

## Diagnostic accuracy of B-scan in predicting retinoblastoma in children, taking Magnetic Resonance Imaging of orbits as gold standard

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### Abstract

The objective of this study was to determine the diagnostic accuracy of B-scan in predicting retinoblastoma (Rb) taking Magnetic Resonance Imaging (MRI) as a gold standard. A cross-sectional validation study was conducted in the Radiology Department of Fauji Foundation Hospital from May 20 to Nov 20, 2017. Children fulfilling the inclusion criteria were selected after informed consent and detailed history was taken for investigation of Rb. B-scan of both eyes was done using 7.5-10 MHz probe, followed by MRI of both eyes in the same patients using 1.5 Tesla MRI machine with the help of qualified MRI technicians. Data analysis was done by SPSS version 16.0. The diagnostic accuracy, sensitivity, specificity, PPV and NPV of B-scan in prediction of Rb as compared to MRI was 90.45%, 82.28%, 90.54% and 90.28% respectively. The study concluded that diagnostic accuracy of B-scan as compared to MRI is substantial in Retinoblastoma.

**Keywords:** B-scan, Leukocoria, Magnetic Resonance Imaging, Ocular malignancy, Retinoblastoma.

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### Introduction

Retinoblastoma is the most common primary ocular malignancy of childhood. It is the most common paediatric ocular tumour in Pakistan as well. Worldwide, about one case of retinoblastoma (Rb) per 15,000 - 20,000 live births is recorded.<sup>1</sup> Retinoblastoma is curable. If detected while still confined to the globe and if there are no metastatic risk factors, the child will nearly always survive following appropriate treatment. Prevalence of retinoblastoma is 38.9%.<sup>2</sup>

Children mostly present with feature of leukocoria; however, there can be associated strabismus, red eye and poor vision. The diagnosis of retinoblastoma is usually established on the basis of B-scan and MRI orbits. Every

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suspected patient of retinoblastoma should have ultrasound orbits done, before performing MRI orbits.<sup>3</sup>

The human eye, with its superficial position and its fluid-filled structures, is ideally suited for B-scan. Linear high frequency probe (7.5-13.0 MHz) is used. Minimal transducer pressure should be used to prevent collapse of anterior chamber. B-scan is contraindicated in traumatic eye injuries and suspected eye rupture.<sup>4</sup>

The overall sensitivity, specificity, positive predictive value, negative predictive value and accuracy of B-scan were 94.2%, 98.8%, 99.1%, 92.2% and 94.9% (p-value < 0.0001) respectively for the diagnosis of ocular pathologies.<sup>5</sup>

MRI has emerged as gold standard modality for pre-treatment assessment, i.e. for diagnostic confirmation, detection of the extent of local tumour, detection of associated developmental malformation of the brain, and detection of associated intracranial primitive neuro-ectodermal tumour (trilateral retinoblastoma).<sup>2</sup> The accuracy of MRI in detecting choroidal invasion was 68% (sensitivity, 60%; specificity, 80%).<sup>6</sup>

Retinoblastoma was associated with near certain death just over a century ago. Early tumour recognition aided by indirect ophthalmoscopy and refined enucleation techniques contributed to improved survival from 5% in 1896 to 81% in 1967.<sup>7</sup>

Leukocoria is the most common presenting feature of retinoblastoma, followed by strabismus, painful blind eye and loss of vision. The clinical presentation of retinoblastoma depends on the stage of the disease.<sup>8</sup>

Magnetic Resonance Imaging (MRI) is not as specific for diagnosing retinoblastoma as Computerised Tomography scanning because of MRI's insensitivity for detecting calcium. When calcium is detected, it may be seen as an area of low signal intensity on all pulse sequences.<sup>9</sup>

The rationale of this study was to determine the diagnostic accuracy of B-scan in retinoblastoma as compared with MRI. MRI is a very expensive diagnostic modality, is unaffordable for the majority of population, is available at only limited centres, requires special expertise

and has to be carried out under anaesthesia in various clinical situations. Use of B-scan will reduce the number of MRI examinations and unnecessary burden on the hospital and society. This in turn will benefit the patients by reducing the cost and anxiety of patients, especially who are claustrophobic.

