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Ultrasonographic findings in eyes with retinopathy of prematurity in Malaysia

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Abstract

RetCam is an excellent screening tool for the detection of retinopathy of prematurity (ROP). However, affordability is a barrier when adopting the use of RetCam in developing countries. We aimed to describe different stages of ROP using ultrasonographic B-scan and to evaluate the association between funduscopic examinations and ultrasonographic B-scan findings in premature neonates with ROP in Malaysia. A descriptive cross sectional study was conducted in 90 eyes of 47 premature neonates with different stages of ROP in three tertiary hospitals in Malaysia. Experienced ophthalmologists performed detailed funduscopic examinations using binocular indirect ophthalmoscopy (BIO). A masked examiner performed a 10 MHz ultrasonographic B-scan evaluation with 12 meridian position images within 48 hours of clinical diagnosis. Data from the clinical examination and ultrasonographic findings were collected and analysed. We recruited 37 eyes (41.1%) with stage 1 ROP, 29 eyes (32.3%) with stage 2, 18 eyes (20.0%) with stage 3, and 3 eyes (3.3%) with stages 4 and 5 based on the clinical assessment. Ultrasonography correctly identified 3 (8.1%) stage 1 eyes, 17 (58.6%) stage 2 eyes, 13 (72.2%) stage 3 eyes, and 3 each (100%) of the stage 4 and 5 eyes. There was a significant association between the funduscopic signs and the ultrasound findings for stage 2 ROP and above (Fisher's exact test, p <0.001). In conclusion, all stages of ROP were detected and described with a 10 MHz ultrasonic B-scan system. A significant association was observed between funduscopic signs and ultrasonographic findings in premature Malaysian neonates with stage 2 ROP and above.

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Ultrasonographic Findings in Eyes with Retinopathy

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SUMMARY

RetCam is an excellent screening tool for the detection of retinopathy of prematurity (ROP). However, affordability is a barrier when adopting the use of RetCam in developing countries. We aimed to describe different stages of ROP using ultrasonographic B-scan and to evaluate the association between funduscopic examinations and ultrasonographic B-scan findings in premature neonates with ROP in Malaysia. A descriptive cross sectional study was conducted in 90 eyes of 47 premature neonates with different stages of ROP in three tertiary hospitals in Malaysia. Experienced ophthalmologists performed detailed funduscopic examinations using binocular indirect ophthalmoscopy (BIO). A masked examiner performed a 10 MHz ultrasonographic B-scan evaluation with 12 meridian position images within 48 hours of clinical diagnosis. Data from the clinical examination and ultrasonographic findings were collected and analysed. We recruited 37 eyes (41.1%) with stage 1 ROP, 29 eyes (32.3%) with stage 2, 18 eyes (20.0%) with stage 3, and 3 eyes (3.3%) with stages 4 and 5 based on the clinical assessment. Ultrasonography correctly identified 3 (8.1%) stage 1 eyes, 17 (58.6%) stage 2 eyes, 13 (72.2%) stage 3 eyes, and 3 each (100%) of the stage 4 and 5 eyes. There was a significant association between the funduscopic signs and the ultrasound findings for stage 2 ROP and above (Fisher's exact test, p <0.001). In conclusion, all stages of ROP were detected and described with a 10 MHz ultrasonic B-scan system. A significant association was observed between funduscopic signs and ultrasonographic findings in premature Malaysian neonates with stage 2 ROP and above.

KEY WORDS:

Retinopathy of prematurity, funduscopic signs, B-scan ultrasonographic findings

INTRODUCTION

Premature neonates at risk of developing retinopathy of prematurity (ROP) are routinely screened with binocular indirect ophthalmoscopy (BIO). Those who are born with a birth weight less than 1500 grams, a gestational age ≤30 weeks, a birth weight between 1500 and 2000 grams, and an unstable clinical condition require serial funduscopic examinations until each eye is no longer at risk o vision-threatening ROP[1,2]. Infants are considered risk when they reach a postmenstrual age of 45 w full retinal vascularisation, the absence of p disease, zone III retinal vascularisation without pl I or II ROP, or regression of ROP[1,2].

