Ultrasound findings in ocular trauma

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**Abstract**

Objective: To evaluate the frequencies of various eye and/or orbital disorders by ultrasound examination in patients with ocular trauma.

Materials and methods: This prospective and descriptive study was conducted on 100 patients with ocular trauma treated in the Conde de Valenciana Institute from March to November 2014. Ultrasound examination was performed primarily using ultrasound B mode, with standardized A mode only used as correlation method. Age, gender, type of trauma, and various ultrasound findings were recorded.

Results: Ocular trauma was more frequent in men (83%) compared to women (17%). The left eye was affected in 55%, and right eye in 45%, with 55% being open traumas and 45% blunt traumas. Most cases were young patients with a mean age of 33.7 years, with the group between 41 and 50 years being the most affected. Among the most frequent injuries found was the vitreous hemorrhage (45%) and posterior hyaloid detachment (38%), followed by retinal detachment (32%), and choroidal detachment (18%).

Conclusion: Ultrasound remains as the investigation method of choice in patients with ocular trauma, since it is a simple, cheap and non-invasive study, and can be very useful in providing diagnostic and prognostic information. This study demonstrated that trauma is more common in young men, with vitreous hemorrhage as the most common finding.

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**Hallazgos ecográficos en trauma ocular**

**Resumen**

Objetivo: Evaluar las frecuencias de las distintas alteraciones oculares en pacientes con trauma ocular, mediante estudio ecográfico.

Materiales y métodos: Este estudio prospectivo y descriptivo incluyó a 100 ojos evaluados en el Instituto Conde de Valenciana debido a traumatismo ocular desde marzo hasta noviembre del 2014. Se realizó la exploración ecográfica empleando principalmente el ultrasonido modo B y solo el modo A estandarizado como método de correlación. Se recogieron la edad, género, tipo de trauma y los distintos hallazgos ecográficos encontrados.

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Introduction

Ocular trauma is defined as a lesion originated by concussion or open mechanisms over the ocular globe and its peripheral structures, which produces tissue damage in varying degrees, temporarily or permanently compromising visual function.1  

Ocular trauma is a common trauma at the emergency services of hospitals, comprising approximately 3% of all admissions.2 Physical aggression, sports, industrial and agricultural work activities, construction and traffic accidents are among the main causes.3  

Overall, 80% of ocular traumas occur in males, most of them between 20 and 40 years of age.1–4 Contrary to what might be expected, it is known that the place where most ocular injuries occur is at home, followed by the streets, industrial premises and during sporting activities.5  

These patients are a challenge for ultrasound operators as frequently the study must be carried out through the eyelids due to pain or the possible disorganization of intraocular structures. However, through methodical and careful assessments, a reasonably certain diagnostic can be obtained.6–7 In these cases, ultrasound echography is indicated mainly due to opacity and the impossibility of carrying out an adequate ophthalmological exploration.  

Despite recent technologies, ultrasound continues to play an irreplaceable role in the diagnostic and follow-up of ocular traumas.8–9 The objective of the present study was to determine ocular or orbital alterations utilizing ultrasound studies in patients with ocular trauma who could not be assessed with an ophthalmological exploration.

Materials and methods

The present prospective and descriptive study included 100 eyes examined at the Conde de Valenciana Institute for ocular trauma between March and December 2014, regardless of patient age or gender, to carry out the study by means of an ecographic exploration according to previous medical indication.  

All the ultrasound studies were carried out in the Echography Unit of said hospital by equipment with mode A/B, standardized mode A as well as UBM (Aviso S, Quantel Medical®, Cedex, France) (Fig. 1). In all cases, said examination was carried out with the patient lying on a reclined chair and placing the ultrasound probe over the eyelids or cornea or conjunctiva if possible, applying the smallest amount of manipulation and instilling 2% methylcellulose as coupling medium. In open trauma cases, a new and sterile methylcellulose flask was used applying methylcellulose in abundance to avoid exerting pressure over the ocular globe. A systematic echography exploration was carried out and the diagnostics of observed diseases were based on topographic, quantitative and kinetic biometric characteristics, utilizing primarily ultrasound in mode B, while standardized mode A was used as correlation method. Recorded patient data comprised age, gender, injured eye, type of trauma and ecographic findings.  

The study excluded cases in which the patient was uncooperative to the point of jeopardizing the reliability of the examination. In addition, the study excluded cases with incomplete ultrasound or ophthalmological report. The study was approved by the Ethics Committee of the hospital in which it was carried out.
For categorical variables, frequencies and percentages were calculated, while for continuous variables the averages, standard deviations, maximum and minimum were calculated. Pearson's Chi square test was used for comparing percentages and, the t test for student for comparing averages.

