasthan, INDIA.

STUDY DURATION: This observational descriptive based study was conducted out for the time period of seven months from December 2021 to July 2022 at College of Paramedical Technology, NIMS University, Jaipur, Rajasthan, India.

SELECTION CRITERIA

Inclusion Criteria

1. Trauma patients scheduled for CT scan of Brain.
2. Age group from 20-60 years 3. Patients willing to take part in the Study.

Exclusion Criteria

1. Non-Traumatic patients.
2. Non cooperative patients.
3. Patients aged below 20 years and aged above 60 years

STUDY POPULATION

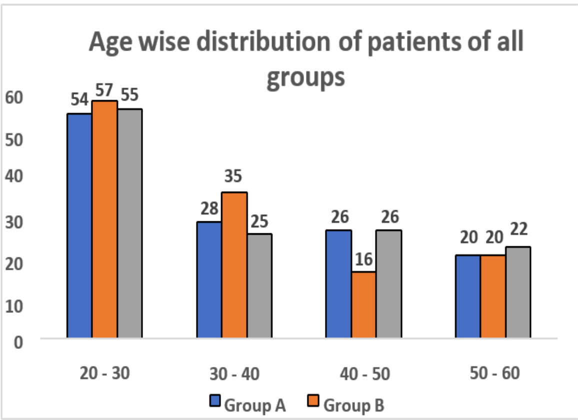
The study population consisted of 384 traumatic patients referred for CT scan of brain from the department of Radio- Diagnosis and Imaging, NIMS Hospital, Jaipur

METHOD OF DATA COLLECTION

A group of 3 was made in which each group contains 128 patients. Three sets of technical factors were applied for the three groups of patients. Group A patients underwent technical factor of 120 kVp and 450 mAs. Group B patients underwent technical factor of 120 kVp and 400 mAs. Group C patients underwent technical factor of 100 kVp and 350 mAs. Hence a total of 384 patients was included in the study. A Philips 128 slice CT scan machine was used for the study. Each group of patients was followed by the Radiologist evaluating the pathology and accessing the quality of the image. Result was obtained, and approximate DLP of each group was calculated.

Table 1: Frequency distribution of age of patients of all group

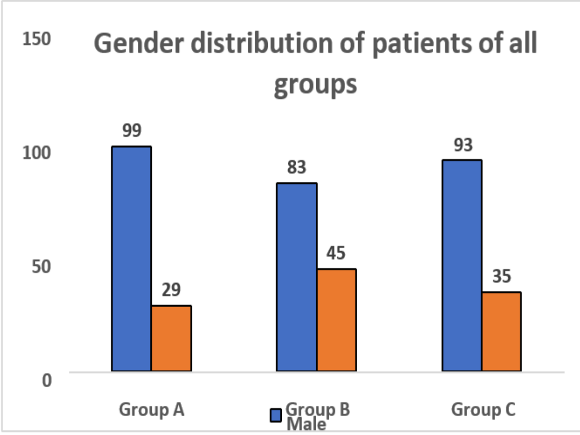
Age Interval	Group A	Group B	Group C
20 – 30	54 (42.19%)	57 (44.53%)	55 (42.97%)
30 – 40	28 (21.88%)	35 (27.34%)	25 (19.53%)
40 – 50	26 (20.31%)	16 (12.50%)	26 (20.31%)
50 – 60	20 (15.63%)	20 (15.63%)	22 (17.19%)



□ Out of 384 patients selected for the study, 275 (71.61%) were males and 109 (28.38%) were females. The outcome shows that out of all three groups, males are the most affected traumatic patients when compared to females.

