Enucleations, Eviscerations, and Exenterations at a Supratertiary-care Hospital in Puerto Rico: A Retrospective Study

Nicole P. Rebollo, MD*; Hiram J. Jiménez, MD†; Ambar Ramírez, MD†;
Jan C. Ortiz, MD*; Julio A. Rodríguez, MD*

Objective: To provide a descriptive analysis of the indications and the intraoperative and postoperative complications of eye enucleations and eviscerations, and orbital exenterations performed at the only academic institution in Puerto Rico providing supratertiary care.

Methods: A retrospective medical record review of patients who underwent enucleations, eviscerations, and exenterations from January 2015 through June 2020 was conducted. The data were analyzed to generate a descriptive profile of the demographic characteristics of the patients, their clinical indications and surgical complications, and a histopathological diagnosis per type of eye-removal procedure.

Results: A total of 118 eyes were removed via enucleation, evisceration, or exenteration over the 66-month study period. The average patient age was 64 (±17.5) years and 63.8% of the patients were male. The most frequently performed eye-removal procedure was enucleation (73.7%), followed by evisceration (18.6%) and exenteration (7.6%). The main clinical indications for enucleations and eviscerations were infectious processes, namely panophthalmitis, endophthalmitis, and/or perforated corneal ulcers, that failed medical management. In our sample, squamous cell carcinoma was the most common diagnosis (both clinically and histopathologically) leading to exenteration. Postoperative complications in our patient cohort were minimal.

Conclusion: At our institution, enucleations predominate over eviscerations. Retrospective reviews published in recent years indicate that the rate of eviscerations at our institution is comparatively low. The results of this study, the first of its kind at our institution, may encourage a re-evaluation of the indications for evisceration versus enucleation in our patient population. [*P R Health Sci J 2022;41(3):142-148*]

Key words: Enucleations, Eviscerations, Exenterations, Puerto Rico

The decision to surgically remove an eye is one that weighs heavily on an ophthalmologist. However, when trauma causes the irreparable loss of ocular architecture, when ocular disease causes recalcitrant pain that is unresponsive to medical management, or when an ocular malignancy is present, removal may be necessary. The 3 main surgical approaches for eye removal are evisceration, enucleation, and exenteration.

The evisceration of an eye involves the removal of its intraocular contents, while preserving the sclera, usually with the placement of an implant inside the scleral cavity. Evisceration is indicated in endophthalmitis that is unresponsive to treatment, and in painful blind eye. However, it is contraindicated in eyes with intraocular tumors (1). Evisceration has been associated with an increased risk of sympathetic ophthalmia and the possibility of missing an intraocular malignancy. Historically, this has caused some ophthalmologists to hesitate to recommend evisceration. Nonetheless, some studies have reported a trend toward surgeon preference for evisceration over enucleation, even in trauma settings (2–6). A retrospective study by Nakra et al at a single academic center in Los Angeles demonstrated that motility after evisceration was statistically greater than such motility after enucleation, as graded by blinded observers (7). In a study in which ophthalmic plastic and reconstructive surgeons were asked about their preferred practice patterns regarding enucleations versus eviscerations, recent fellowship graduates had a greater tendency to pursue evisceration than did more senior surgeons (8).

*Department of Ophthalmology, University of Puerto Rico Medical Sciences Campus, San Juan, Puerto Rico; †School of Medicine, University of Puerto Rico Medical Sciences Campus, San Juan, Puerto Rico

The authors have no conflicts of interest to disclose.

Address correspondence to: Nicole Paola Rebollo, MD, University of Puerto Rico, Department of Ophthalmology, PO Box 365067, San Juan, PR 00936-5067. Email: npaola.rebollo@gmail.com

Enucleation removes the eyeglobe, severing it from its muscular and tenon's capsule attachments, all of which remain in the orbit. Indications for enucleation are panophthalmitis unresponsive to treatment, painful blind eye, intraocular malignancy, irreparable ocular trauma, and severe microphthalmia (1). Enucleation is still the primary eye-removal procedure done at most institutions. Enucleation, however, can be technically more challenging in patients with severe infections or with severe trauma, as the surgical and recovery times are greater.