Results

Of the overall sample, 83% were males and 17% females, with the same number of patients in each group (n = 100), a proportion of 4.88:1. In 55% (55 cases) of traumas, the left eye was involved and in 45% (45 cases) it was the right eye. Over half of studied cases were caused by open trauma (55%, 55 cases) and the rest to blunt traumas (45%, 45 cases).

The average age was 33.7 years ± 19.99. However, the range was from 1 to 87 years. The cases were divided by age group as follows: group 1 (0–10 years); group 2 (11–20 years); group 3 (21–30 years); group 4 (31–40 years); group 5 (41–50 years); group 6 (51–60 years); group 7 (61–70 years) and group 8 (>70 years) (Fig. 2).

The lesions found in the ultrasound ecographic study are shown in Fig. 3 in order of frequency. Other abnormalities that were identified but not shown in said figure include: 11% (11 cases) with significant retinochoroidal thickening, one case of phacodonesis, one with cyclodialysis, one with choroidal fructures, one orbital hematoma and one with intraocular air (not due to surgical procedures).

The findings of previous surgery in said eyes comprised 4 with scleral cerclage, 2 with silicon oil in vitreous cavity and one with perfluorocarbonates. It is important to mention that 8% of the sample was completely normal in ultrasound exploration (2 of which were open traumas).

Discussion

In the present study it was observed that the majority of studied patients were young, with 81% (81 cases) of the sample being under 50. The age group of patients with most cases was 41–50 years (group 5) with 23 cases. In accordance with the vast majority of the literature, the results of this study confirm that traumas are more common in younger individuals in productive age.1–5

In accordance with the above, 83% of cases (83 eyes) were male, which confirms well-known epidemiological data on ocular trauma in this population (as well as for other types of trauma).1–5 Said results closely match the data of the USA Eye Injury Registry (USEIR) (33 years; 80% males; a proportion of 4.6:1).4

In what concerns the eye which suffered the trauma, the difference is small: 45% (45 cases) in the right eye and 55% (55 cases) in the left eye. The 2002 revision of USEIR and that of India reported that up to 12% of ocular traumas are open.4 The present study observed a large difference. In fact, open trauma was only slightly less common than blunt trauma with 49 (49 cases) vs 51% (51 cases). Obviously the USEIR data are clinical. The present study only collected data of patients who underwent ultrasound exploration and accordingly are not comparable. It seems reasonable that 49% of traumas requiring ultrasound exploration were open. A similar study reported a nearly identical incidence, with 50.5% of blunt traumas and 49.5% of open traumas.5

When comparing the type of trauma with gender, no association was found (Pearson’s Chi square p = 0.790). The same result was found when comparing the type of trauma with age groups (p = 1.59).

In what concerns ultrasound findings in traumatized eyes, at present there are very few studies on the subject,8–14 some of which commented the usefulness of ultramicroscopy or ultrasound immersion mode B in these patients.11,15–18 Due to the acute nature of trauma in the majority of patients, nearly half being open, those 2 methods of study were not possible and could even be dangerous in open trauma cases.

Even though, to the best of our knowledge, there are no studies assessing the risks of performing ultrasound in an open trauma, there are some comments10 together with the theoretical risk of compressing the ocular globe enough to produce partial expulsion of the intraocular content.
In these cases it would be more convenient to perform a primary closure of the injury with subsequent ultrasound. In fact, this is the protocol of some ocular trauma echography studies.6,14

In contrast, the possible benefits of assessing the condition of the ocular globe before surgery must be considered, as this could facilitate surgical planning. As commented above, the ecographic explorations of these patients were carried out with great care.

The most frequently reported ultrasound lesion found in this study was vitreous hemorrhage in 45% (45 cases) (Fig. 4). In a study by Dastevska-Djosevska9, which is very similar to the present one but assessing 182 eyes, vitreous hemorrhage exhibited a prevalence of 20.9% and also was the most common finding. Another study by Parchand et al.6 reported 51.7%.

The second most frequently reported lesion was posterior hyaloids detachment with 38% (38 cases) (Fig. 4) which, when compared with the above mentioned report, it was seen that the present statistics were based on a much larger amount of eyes (3.8%). It must be stated that, even though the majority of patients were young, many could already exhibit data on said detachment as part of the natural evolution of the eye and certainly cannot be entirely attributed to traumatisms.