Table 2: Gender distribution of patients of all groups

Gender	Group A	Group B	Group C
Male	99 (77.34%)	83 (64.84%)	93 (72.66%)
Female	29 (22.66%)	45 (35.16%)	35 (27.34%)



Out of the result obtained based on image quality, Group A (with 120 kVp and 450 mAs) and Group B (with 120 kVp and 400 mAs) serves 100% excellent quality images whereas Group C (with 100 kVp and 350 mAs) serves 98.44% average quality images. All the result obtained are plotted on the bar graph as shown below

Table 3: Groupwise distribution of image quality dependent on technical factors

Image quality		Group A		Group B		Group C
Excellent		128 (100%)		128 (100%)	0	
Good	0		0			02 (1.56%)
Average	0		0			126 (98.44%)
Poor	0		0		0	

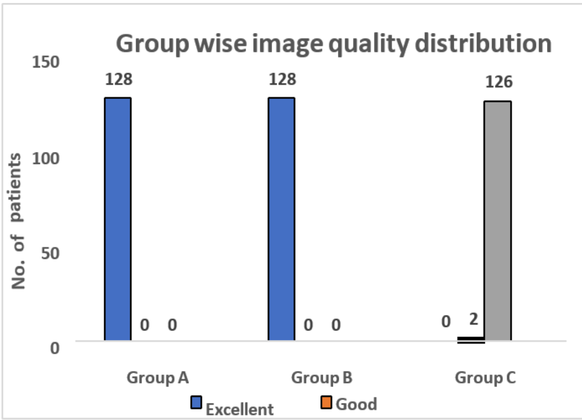


Table 4: Dose Length Product (DLP) reading for different Group population. mGy*cm

Group	Minimum	Maximum	Mean	Standard Deviation
Group A	1339.2	1983.2	1459.660	188.007
Group B	1205.2	1358.2	1238.046	40.8573
Group C	637.3	738.9	667.631	28.9621

- For the study population in Group A, the minimum DLP readings was at 13392.2 mGy*cm and 1983.2 mGy*cm was the maximum. 1459.660±188.007 mGy*cm is the mean and SD for Group A scans.

- For the study population in Group B, the minimum DLP readings was at 1205.2 mGy*cm and 1358.2 mGy*cm was the maximum. 1238.046±40.857 mGy*cm is the mean and SD for Group B scans.
- For the study population in Group C, the minimum DLP readings was at 637.3 mGy*cm and 738.9 mGy*cm was the maximum. 667.631±28.962 mGy*cm is the mean and SD for Group C scans.

Table 5: Descriptive statistics of all groups

Characteristics	Group A	Group B	Group C	ANOVA (F-test)	P - value	Significance
Mean ± SD	36.64 ± 11.77	35.32 ± 11.9	36.8 ± 12.1	0.602	0.548457	Not significant
Median	35	33	34.5		------	
Inter quartile range	(26, 45)	(25, 45)	(25, 49)			

DISCUSSION

Traumatic brain injury (TBI) is a significant medical problem liable for extensive mortality and long-haul dreariness around the world. TBI is actual injury to cerebrum tissue that is actual injury to cerebrum tissue which briefly or for all time weakens cerebrum capability. Primary determination is suspected clinically and affirmed basically by computed tomography (CT). But there are certain limitations where concerns have been raised with respect to the expected risk of malignant growth acceptance from CT because of radiation involved in expanded utilization of CT for evaluation.

Fotso Kamdem Eddy et.al [11] conducted a study on 'Optimization of the scan length of head traumas on the pediatric and adult CT scan and proposition of a new acquisition limit'. In his study, he concluded that radiation dose to the brain could be decreased by restricting acquisition to the level of the cervical spine 2 from cervical spine 4, specially to protect the thyroid gland from ionising radiation. But in our study, reducing the technical factors resulted in achieving low radiation dose to the patient. Aim of both the studies were to decrease the radiation dose but implementation of both the study developed a different result. Fabio Paolicch et.al [12] conducted a study on 'Optimizing the Balance Between Radiation Dose and Image Quality in Pediatric Head CT: Findings Before and After Intensive Radiologic Staff Training'. In this study, he scanned the patients of age group from 1 month old to 14 years old before and after intensive training of staff radiologists and technologists in optimization of CT technique. He concluded that Radiologic staff training can be effective in reducing radiation dose while preserving diagnostic image quality in pediatric head CT examinations. But in our studythe staff radiologists and technologists were already trained in optimizing the dose and the age group was selected between 20-60 years. In both thestudies, it is concluded that optimization of CT dose is the main objective. Homer C. Tien et.al [13] conducted a study on 'Radiation Exposure from Diagnostic Imaging in Severely Injured Trauma Patients'. He measured the radiation doses received by all the trauma patients from diagnostic imaging. He concluded that trauma patients are exposed to significant radiation doses from diagnostic imaging, resulting in a small but measurable excess cancer risk. This small individual risk may become a greater public health issue as more CT examinations are performed and hence unnecessary CT scans should be avoided. But in our study, we measured the radiation doses of only brain trauma cases. The difference is that they measured doses received by the patients from diagnostic centers and we measured doses from Medical College Hospital.