## Patients/Methods and Results

This cross-sectional validation study was conducted at the Radiology Department of Fauji Foundation Hospital from May 20, 2017 to Nov 20, 2017 after approval from ethical review committee of Fauji Foundation Hospital Rawalpindi. Consecutive non-probability sampling technique was used. With the help of sensitivity/specificity calculator, the Confidence level was (1-a) =95%, Prevalence (P) = 39%<sup>2</sup>, Absolute precision required for sensitivity=6 %, Sensitivity of B scan=94.2%<sup>7</sup>, Specificity of B scan=98.8%<sup>7</sup>, Absolute precision

**Table-1:** Demographic characteristics of children with retinoblastoma.

| Variable                     | Statistics  |
|------------------------------|---|
| Mean Age (years)             | Mean + (2.82 + 1.48)  |
| Gender                       | Males = 133 (60.5%)<br>Females = 87 (39.5%)   |
| Family history               | Yes = 62 (28.2%)<br>No = 158 (71.8%)  |
| Clinical features            | Leukocoria= 137 (62.3%)<br>Strabismus= 15 (6.8%)<br>Red eye = 18 (8.2%)<br>Poor vision = 50 (22.7%) |
| Distribution of eye involved | Right= 63 (28.6%)<br>Left= 61 (27.7%)<br>Both = 96 (43.6%)  |

SD = Standard deviation.

**Table-2:** 2 X 2 table showing Diagnostic Accuracy of B-Scan by taking Retinoblastoma MRI as Gold Standard.

|                        | Retinoblastoma MRI |              | Total        |
|------------------------|--------------------|--------------|--------------|
|                        | Positive           | Negative     |              |
| <b>B-Scan Findings</b> |                    |              |              |
| Positive               | 134<br>95.0%       | 14<br>17.7%  | 148<br>67.3% |
| Negative               | 7<br>5.0%          | 65<br>82.3%  | 72<br>32.7%  |
| Total                  | 141<br>100.0%      | 79<br>100.0% | 220          |

Sensitivity: 95.04%

Specificity: 82.28%

PPV: 90.54%

NPV: 90.28%

Diagnostic Accuracy: 90.45%

Likelihood Ratio: 5.36

required for Specificity of B scan= 2%. The study sample size (n) was 220 patients. Children (6 months — 5 years of age) presenting with any of the features such as leukocoria (white pupil), strabismus (squint), red eye and poor vision were included. Children who were not previously diagnosed, had not undergone chemotherapy and radiotherapy and had no history of trauma to the eye were excluded from the study. Children fulfilling the study criteria were selected and a written informed consent was taken from their parents. Detailed history of the patients who were present in the radiology department for investigation of retinoblastoma was taken, and then B-Scan of both eyes was performed, using 7.5 - 10 MHz probe. It was followed by MRI examination of both eyes in the same patients using 1.5 Tesla MRI machine with the help of qualified MRI technicians. All the information was personally collected by the researcher to reduce selection bias and maintenance of quality of data. Data was entered in SPSS software (version 16.0). Descriptive statistics of the right and left eyes were used to calculate qualitative and quantitative variables. The qualitative (categorical) variables such as gender, clinical features, true positives and true negatives were measured for frequency and percentages. While the Quantitative (continuous) variables like age as mean ± standard deviation were checked. To calculate sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) a 2x2 table was constructed. The results were described and data was presented as tables and graphs. Effect modifier such as age, gender, clinical features and family history was controlled by stratification. Post stratification diagnostic accuracy was applied. The demographic characters of the enrolled patients (n=220) in the study are depicted in Table-1. The aim of the study was to determine the diagnostic accuracy of B-scan in prediction of retinoblastoma by keeping MRI as a gold standard. A 2x2 table was used to calculate the diagnostic accuracy, sensitivity, specificity, PPV and NPV of B-scan, which was 90.45%, 82.28%, 90.54% and 90.28% respectively whereas likelihood ratio was 5.36.

Effect modifiers like such as age (years), gender and family history were stratified and compared with B-scan and MRI findings. Chi-square test was applied and comparison of each modifier with B-scan and MRI findings was done which was highly significant (p<0.001).

## Conclusion

The study concluded that the diagnostic accuracy of B-scan in retinoblastoma in comparison with MRI is

substantial. Thus, the use of B-scan will reduce the number of MRI examinations and unnecessary burden on the hospital and society. Furthermore, it will also be an added benefit to the patients as it will reduce cost and anxiety of patients, especially who are claustrophobic.

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**Conflict of Interest:** there is no any conflict of interest

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