BIO is the gold standard for the detection of ROP the procedure requires pupillary dilation, the ap an eye speculum and a scleral indenter, and prop and skilful examiners. Furthermore, it is time con can be stressful to premature neonates[5-7]. Re promising modality that has the potential to rep of BIO in ROP screening[8-10]. It eliminates the topical dilating drops and scleral indenters. H price of the instrument appears to be the m limiting its availability in the majority of particularly in developing countries such as Mal

In contrast, ophthalmic ultrasonography is a re expensive diagnostic device that is availab ophthalmology clinics worldwide. It is a potentia tool for ROP[11-15], and it allows visualisation of ret through closed eyelids. It also eliminates the nee dilating drops and the application of an eye sp indenter, and it causes less stress for premature in compared with BIO. This study aimed to desc ultrasonographic findings in various clinical st and to evaluate the association between the signs and ultrasonographic findings of ROP in Malaysian neonates.

MATERIALS AND METHODS

A total of 47 premature neonates (90 eyes) who selection criteria were recruited into the study. Th centres in Malaysia participated in this stud Universiti Sains Malaysia, Hospital Raja Peremp II, Kota Bharu, and Hospital Kuala Lumpur. Th conducted from September 2007 through Octo accordance with the Declaration of Helsinki. protocol was approved by the Research c Committee of the School of Medical Sciences, Uni Malaysia. All parents/guardians were informed

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objectives, methods and implications of the study before obtaining consent for the participation of their neonates.

The inclusion criteria were premature neonates diagnosed with ROP by clinical assessment and consent provided by the parents/guardians. Premature neonates who had poor media separately because the findings in each eye were i and may not have been symmetrical. Table I sum demographic and clinical characteristics of the p subjects. Both genders were equally affected, and of Malay ethnicity. Neonates born at less tha gestation composed 72.3% of the study popu

All of the neonates underwent thorough dilated funduscopic assessments conducted by senior ophthalmologist selected at each centre. The pupils were dilated using 0.5% cyclopentolate one hour prior to the examination. An eyelid speculum and a scleral indenter were used during the retinal examination. The clinical diagnoses were made based on the international classification[16].

Ultrasonographic examinations (10 MHz probes and the AVISO, Quantel Medical Inc.) were performed by identified masked personnel within 48 hours of the clinical diagnosis. Topical anaesthetic drops were instilled, and an adequate amount of hypoallergenic ultrasonic gel was used. The ultrasound probe was gently applied on the closed eyelids, and it was oriented in 12 clock-hour positions with the transducer marker pointing towards the centre of the eye (Fig. 1). Three ultrasonographic images were taken, and the best images were recorded digitally. Ultrasonographic findings were considered significant based on the descriptions by Jokl *et al*[12].

The obtained demographic and clinic data were entered into the data collection sheets. Two identified masked investigators were responsible for evaluating and analysing the ultrasonographic findings from all of the participating centres. The Statistical Package for Social Sciences for Windows version 18 was used for the data analysis. A p-value of < 0.05 was considered statistically significant. Fisher's exact test was used to calculate the significance level of the association between funduscopic signs and ultrasonographic findings at all stages of ROP ($p < 0.001$).

RESULTS

We recruited 90 eyes (47 premature neonates) from three tertiary centres in Malaysia. The eyes were analysed

20%, and the remaining premature neonates ha
ROP.

Table II summarises the clinical diagnoses bc
funduscopic signs and specific ultrasonograph
observed in our subjects. Figures 2, 3 and
ultrasonographic findings observed in our patien
shallow and broad retinal thickening, giant
partial and total retinal detachment.

Table III displays the association between t
diagnoses based on funduscopic signs and ultra
findings. A high percentage, 91.9% (34 eyes), o
neonates with stage 1 ROP observed during the

Table I: Demographic and clinical characteri

Characteristics	n (%)
Gender	
Male	22 (46.8)
Female	25 (53.2)
Race	
Malay	41 (87.2)
Chinese	3 (6.4)
Indian	1 (2.1)
Others	2 (4.3)
Period of gestation	
25-29 weeks	34 (72.3)
30-34 weeks	13 (27.7)
Birth weight (gram)	
< 750	2 (4.2)
751 – 1000	21 (44.7)
1001 – 1530	24 (51.1)
Clinical Stages of ROP*	
Stage 1	37 (41.1)
Stage 2	29 (32.3)
Stage 3	18 (20.0)
Stage 4	3 (3.3)
Stage 5	3 (3.3)

*calculated based on 90 eyes

Table II: Ultrasonographic findings in various stages of clinically diagnosed ROP

