

■ **Original article**

An electro-physiological device to assess status of vitreous transparency

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Abstract

Introduction: Evaluation of optical media is important in ophthalmic practice.

Objective: to design and tryout an electro-physiological device in order to assess the transparency of the vitreous.

Materials and methods: A media-meter was designed where a light sensitive sensor was placed on the cornea and adjoining sclera during the process of trans-illumination. The trans-corneal (TC) and trans-scleral (TS) light transmittance were recorded objectively. By standardizing these readings on normal eyes, it was possible to suspect any cause of vitreous turbidity in eyes where the transmittance of light was observed to be less than the normal readings.

Statistics: Media-meter values were compared using Student's unpaired t- test for comparison between both the groups. Pearson or Spearman correlation coefficients were calculated for pooled media-meter values obtained from patients with endophthalmitis.

Results: The readings were obtained by TC and TS media-metry with white light in 20 eyes that served to standardize the device. The mean values for the intensity recorded on the media-meter were 206 to 74 Lux and after log-values conversion were 2.14 (range 2.36 to 1.87) and 45 to 31 Lux and after log conversion 1.60 (range 1.66 to 1.49) for TC and TS media-meter respectively. There was a highly significant difference between normal eye readings and the corresponding values obtained for TC and TS media-meter values in eyes with endophthalmitis.

Conclusion: The media-meter can be used to evaluate vitreous transparency.

Key words: trans-illumination, media-meter, endophthalmitis, vitreous transparency

Introduction

Transparent vitreous is mandatory for clear vision. It is important to know the vitreous status prior to cataract surgery. It is not possible to accurately predict the vitreous transparency in the presence of a mature cataract. This problem gets all the more compounded if the cataract is accompanied with a dense corneal opacity.

There could be various causes where the vitreous humor may not be completely transparent. The presence of vitreous hemorrhage, endophthalmitis, vitreous degeneration etc will drastically compromise the visual acuity achieved after a successful cataract surgery. Whereas it is simple to ascertain the transparency of the cornea, lens and anterior chamber of the eye, it is not yet possible to determine the status of the vitreous clarity by conventional methods. It would be possible and easy to assess the transparency of the vitreous by direct view when the cornea, AC and lens are clear, but it is impossible to evaluate the vitreous transparency in the case of corneal opacity, cataract, vitreous hemorrhage or endophthalmitis (Gupta et al 2004). Ultrasonography

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might be of some help when the hazy optical media prevents the evaluation of vitreous nature (Das et al 1995).

A cold endophthalmitis is a rare condition that may be lurking in the eye hidden behind a mature cataract. There even may at times be an unsuspected hemorrhage in the vitreous which may only become known when the cataract surgery is done and the vision does not improve. Endophthalmitis is also the most devastating complication of intra ocular surgery and penetrating trauma to the eye. When this happens, it leaves the patient distraught and the confidence of the operating surgeon is shattered, and there is always a possibility of medico-legal issues. The typical clinical characteristics are increasing pain and redness with decreasing visual acuity. Pain, although thought to be a major diagnostic symptom is absent in 25 % of the patients (Bernad & Doft, 1995). Hypopyon is almost always present; lid edema and raised intra ocular pressure may be present (Pullafiti et al 1982, Rowsey et al 1982, Flynn et al 1989, Rowsey et al 1989). Occasionally the signs and symptoms are subtle and misleading in the early stages before the condition becomes fulminate (Das et al 1995).

Visual acuity and clarity of vitreous were the two most important clinical criteria used for the assessment of treatment outcome in Endophthalmitis Vitrectomy Study (Bernad & Doft, 1995). This calibrated technique of trans-illumination can help to assess vitreous transparency even in the presence of corneal and lens opacities.

In this study, we have designed a simple instrument that can give an objective and reproducible assessment of the degree of vitreous transparency prior to contemplating cataract surgery. The media-meter can detect the presence of vitreous hemorrhage, endophthalmitis and other causes of vitreous turbidity, even in the presence of a mature cataract or corneal opacity.

Materials and methods

Twenty eyes of 10 subjects were taken up for the study to standardize the instrument readings. All subjects were in the age range of 20 to 35 years. All eyes had no pathology whatsoever with a vision of 6/6. Informed consent was obtained in each case. The study was carried out in accordance with the

Declaration of Helsinki. A media-meter was used to examine the vitreous clarity in all participants.

The media-meter

The media-meter consists of two basic components: a light source and a luxmeter. A conventional Heine Finoff Trans-illuminator was used as a light source with a constant light intensity of 3000 Lux. A Mastech MS6610 Luxmeter, with a range of 0-50,000 Lux was used as the light sensor.

The light sensor of the Luxmeter was placed on the anesthetized cornea or scleral area of the subject's eye during media-metry (Figure 1 & Figure 2). The sensor was mounted in a light tight, blackened plastic tube to shield it from external light so that only light emanating from the pupil reached it. The diameter of this probe was 12 mm so that it matched with the corneal diameter exactly.



Figure 1 (photograph of Media-metry in process)

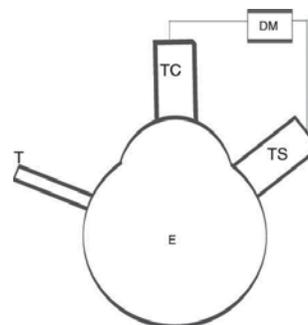


FIGURE- 2

Fig 2 Diagrammatic representation of Media-metry
 TC-Trans Corneal, TS-Trans Scleral.
 T-Transilluminator, DM- Luxmeter, E-Vitreous cavity

The basic principle of the media-meter is that any light that reaches the vitreous cavity is reflected from the retina and choroids. Thus the intensity of light emanating from the pupil and the sclera during media-metry is directly proportional to the transparency of the ocular media. For example, if the clarity of the ocular media is reduced because of the presence of cells or protein that absorb white light, there will be a corresponding decrease in the amount of light emanating from the cornea and sclera and the luxmeter reading will be lower than the normal eye with transparent media. The intensity of the light coming from the pupil is displayed on a sensitive digital luxmeter which can be recorded.