The following findings were retina detachment (RD) in 32% (32 cases), of which 20 (62.5%) were open traumas, 6 were complete (18.7%) (Fig. 5). In a study which only assessed postoperative open trauma eyes13 performing 210 echographies, 32 RD were identified (15.2%), of which 14 were complete (43.75%). Choroidal detachment (CD) was observed in 18% (18 cases), of which 13 (72.2%) were, as commonly seen, in open traumas.6,7 The above referenced study documented 91 CD (43.3%), whereas Dastevska-Djosevska9 reported 4.4% RD and 1.1% CD.

Scleral ruptures were observed in 13% (13 cases). No previous reports were found on said ruptures. It is interesting to note that only 10 of the 13 identified ruptures were clinically reported as open traumas, which means that 3 cases were hidden ruptures. In fact, this is an indication for echography in a very hypotensive eye.

Cataracts were detected in 11% (11 cases) although it is known that ultrasound is able to detect cataracts only in moderate to important stages,6,7 which means that it is not a reliable finding. Even so, another study reported a prevalence of 14.2%.8

Foreign bodies were found in 10% (10 cases) (Fig. 6); all were intraocular except one that was in the orbit. The literature reported this finding in 6.6%9 and in 33.9%.8 Ultrasound is an excellent tool for identifying foreign bodies due to its sensitivity and specificity of up to 100%.6 Interestingly, only 7 out of the

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Fig. 4 – Mode B echography showing dot-shaped moderately dense echoes limited by a partially detached posterior hyaloids, corresponding to recent vitreous hemorrhage.

Fig. 5 – Mode B echography showing V-shaped thickened membrane inserted in the optic nerve and the ora serrata corresponding complete RD (OD = RE).

Fig. 6 – Mode B echography showing echodensity around highly luminous echo, which persists due to low gain and produces posterior acoustic shadow. These findings are compatible with intraocular foreign body with surrounding hemorrhage (OD = RE).
10 reported cases were initially described as open trauma. In fact, in one case no hidden scleral ruptures were found, i.e., the entry point of the foreign body was not found, although this could be explained due to the high velocity of some objects when penetrating the ocular globe.

In addition, 9% (9 cases) exhibited aphakia, although only 7 of these involved lens/intraocular lens dislocations. Other authors reported 6.6% of cases. A prevalence of 9% (9 cases) was found for vitreous or sub-hyaloid cellularity, 8% (8 cases) with subretinal hemorrhage and 5% (5 cases) with posterior capsular rupture although, as commented for the cataract data, these findings are not very reliable. In addition, to achieve greater diagnostic certainty it would be necessary to perform at least an immersion mode B ultrasound and, if possible, UBM (which is not possible in acute trauma, above all if these are open).

Overall, 4% (4 cases) of cases were detected with diminished anteroposterior ocular axis when examined with mode B echography and, even though this was evidence by simple observation, an axial section was taken of the opposite eye for comparative purposes. Two percent (2 cases) exhibited disorganization of intraocular structures where it was not possible to identify them with certainty (burst eyelash cases).

Finally, endophthalmitis cases appeared in 2 eyes (2%), compared with 3.3% and 7.14%. In other studies, traumatic endophthalmitis accounted for 25% of all endophthalmitis cases, but 7% of open trauma cases developed endophthalmitis. Other sources reported 3%. The risk increases with every hour of delay of surgery, and the presence of intraocular foreign bodies doubles the risk of endophthalmitis.

Without being a primary objective of this study, the usefulness of echography for documenting findings in trauma and comparing them with those found in vitreoretinal retina surgery has already been assessed. In what concerns vitreous hemorrhage, in cases of hemorragic CD, foreign bodies and vitreous exudates ultrasound exhibits a sensitivity and specificity of up to 100%. Similarly, in RD cases it also exhibits a very high detection rate of between 90% and 98%.

A comparative analysis was carried out comparing echographic findings with patient gender, without finding association in any of the cases (Pearson’s Chi square >p> 0.05), with the exception of lens dislocation where this alteration was more frequently found in males (p = 0.03).

Similarly, ultrasound findings were compared with age and only in the case of PVD a statistically significant association was demonstrated (t for Student p = 0.044).

Conclusions
The results of the present study demonstrate that the gender most commonly affected by ocular trauma is the masculine gender (83%), without significant differences between lesion type or injured eye. Similarly, ocular trauma was more frequent in younger patients, with the most affected age group being between 41 and 50 years of age, with an average age of 33.7 years. The most commonly observed echographic finding, regardless of the type of lesion, was vitreous hemorrhage.

Even though the technology utilized for ocular echography has not changed significantly since the 70s, it still remains as the paraclinical study of choice for ocular trauma because it is safe, effective and inexpensive. In addition, it allows ophthalmologists to assess the effects of applied therapy as well as the best surgical approach if that were the case.

Conflict of interest
No conflict of interest was declared by the authors.

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