Orbital exenteration removes the eye globe in addition to all other orbital contents, which may include the eyelids and orbital walls (9). The main indication for pursuing orbital exenteration is the presence of invasive orbital neoplasms that may arise from ocular and periocular structures (10). Even though it represents a radical and disfiguring procedure, its aim is to reduce the potential for metastasis as well as improve patient survival rates.

This retrospective study intended to provide a description of the epidemiology, clinical indications, and histopathological diagnosis leading to the surgical removal of an eye or the orbital contents in patients at a main academic center in Puerto Rico over the course of 5.5 years. Complication rates within the first year of surgery are described, which description provides insight into areas of potential improvement in the current surgical techniques and procedures.

Methods

A retrospective review of medical records was performed; said records were of patients who had undergone evisceration, enucleation, or exenteration surgeries carried out by members of the Ophthalmology Department at the Puerto Rico Medical Center (PRMC). The PRMC receives all the severe ocular trauma cases and severe endophthalmitis cases in Puerto Rico, as well as most of those dealing with ocular malignancies. Data were collected for patients over a 66-month period, between January 2015 and June 2020, inclusive.

Patients were identified by searching the code sets of both the Current Procedural Terminology and International Classification of Diseases, 10th revision, for conditions that are indications of the 3 procedures described, herein. Because our institution has a hybrid charting system, a review of both paper-based and electronic records was carried out.

The inclusion criteria were being equal to or greater than 18 years old and having had any of the listed surgical procedures performed at the PRMC within the described timeframe. The exclusion criteria were being under 18 years of age and not having had any of the surgical procedures described.

Enucleations and eviscerations were performed as described in the medical literature, with or without an implant and with or without muscles attached to the implant. At our institution, the principal implants used are non-porous silicone and acrylic spheres without wrapping. All the enucleations included an appropriately sized conformer (placed with or without tarsorrhaphy, as the clinical situation dictated). Similarly, orbital exenterations were performed as described in the medical literature, with or without the removal of bone and with or without the placement of a meshed graft, as necessary.

Data collected from medical records included demographic information, the affected eye(s), preoperative visual acuity, indication for surgery, the type of surgery performed, the surgeon's training, intraoperative complications (when present), postoperative complications within 1 year after surgery (applicable to a subset of patients), and the pathological diagnosis of the surgical specimen.

Descriptive statistics including mean and standard deviation for continuous variables and frequency distribution and percentage were performed. Chi-square analyses were done to evaluate the association between gender, age group, and indications for surgery and the procedure performed. Data with a P value of .05 or lower were considered statistically significant. All statistical analyses were done using Microsoft Excel software and Stata, version 14.0.

The study received approval by the Institutional Review Board (IRB) of the University of Puerto Rico School of Medicine (IRB protocol B2270120) and complies with Health Insurance Portability and Accountability Act regulations.

Results

Over the course of 66 months, extending from January 2015 through June 2020, a total of 118 eye-removal procedures were performed on 116 patients at the PRMC. Two of said patients underwent bilateral enucleation in the setting of trauma. An estimated 425 ophthalmological surgeries are performed yearly at this institution, out of which approximately 5% are eye-removal procedures.

The demographic characteristics are summarized in Table 1. Overall, the mean age of the patients was 64 (±17.5) years, with a median age of 66 years, and most were male (74, 63.8%). Enucleations were more common in the age cohort of 60 to 69 years, eviscerations were more common in the age cohort of 80 to 89 years, and exenterations were more frequent in the age cohort of 70 to 79 years. The majority of the patients who underwent enucleation or exenteration were male, while eviscerations were most commonly performed on females. Enucleation was the most commonly performed procedure (87, 73.7%), followed by evisceration (22, 18.6%) and exenteration (9, 7.6%).

Table 2 summarizes the clinical indications and histopathological diagnosis for the removal of an eye. In our study, the main clinical indication was an infectious process, namely endophthalmitis (22, 19%), panophthalmitis (20, 17%), or a perforated corneal ulcer with uveal prolapse (16, 13%). The second most common indication was trauma (28, 24.5%), followed by painful blind eye (19, 16.9%) and malignancy (13, 10.1%). All the surgical specimens (n = 118) were submitted to the institution's anatomic pathology laboratory

Table 1. Demographic characteristics of patients who underwent enucleation, evisceration, and exenteration, Puerto Rico Medical Center, January 2015 – June 2020 (N = 116 patients).