Table 1
Mediameter readings for normal eyes

Patient No	Age/ Sex	Media-meter readings (log value) [Lux]	
		Trans-corneal (TC)	Trans-scleral (TS).
1.	23/M	104(2.02)	39(1.59)
2.	29/F	206(2.31)	45(1.65)
3.	26/F	190(2.28)	44(1.64)
4.	34/M	155(2.19)	37(1.57)
5.	28/M	98(1.99)	40(1.60)
6.	25/F	74(1.87)	31(1.49)
7.	27/M	118(2.67)	41(1.61)
8.	22/M	75(1.88)	34(1.53)
9.	32/M	170(2.29)	33(1.52)
10.	24/F	102(2.01)	45(1.65)
11.	35/M	180(2.25)	44(1.64)
12.	24/F	206(2.31)	42(1.62)
13.	29/F	204(2.31)	42(1.62)
14.	21/M	172(2.24)	45(1.65)
15.	21/F	145(2.16)	34(1.53)
16.	27/M	175(2.24)	43(1.63)
17.	29/M	146(2.16)	39(1.59)
18.	23/F	104(2.02)	45(1.65)
19.	35/F	78(1.89)	34(1.53)
20.	32/F	170(2.29)	33(1.52)

Table 2 consists of comparative TC and TS readings in 11 eyes with an established diagnosis of endophthalmitis following extra-capsular cataract extraction with an IOL implantation.

Table 2
Mediameter readings in cases of endophthalmitis

Patient No	Age/ Sex	Media-meter readings (log value) [Lux]	
		Trans-corneal (TC)	Trans-scleral (TS).
1.	23/M	104(2.02)	39(1.59)
1.	51/M	49(1.69)	23(1.36)
2.	49/M	47(1.67)	25(1.40)
3.	51/M	68(1.83)	29(1.46)
4.	60/M	43(1.63)	23(1.36)
5.	60/F	68(1.83)	30(1.48)
6.	55/F	39(1.59)	22(1.34)
7.	55/M	50(1.70)	26(1.41)
8.	58/M	55(1.74)	29(1.46)
9.	49/F	45(1.65)	27(1.43)
10.	53/M	62(1.79)	28(1.45)
11.	56/F	58(1.76)	30(1.48).

There was a highly significant difference between normal eye readings and the corresponding values obtained for TC and TS media-meter values in eyes with endophthalmitis (Table 3).

Table 3
Comparison of media-meter readings for normal and endophthalmitis eyes

Site	Mean Log value (SD)		p Value
	Normal	Endophthalmitis	
Transcorneal	2.14(0.16)	1.72(0.08)	<0.001
Trans Sclera	1.60(0.05)	1.42(0.05)	<0.001

To establish the normal range of readings expected in the general population

For the media-meter to be of any utility it was essential to know the range of Trans-corneal (TC) and trans-scleral (TS) readings in normal eyes with totally transparent media. Twenty eyes of 10

participants underwent this technique for standardization of the instrument. All eyes were devoid of any pathology and had an uncorrected vision of 6/6 on the Snellen chart.

Both TC and TS media-metry were performed under full mydriasis and topical anesthesia. The luxmeter probe was placed on the cornea for TC media-metry and on the nasal sclera for TS media-metry (Figure 2). In TS media-metry the light tight probe was placed between the limbus and the insertion of the medial rectus and precisely 3mm from the nasal limbus. The light source of the trans-illuminator was positioned at a fixed distance of 8 mm from the limbus on the temporal side, so that it occupied a position along the upper border of the lateral rectus muscle. The intensity of the light emerging from the pupil was measured using the digital luxmeter and recorded.

Results

Table 1 shows the readings obtained by TC and TS media-metry with white light in 20 eyes that served to standardize the device. The mean values for the intensity recorded on the media-meter were 206 to 74 Lux and after log-values conversion were 2.14 (range 2.36 to 1.87) and 45 to 31 Lux and after log conversion 1.60 (range 1.66 to 1.49) for TC and TS media-meter respectively.

Statistical analysis

Media-meter values were compared using Student's unpaired t- test for comparison between both the groups. Pearson or Spearman correlation coefficients were calculated for pooled media-meter values obtained from patients with endophthalmitis. A p value of <0.05 was considered significant. All luxmeter readings were logarithmically transformed before analysis, which was performed using the Statistical Package for the Social Sciences version 11.0.

Discussion

The technique of trans-illumination has long been regarded as a useful diagnostic and prognostic test, although it has gone into near oblivion due to its purely subjective nature. Although it has been used in ophthalmology since the middle of the 19th century, very little has been done to improve the technique. Due to the presence of transparent media in the eye, trans-illumination has a tremendous potential of use in ophthalmology. To enhance the scope and usefulness of this technique, a media-meter was

designed for use in this study that proved to be capable of assessing the clarity of vitreous, even in the presence of a corneal opacity or cataract, when the fundus could not be directly visualized. The aim of this study was to determine whether the media-meter could be used to accurately diagnose endophthalmitis and also to monitor its progression and/or response to treatment.

Conclusion

Having established the range of values expected in normal eyes, it was possible to determine and diagnose those eyes with vitreous turbidity as in cases of endophthalmitis. Thus, a reduced transmittance of light as compared to normal eyes raised the suspicion of a lesion in the vitreous compromising its transparency and hence its light transmittance.

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