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Exophthalmometry Value in Normal and Proptosis Eye of Reconstruction, Oculoplasty and Oncology Patients in Sanglah General Hospital Bali

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Exophthalmometry is a routine examination procedure for proptosis or ocular protrusion patients. Hertel exophthalmometer is the most commonly used device, including in Sanglah General Hospital as tertiary care centre in Bali. The exophthalmometric measures tend to vary with age, sex, and race. Therefore, many investigators conducted researches to determine the normal value of exophthalmometry result in their populations, however there is no prior study on Indonesia population, specifically in Bali. This research is an observational study with cross sectional approach using data that were collected retrospectively based on medical record of patients with proptosis condition in ROO division, eye clinic of Sanglah General Hospital Bali in period between January 2017 to June 2018. Hertel Exophthalmometer was used to measure eyeball position toward orbital space in normal eyes and proptosis eyes, especially in axial proptosis type. The subjects were 97 patients with proptosis, which is 51 patients (65 eyes) with axial type. Mean exophthalmometry value on normal eyes (37 eyes) in this study was 13.86 ± 0.51 mm and for the eyes with proptosis condition (65 eyes) the mean value 17.32 ± 0.37 mm.

Keywords: Hertel exophthalmometer, proptosis, axial type, normal value, exophthalmometric value.

Proptosis is a clinical manifestation of a pathologic condition that resulting in a shift of eyeball position to be protruded anteriorly. There are many conditions that could be primary cause of proptosis as orbital space is a bony chamber consist of many organs such as the eyeball, extraocular muscles, nerve fibers, fat and vascular structures.[1] Of all the methods that have been proposed to evaluate globe position, the Hertel exophthalmometer is the most widely used tool.[2] Despite its low accuracy, this tool is very simple and wasy to perform, hence widely applied in clinical practice.

Various literature has shown heterogenicity in exophthalmometric value across race and geographical locations. Based on this subject, establishing a population specific set of normal value of exophthalmometer examination is critical for diagnosis, evaluating severity, monitoring and planning treatment as it could be used to dissociate patient with proptosis.[3] This study reports on the range of exophthalmometric values

(EV) in normal and proptosis eye of patients in reconstruction, oculoplasty and oncology (ROO) division of eye clinic in tertiary care centre, Sanglah General Hospital Bali with certain correlating characteristics such as gender, age, visual acuity and living environment. There is no prior study on Indonesian population, specifically in Bali, that reported similar parameters is the main reason for this study to be implemented. Thus, we will have baseline data as reference for determining whether a patient has eyeball protrusion based on a specific population or what is known as the absolute exophthalmometric value.

METHODS

The study was conducted in Sanglah General Hospital Bali on the period between January 1st 2017 to June 30th 2018. This is an observational study with cross sectional approach, using exophthalmometry examination data that were collected retrospectively from patient's medical record in ROO division of Sanglah General Hospital Bali. The position of the eyeball was measured using Hertel exophthalmometer (Carl Zeiss). Measurements were taken in a well-lit room, with the subject sitting upright. The Hertel's exophthalmometer rested on the lateral orbital rim, while the subjects look forwards. Through the mirrors and a millimeter scale, position of the corneal apex relative to the outer orbital margin was measured and recorded. All collected data were analyzed using SPSS software ver. 24.0. The mean and standard deviations were calculated. Correlations between visual acuity and Hertel's value was analyzed using Pearson's correlation test, with P <0.05 was considered statistically significant.

RESULTS

A total of 106 patients with proptosis came to ROO division of eye clinic in Sanglah General Hospital January 1st 2017 until June 30th 2018. Among those patients, there were 97 subjects with 112 proptosis eyes that fulfilled inclusion and exclusion criteria, consisting of 42 males (43.3%) and 55 females (56.7%). Subjects were divided into 5 age group, late childhood (9-11 years old), adolescence (12-20 years old), early adulthood (21-35 years old), midlife (36-50 years old).[4] Mostly patients, 39 subjects (40.2%) were midlife age group. As many as 76 out of 97 subjects (78.4%) live in Bali, with 17 subjects (22.4 %) are Denpasar residents.

Proptosis patients in this study were predominantly axial type 51 subjects (65 eyes)

Table 1. Study subject characteristics

Characteristics	Result
Sex (%)	
Male	42 (43.3%)
Female	55 (56.7%)
Age group (years old)	
09 - 11	2 (2.1%)
12 - 20	7 (7.2%)
21 - 35	17 (17.5%)
36 - 50	39 (40.2%)
51 - 80	32 (33%)
Bali domicile (%)	
Denpasar	17 (22.4%)
Badung	11 (14.5%)
Gianyar	9 (11.8%)
Karangasem	9 (11.8%)
Tabanan	8 (10.5%)
Singaraja	8 (10.5%)
Jembrana	7 (9.2%)
Bangli	4 (5.3%)
Klungkung	3 (3.9%)
Visual acuity (logMar)	
≥ 0.1	32 (28.6%)
< 0.1 dan ≥ 0.5	39 (34.8%)
< 0.5 dan ≥ 0.9	6 (5.4%)
< 0.9 dan ≥ 1.3	1 (0.9%)
< 1.3 dan ≥ 1.6	2 (1.8%)
< 1.6 dan > 3.0	12 (10.7%)
3.0	20 (17.9%)

Table 2. Proptosis type

Type	Number of subjects
Axial	51 (52.6%)
Non-axial	46 (47.4%)

Table 3. Exophthalmometry mean value

Exophthalmometric value	Result (mean ± SD)
Normal	13.86 ± 0.51
Proptosis	17.32 ± 0.37

rather than non-axial type as presented in table 2. Exophthalmometric value was measured on those eye with axial type proptosis. Mean value on normal eyes (37 eyes) in this study were 3,86 ± 0.51 mm (mean ± SD). Minimum and maximum value in exophthalmometry examination were 8 and 19 mm respectively. On the other hand, the eyes with proptosis condition (65 eyes) in this study showed mean exophthalmometric value were 17,32 ± 0.37 mm as shown in table 3. There was no statistically significant correlation between exophthalmometric value and visual acuity.