Demographic characteristic	All cases N = 116	Enucleations n = 85	Eviscerations n = 22	Exenterations n = 9
Age (years) (mean ± SD)	64 ± 17.5	62 ± 18	72 ± 13	64 ± 18
Age (years) (median, range)	(66, 19–95)	(65, 19–95)	(72.5, 44–91)	(75, 26–81)
Age group (years)*	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
0–19	1 (0.9)	1 (1.1)	0 (0.0)	0 (0.0)
20–29	6 (5.2)	5 (5.9)	0 (0.0)	1 (11.1)
30–39	5 (4.3)	5 (5.9)	0 (0.0)	0 (0.0)
40–49	11 (9.5)	9 (10.6)	1 (4.6)	1 (11.1)
50–59	17 (14.7)	14 (16.5)	2 (9.1)	1 (11.1)
60–69	27 (23.3)	20 (23.5)	6 (27.3)	1 (11.1)
70–79	24 (20.7)	16 (18.8)	4 (18.2)	4 (44.4)
80–89	21 (18.1)	12 (14.1)	8 (36.4)	1 (11.1)
90–99	4 (3.5)	3 (3.5)	1 (4.6)	0
Gender*				
Male	74 (64%)	57 (65.5%)	9 (41%)	8 (89%)
Female	42 (36%)	28 (32.2%)	13 (59%)	1 (11%)

*P value < .05

for histopathological diagnosis. Infectious processes, including panophthalmitis, endophthalmitis, and keratitis, were the most frequent pathological diagnoses (48.3%).

Figure 1 shows that all the exenteration procedures were performed by oculoplastic surgeons, while enucleations and eviscerations were performed mainly by non-oculoplastic surgeons serving as on-call attending surgeons at our institution.

Figure 2 shows the number of procedures per year. An average of 21.4 cases were performed yearly, with 2016 having the greatest number of eye-removal procedures over the course of the study period.

Preoperative visual acuities were no light perception (NLP) in 88 eyes (74.6%); 16 patients had light perception (LP) vision (13.6%). Two patients had hand motion (HM) visual acuity, and 5 had counting fingers (CF) or better visual acuity. Among patients with CF or better visual acuity, indications for eye removal were invasive basal cell carcinoma (BCC), a painful eye secondary to long-standing tractional retinal detachment, an aggressive endophthalmitis secondary to moxifloxacin use, invasive orbital squamous cell carcinoma (SCC), and invasive melanoma of the orbit. There were 7 cases in which visual acuity could not be assessed due to the altered mental status of each of the patients.

Clinical indications for enucleation varied amongst the age cohorts, as shown in Figure 3. While infection was the most common indication overall, in the age cohort of 30 to 39 years, painful blind eye was the most prevalent indication. In the age cohort of 50 to 59 years, trauma was the most prevalent indication for enucleation. Evisceration procedures were performed only in patients older than 40 years of age, with endophthalmitis being the most common indication across most of the age groups. For exenteration, SCC was the most common etiology to justify the procedure across the age cohorts of 40 to 49 and 60 to 89 years.

No intraoperative complications were reported for any of the 118 eye-removal procedures in our study, although there was 1 case with an implant extrusion after surgery on the same day. There was no postoperative follow-up reported in 24 of the medical records, thus excluding them from the analysis of postoperative complications (Figure 4). The shortest documented follow-up period was at postoperative day 1 and the longest, 34 months. The average follow-up period was 365 days.

In the study sample, oculoplastic surgeons performed 40 surgeries and non-oculoplastic surgeons performed 77 surgeries. One patient's medical chart had no information available regarding the operating surgeon's

Table 2. Clinical indications and histopathologic diagnoses for enucleations, eviscerations, and exenteration procedures, Puerto Rico Medical Center, January 2015 – June 2020 (N = 118 eyes).