Funduscopic Signs	Ultrasonographic Findings				
	No finding	Shallow retinal thickening / ridge	Broad retinal thickening / giant ridge	Partial retinal detachment	Tot deta
Stage 1 (n=37)	34 (91.9)	3 (8.1)	0 (0.0)	0 (0.0)	0
Stage 2 (n=29)	12 (41.4)	17 (58.6)	0 (0.0)	0 (0.0)	0
Stage 3 (n=18)	5 (27.8)	1 (5.6)	12 (66.6)	0 (0.0)	0
Stage 4 (n=3)	0 (0.0)	0 (0.0)	0 (0.0)	3 (100.0)	0
Stage 5 (n=3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3

Table III: Association of funduscopic signs and ultrasonographic findings

Funduscopic Signs	Identification of ROP by ultrasonography		p value
	Yes n (%)	No n (%)	
Stage 1 (n = 37)	3 (8.1%)	34 (91.9%)	
Stage 2 (n = 29)	17 (58.6%)	12 (41.4%)	
Stage 3 (n = 18)	13 (72.2%)	5 (27.8%)	<0.001
Stage 4 (n = 3)	3 (100.0%)	0 (0.0%)	
Stage 5 (n = 3)	3 (100.0%)	0 (0.0%)	

$p < 0.05$ (Fisher's exact test)

Fig. 1: The orientation of ultrasound probe in 12 clock hour positions with the transducer marker pointed toward the cen get the meridians images.

Fig. 2: Ultrasonographic findings observed in pre-threshold ROP. (a) Shallow retinal thickening corresponds with clinical (b) Retinal thickening with ridge seen in patient with clinical stage 2 ROP.

Fig. 3: Ultrasonographic findings observed in threshold ROP. (a) Stage 3 ROP shows a giant ridge with two apexes. (b) shows a giant ridge with vitreous fibrous band traction (yellow arrow).

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Fig. 4: Ultrasonographic findings observed in advanced ROP. (a) Stage 4a shows a partial retinal detachment as the ret anteriorly toward lens margin by vitreous condensation. (b) Stage 4b displays a more severe form of partial retinal with donut appearance. (c) Stage 5 ROP shows a total retinal detachment. (d) Stage 5 ROP reveals a folded and sc into funnel shaped

examination revealed no detectable signs (termed a negative sign) in the ultrasonographic evaluations. Stage 2 and 3 ROP showed a higher percentage of detectable ultrasonographic features, at 58.6% and 72.2%, respectively. Stage 4 and 5 ROP displayed 100% agreement between the funduscopic signs and ultrasonographic findings. Fisher's exact test identified a significant association between the funduscopic signs and ultrasonographic findings ($p<0.01$) for stage 2 ROP and above.

DISCUSSION

The ultrasonographic findings in stage 4 and 5 ROP have been described in published case reports and series[11,14,15,17,19]. Jokl *et al* evaluated the use of ophthalmic ultrasonography for screening stage 2 and 3 ROP in 34 premature eyes using a 10 MHz probe[12] and stage 1 through 4 ROP in 38 premature eyes with a 20 Hz probe[13].

We chose to evaluate all stages of ROP using ophthalmic ultrasonography because the majority of eye clinics in Malaysia do not have access to a RetCam. We e eyes of premature neonates with stage 1 to 3 ROI with stage 4 and 5 ROP throughout our study pe

Our study revealed that 91.9% of stage 1 diagnosed during a clinical examination show signs during the ultrasonographic examination. (3 eyes) of the premature eyes with stage 1 ROI during the clinical examination displayed the co signs during the ultrasound assessment. Two e shallow retinal thickening, while one eye h triangular protrusion, suggestive of a ridge, in images taken.

In contrast to our findings, Jokl *et al* reported th eyes with stage 1 ROP showed agreer ultrasonographic examinations using a 10 M However, the other study by Jokl *et al* did n ultrasonographic findings in stage 1 ROP usin probe[13].

The examiner's skill is crucial for obtaining a clear and good ultrasonographic image. The likelihood of misdiagnosing stage 1 ROP using ultrasonography (Fig. 2a) was greater than 90% in our study. We found it technically difficult to detect localised shallow retinal thickening in this group of patients. This is because the demarcation line in stage 1 ROP that represents hyperplasia of the spindle cells is too thin to be detected by the ultrasound beam[18].