DISCUSSION

Proptosis is defined as clinical manifestation that often occurs in various diseases in the structures inside or around orbital space, and in some systemic diseases.[1,5-8] This symptom mostly means that there is orbital volume increase. Primary cause of proptosis eyes could be benign or malignant lesion, and the focus mostly come from bone, vascular structures, nerve fiber, muscle or connective tissue.[5,7-8]

Proptosis, especially the axial type, can be measured using hertel exophthalmometer to determine exophthalmometry value. Exophthalmometry is simple and routine clinical examination to measure eyeball position to orbital space quantitatively. Measurements were taken in a well-lit room, with the subject sitting upright. The Hertel's exophthalmometer rested on the lateral orbital rim, while the subjects look forwards. Through the mirrors and a millimeter scale, position of the corneal apex relative to the outer orbital margin was measured and recorded. The result of exophthalmometry examination that exceed 20 mm (absolute EV) or difference of 2-3 mm or more between both eyes (relative EV) indicating a proptosis regardless of the normal value.[9,10]

Absolute exophthalmometric value (EV) means reference to measurements of the general population; relative EV refers to value with reference to contralateral eye; while comparative EV means compare with the earlier measurements. Which is the aim of this study is to have an exophthalmometric value in our specific population or an absolute EV.[10,11] The absolute EV is useful in diagnosing bilateral proptosis, relative EV measures the asymmetry of protrusion between to eyes, hence useful in diagnosing unilateral

Table 4. Correlation of exophthalmometric value and visual acuity

		Exophthalmometric value	Visual acuity
Exophthalmometric value	Pearson Correlation Sig. (2-tailed)N	1 65	0.193 0.124 65
Visual acuity	Pearson Correlation Sig. (2-tailed)N	0.193 0.124 65	1 65

Table 5. Comparison of mean exphthalmometric value (EV) in several different studies

Study	Location	EV (mm)	
		Normal	Proptosis
Bilen et al (2007)	Turkey	13.44 ± 2.6	-
Jarusaitiene et al (2014)	Lithuania, Europe	14.91 ± 1.68	-
Karti et al (2015)	Turkey	15.7 ± 2.6	-
Ramli et al (2015)	Malaysia	14.5 ± 2.2	20.5 ± 3.9
Wu et al (2015)	China	15.0 ± 2.0	-
Choi and Lee (2017)	South Korea	14.81 ± 2.26	17.96 ± 2.65
This study	Bali, Indonesia	13.86 ± 0.51	17.32 ± 0.37

proptosis.[12] The findings of our study are useful in providing information to support further research in orbital conditions, particularly for population of Bali, Indonesia, as this study can provide local reference values of hertel exophthalmometry examination to assess disease severity and monitoring disease progression in future research.

Study that was done by Bilen et al presented mean EV of normal eyes of male subjects in Turkish population was 3,44 ± 2,6 mm, with the minimum and maximum value were 8 and 20 mm respectively. While Jarusaitiene et al study on certain population, children and adult, in Lithuania showed mean EV of 14,91 ± 1,68 mm. Karti et al made another study on adult group age of Turkish population and the result is different significantly with EV of 5,7 ± 2,6 mm.[13-15]

A study conducted at the Eyes Clinic of University of Malaya Medical Center (Malaysia) by Ramli et al revealed that the mean Hertel measurement in normal eyes was 14.5 ± 2.2 mm, while in the proptosis group it was 20.5 ± 3.9 mm. Research by Wu et al on normal eyes of the Chinese population, obtained the mean value of Hertel measurement on the right eye was 15.0 ± 2.0 mm and the left eye was 15.0 ± 1.9 mm. A study of 69 eyes with thyroid-associated orbitopathy at Hallyn University Sacred Heart Hospital (Korea) by Choi and Lee, found a mean of 17.96 ± 2.65 mm, while the mean of normal eyes was 14.81 ± 2.26 mm.[16-18]

Cheung et al were using different approach for their study. They divided the examination result based on subject's gender for normal EV measurement.[11] According to the resut of our study, the mean EV as the result of hertel exophthalmometer examination is 13,86 ± 0,51 on normal eyes and 17,32 ± 0,37 on proptosis eyes. The statistic number didn't differ significantly on both normal and proptosis eyes with some studies. While this could be contributed by several factors, but population seemed to influence the result as shown in the study by Ramli et al in Malaysian population which consist of various ethnicity presenting bigger EV mean in proptosis eyes.

Several limitations were identified in our study. First, the number of subject is too small means bigger bias to the result statistically. It would be relevant to conduct another study with bigger population to establish better set of normal EV. Second, the results of exophthalmometry counducted on the same individual but were performed by different examiners, which may also cause bias. Future studies are preferable to be carried out prospectively, with a large sample size, and the examination carried out by the same person/observer.

CONCLUSION

Knowledge on normal exophthalmometric value has important implications on the diagnosis and management of ocular and orbital disease of various etiologies. While the normal value could be used as the standard of examination in certain population, the EV of proptosis eyes could give better understanding of ocular and orbital disorder that could lead to proptosis condition.

Conflict of Interest

All authors declared that they have no conflict of interest.

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