Clinical indication*	All cases N = 118	Enucleations n = 87	Eviscerations n = 22	Exenterations n = 9
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
Panophthalmitis	20 (17)	19 (22)	1 (5)	0
Endophthalmitis	22 (19)	20 (23)	2 (9)	0
Perforated corneal ulcer in a blind eye	16 (13)	7 (8)	9 (41)	0
Painful blind eye	19 (16)	15 (17)	4 (18)	0
Malignancy	13 (11)	4 (5)	0	9 (100)
Trauma (ruptured eye globe)	28 (24)	22 (25)	6 (27)	0
Histopathological diagnosis*				
Panophthalmitis	29 (25)	27 (31)	2 (9)	0
Endophthalmitis/ perforated corneal ulcer	33 (28)	23 (26)	10 (45)	0
Chronic inflammation, phthisis bulbi	18 (15)	15 (17)	3 (14)	0
Ruptured eyeglobe with hemorrhage	25 (21)	18 (21)	7 (32)	0
Malignant process				
Uveal/conjunctival melanoma	3 (2.5)	2 (2)	0	2 (22)
Squamous cell carcinoma/basal cell carcinoma	7 (6)	1 (1)	0	6 (67)
Other (adenoid cystic carcinoma, oncocytic neoplasm)	3 (2.5)	1 (1)	0	1 (11)

*P value < .05

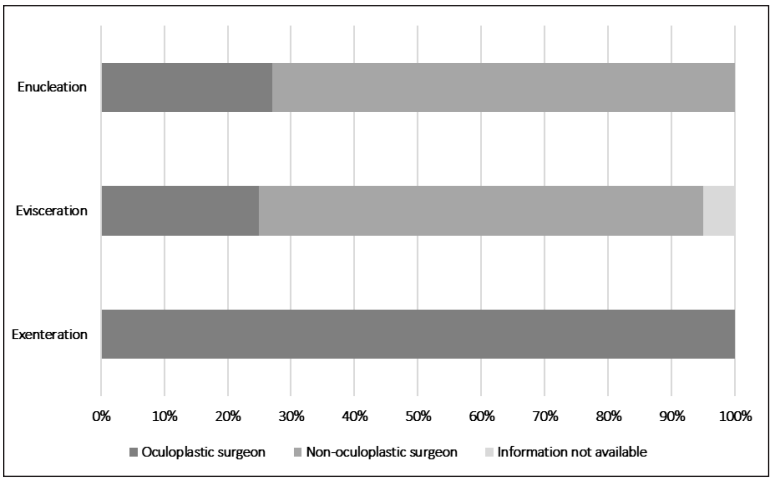

Figure 1. Percentages of eye-removal procedures performed by oculoplastic surgeons and non-oculoplastic surgeons, Puerto Rico Medical Center, January 2015 – June 2020 (N = 118 eyes).

subspecialty. The postoperative complication rates for surgical procedures performed by oculoplastic and non-oculoplastic surgeons were 10% and 13.32%, respectively (data not shown). However, the difference between these groups was not statistically significant (P = .771).

The complications encountered in the patients who underwent enucleation were implant extrusion (2, 2%), persistence of panophthalmitis (1,1%), periorbital cellulitis (1, 1%), phantom eye pain (1, 1%), conformer displacement (2, 2%), and fornix shortening or lid malposition (i.e., ectropion) (1, 1%). Of the 22 evisceration procedures, 1 was performed on a patient who had an extrusion of the implant and 1 on a patient who experienced conformer displacement. Of the 9 exenteration procedures, 3 had no complications up to postoperative year 1. Two patients had complications related to their exenteration at 3 months after surgery, namely an ethmoid fistula and the recurrence of a tumor, which was managed with Gamma Knife surgery. One patient died under circumstances unrelated to the exenteration, and 3 patients were lost to follow-up. Two deaths were observed in the 2-month postoperative period, both related to complications of systemic conditions and not as a consequence of their eye-removal surgery.