CONCLUSION

Study concluded that although better image quality needs to be maintained on contradict to this, radiation dose to the patients cannot be compromised for better image quality. Thereby according to cardinal principles for radiation protection, ALARA principles need to be implemented at all times. Optimization of technical factors yielded a difference is image quality and Group-B gave the best image quality.

REFERENCE

[1]. Bhattacharyya KB. Godfrey Newbold Hounsfield (1919–2004): the man who revolutionized neuroimaging. Annals of Indian Academy of Neurology. 2016 Oct; 19(4):448.
[2]. Paxton R, Ambrose J. The EMI scanner. A brief review of the first 650 patients. The British journal of radiology. 1974 Sep;47 (561):530-65.
[3]. Rodríguez-Triviño CY, Castro IT, Dueñas Z. Hypochloremia in Patients with Severe Traumatic Brain Injury: A Possible Risk Factor for Increased Mortality. World Neurosurgery. 2019 Apr 1;124:e783-8.
[4]. Davis PC. Head trauma. American Journal of Neuroradiology. 2007 Sep 1;28(8):1619-21.
[5]. McCollough CH, Zink FE. Performance evaluation of a multi-slice CT system. Medical physics. 1999 Nov;26(11):2223-30.
[6]. Huda W, Mettler FA. Volume CT dose index and dose-length product displayed during

CT: what good are they?. Radiology. 2011 Jan;258(1):236-42.

[7]. Yu L, Liu X, Leng S, Kofler JM, Ramirez-Giraldo JC, Qu M, Christner J, Fletcher JG, McCollough CH. Radiation dose reduction in computed tomography: techniques and future perspective. Imaging in medicine. 2009 Oct;1(1):65.

[8]. Andrade ME, Borras C, Khoury HJ, Dias SK, Barros VS. Organ doses and risks of computed tomography examinations in Recife, Brazil. Journal of Radiological Protection. 2012 Jul 19;32(3):251.

[9]. Valentin J. Managing patient dose in multi-detector computed tomography (MDCT). New York: Elsevier; 2007.

[10]. Jacobi W. The concept of the effective dose a proposal for the combination of organ doses. Radiation and environmental biophysics. 1975Jun;12(2):101-9.

[11]. Eddy FK, Ngano SO, Jervé FA, Serge A. Optimization of the scan length of head traumas on the pediatric and adult CT scan and proposition of a new acquisition limit. Scientific Reports. 2021 May 26;11(1):1-5.

[12]. Paolicchi F, Faggioni L, Bastiani L, Molinaro S, Puglioli M, Caramella D, Bartolozzi C. Optimizing the balance between radiation dose and image quality in pediatric head CT: findings before and after intensive radiologic staff training. AJR Am J Roentgenol. 2014 Jun 1;202(6):1309-15.

[13]. Tien HC, Tremblay LN, Rizoli SB, Gelberg J, Spencer F, Caldwell C, Brenneman FD. Radiation exposure from diagnostic imaging in severely injured trauma patients. Journal of Trauma and Acute Care Surgery. 2007 Jan 1;62(1):151-6.