We used a conventional 10 MHz handheld probe. This probe provides an axial resolution of approximately 200 µm and focuses on 20-25 mm of tissue. The focal zone falls near the retina in a contact examination that uses ultrasound gel on a closed eyelid[12]. The 20 MHz probe offers a higher

CONCLUSION

Ultrasonography detected all stages of ROP in c although it was technically difficult to detect sta significant association was demonstrated b funduscopic signs and ultrasonographic feature ROP and above. The use of ultrasonograp management of ROP will be advantageous fo neonates with poor pupillary dilation and h particularly in countries with a limited numbe paediatric ophthalmologists and limited RetCam

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stage 2 and 3 ROP (58.6% and 72.2%, respectively). Our patients with stage 2 ROP had findings of shallow retinal thickening and ridges (Fig. 2a and b), while stage 3 ROP displayed broad retinal thickening and giant ridges (Fig. 3a and b).

Jokl *et al* described the corresponding ultrasonographic findings in 2 of 11 eyes (18.2%) with stage 2 ROP and all 3 eyes (100.0%) with stage 3 ROP[12]. Our findings also parallel another observation by Jokl *et al*[13]. Brent *et al* described the presence of a ridge in stage 2 ROP and a neovascular frond in stage 3 ROP that were imaged with ultrasonography in their case series[11].

Stage 4 and 5 ROP were easily detected by ultrasonography in our study (Fig. 4). Three eyes showed evidence of partial retinal detachment, while another 3 eyes displayed signs of total retinal detachment. This included one eye (33.3%) that demonstrated an open posterior and anterior form configuration, while the other two eyes (66.7%) displayed a closed posterior and anterior form. Our findings support the existing role of ophthalmic ultrasonography in the detection of advanced stages of ROP[14,15,17,19].

In 1998, De Juan *et al* described the ultrasonographic appearance of 54 eyes with advanced ROP[19]. The configuration of retinal detachment and the existence of subretinal or choroidal haemorrhage were well described in their study[19]. Azad et al assessed the role of ultrasonography in the management of stage 5 ROP[17]. They noted that 53.3% (8 eyes) of the 83.3% of eyes diagnosed with stage 5 ROP with an anterior open funnel on B-scan ultrasonography had open access to the anterior surgical space and were scheduled for lensectomy[17].

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To investigate retinal maturation in premature infants (gestation age <37 weeks). using computer-assisted indirect ophthalmoscope imaging. Premature infants at postmenstrual age 33-46 weeks, who underwent fundus examinations using computer-aided indirect ophthalmoscopy, were stratified into seven postmenstrual-age groups. Images of macular morphology, peripheral retinal vascularization and fundus ... [Show full abstract]

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Retinopathy of prematurity (ROP) remains a significant threat to vision for extremely premature infants despite the availability of therapeutic modalities capable, in most cases, of managing this disorder. It has been shown in many controlled trials that application of therapies at the appropriate time is essential to successful outcomes in premature infants affected by ROP. Bedside binocular ... [Show full abstract]

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Background and aim: Peter Cerny Ambulance Service - Premature Eye Rescue Program (PCA-PERP) uses digital retinal imaging (DRI) with remote interpretation in bedside ROP screening, which has advantages over binocular indirect ophthalmoscopy (BIO) in screening of premature newborns. We aimed to demonstrate that PCA-PERP provides good value for the money and to model the cost ramifications of a ... [Show full abstract]

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Increasingly, neonatal clinics seek to minimize painful experiences and stress for premature infants. Fundoscopy performed with a binocular indirect ophthalmoscope is the reference examination technique for screening of retinopathy of prematurity (ROP), and it is associated with pain and stress. Wide-field digital retinal imaging is a recent technique that should be evaluated for minimizing ... [Show full abstract]

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Digital binocular indirect ophthalmoscopy for screening of retinopathy of prematurity

January 2015 · International Journal of Ophthalmology

Y.-F. Hu · Ni Tian · Y.-H. Lu

AIM: To investigate the incidence of retinopathy of prematurity (ROP) in infants born in the Panyu district of Guangzhou, China, and to determine the applicability of video-incorporated binocular indirect ophthalmoscopy for its screening in primary hospitals. METHODS: From January 2010 to December 2011, 185 premature infants were examined with a computer-assisted imaging system, using a digital ... [Show full abstract]

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