Discussion

Our study demonstrates that the prevalence of enucleation at our institution across all clinical indications for eye removal is higher than has been reported in the published literature for other, similar, institutions (2,11–13). The most frequent indication for enucleation and evisceration in our study was an infectious process, namely panophthalmitis, endophthalmitis, and/or perforated corneal ulcers in blind eyes, with inadequate response to medical management. Similar to a retrospective study of evisceration published by Arellano-Ganem et al, infectious etiologies are likely more prevalent in our cohort since at our institution the priority in trauma cases is to attempt repair with globe preservation (14). The greater prevalence of enucleation in cases of both panophthalmitis and endophthalmitis contrasts with what has been reported in other recently published literature, wherein evisceration has been reported to be preferred as it may decrease both the likelihood of spread of infection to orbital tissues (2).

In our study cohort, the prevalences of panophthalmitis and endophthalmitis were similar, and evisceration was the least frequent procedure performed. Since panophthalmitis involves the spread of infection to the surrounding orbital tissues, the surgeon preference for enucleation over evisceration in these cases could be justified. A survey of the practice patterns of a number of the members of the American Society of Ophthalmic Plastic and Reconstructive Surgery revealed that 59% of the surgeons surveyed preferred enucleation if there was orbital-tissue involvement, contrasting to 27% who would eviscerate, under the same conditions (15). Other reasons that enucleation appears to be the procedure favored by our faculty include the risk of sympathetic ophthalmia and the fear of implant extrusion when infected sclera is left behind, both of which sequelae are associated with evisceration (16). Similarly, surgeons may prefer to do a single procedure versus a staged procedure consisting of performing an evisceration without an implant (which would be placed in a later procedure), though evidence supports the efficacy of the multistage procedure (15,17–19).

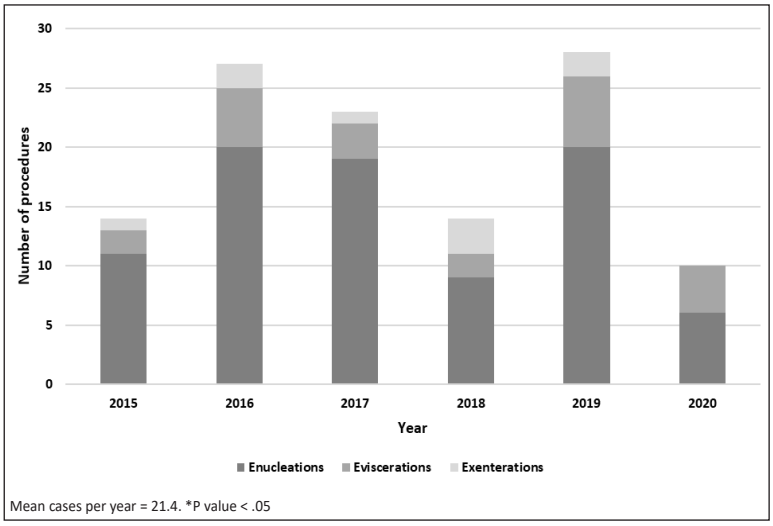

Figure 2. Enucleations, eviscerations, and exenterations per year, Puerto Rico Medical Center, January 2015 – June 2020 (N = 118 eyes).

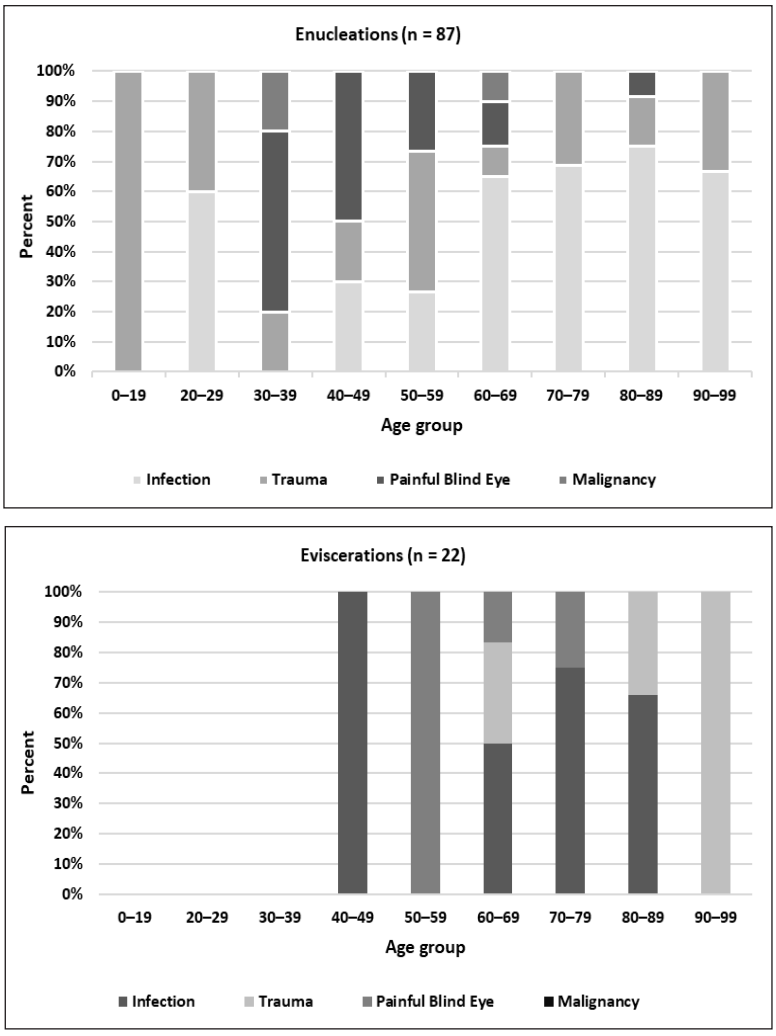

Figure 3. Clinical indications for enucleation and evisceration by age group, Puerto Rico Medical Center, January 2015 – June 2020.

An important consideration is that 25% of the enucleations and eviscerations undertaken in our study were performed by oculoplastics-trained physicians, and the remaining 75% were performed by other ophthalmology specialists; different training backgrounds may have influenced their particular practice patterns.

The second most prevalent cause for enucleation and evisceration in our cohort was trauma. A retrospective study evaluating the variables and outcomes of these procedures in cases of trauma found no trend that favored evisceration (5). In a study by Zheng et al, enucleations were performed mainly to prevent sympathetic ophthalmia in blind eyes that had undergone a ruptured globe repair, while eviscerations were done when primary globe repair was not achievable. This differs from what was done in our trauma population, for whom the decision to perform an enucleation was made primarily (intraoperatively) when globe repair was not feasible. However, multiple studies have reported an increase in the prevalence of evisceration over enucleation, which has been attributed to shorter operative times, better cosmetic outcomes in terms of implant motility, and fewer complications (2,4,7,11,20). At 0.03/100.000, the estimated incidence of sympathetic ophthalmia after intraocular surgery and trauma is almost negligible, which may also contribute to the favoring of evisceration over enucleation (11,20).

An important step prior to performing an ocular evisceration is to exclude the possibility of there being an intraocular tumor. While there has been a low prevalence of unexpected neoplasms in eviscerated specimens, Eagle et al suggest that this probability is higher than the risk of sympathetic uveitis (6,21). Therefore, in patients with an opaque media that precludes the direct visualization of the fundus, ophthalmic ultrasonography, orbital computed tomography, or magnetic resonance imaging should be performed. We should comment that in 27% of the eviscerations that were chronicled, we were not able to find any documentation of preoperative imaging. Nonetheless, in our cohort, no cases with neoplasms were identified on pathological analysis.

Postoperative complications were infrequent in our study group, at least in the first year after a given eye-removal procedure. There was no statistically significant difference in the incidences of postoperative complications between oculoplastic and non-oculoplastic surgeons. The most common postoperative occurrences were implant extrusion and conformer displacement. Implant extrusion was managed with an implant replacement in 2 patients. Another patient had an implant exchange with dermis-fat grafting. One patient was left without an implant and managed with ectropion repair and tarsorrhaphy. Lastly, 1 patient sought a second opinion at another institution. It should be noted that, at our institution, most orbital implants are non-porous silicone or acrylic spheres, which are used because of their lower cost. A review by Hui concluded that, in the presence of endophthalmitis, implants placed primarily in cases of enucleation and evisceration have acceptable retention rates and no difference in extrusion rates exists between porous and non-porous implants (17). Similarly, in cases of endophthalmitis or panophthalmitis, primary implant placement during evisceration has been reported to be feasible and with comparable outcomes to what is seen in those that are free of infection (18,22). Cases of conformer displacement were managed effectively by the placement of a temporary tarsorrhaphy. Two patients had a persistence of an orbital inflammatory process: One had a history of panophthalmitis and the other had a history of trauma; in both cases, an adequate resolution was achieved with systemic antibiotic therapy. Interestingly, 1 patient had a persistence of postoperative pain

after enucleation (phantom eye pain), which has been described as having a prevalence of 23% among patients after eye removal (23). However, the reliability of our patient's complaints is uncertain due to the presence of an underlying psychiatric illness.

Exenteration procedures were included in our data analysis and represented a limited sample size compared to the other 2 eye-removal procedures. A highly disfiguring procedure, exenteration provides local disease control but does not necessarily confers an overall survival benefit (24). Advances in targeted immunotherapies for locally invasive orbital malignancies may eventually displace exenteration as a primary procedure. At our institution, indications for exenterations were invasive orbital malignancies originating from the eyelid, with SCC being the most prevalent histopathological diagnosis in most of the age groups. This contrasts with the known prevalence of BCC as the most frequent malignant skin tumor invading the orbit (9,10). A possible explanation for this difference is that our subset of patients may have more advanced disease at the time of the diagnosis of SCC, as it is a more locally invasive disease compared to BCC. Postoperative complications were recorded for 2 patients: One patient developed an ethmoid fistula 3 months postoperatively and the other developed a tumor recurrence in a similar timeframe; this latter was managed with Gamma Knife surgery.

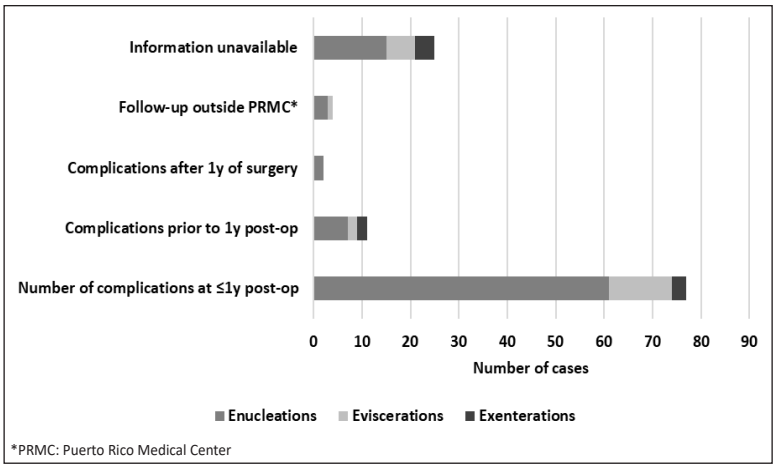

Figure 4. Distribution of cases with and without complications within 1 year of or 1 year after having had a surgical intervention. Puerto Rico Medical Center, January 2015 – June 2020.

Our statistical analysis and our review of the literature suggest that in our patient population, a significant number of patients who undergo enucleation are candidates for evisceration, with the adequate preoperative evaluation. Such patients would benefit from shorter postoperative recovery times and better cosmesis. Additionally, in adequate cases, evisceration can be done with retrobulbar anesthesia, thus decreasing the risks associated with general anesthesia. We, however, recognize that the decision to enucleate versus eviscerate an eye rests on a thorough discussion of the risks versus the benefits between the patient and surgeon.

One of the limitations of our study is the inability to generalize the results to other populations, as the results reported herein correspond to a population receiving supratertiary care at an academic center in Puerto Rico. We anticipate that improved access to information from medical records, which will be made possible with the complete transition to electronic health records in upcoming years, will allow us to re-visit this subject in the future, with more accurate data available for analysis.

To our knowledge, this is the first descriptive report of the eye-removal procedures performed at the main academic center specializing in, among other things, ophthalmology in Puerto Rico. It is hoped that our study makes clear the need for further studies on and modifications in surgical trends that would favor evisceration over enucleation.

Resumen

Objetivos: Proporcionar un análisis descriptivo de las indicaciones, complicaciones intraoperatorias y postoperatorias de enucleaciones, evisceraciones oculares, y exenteraciones orbitales realizadas en la única institución académica que brinda cuidado oftalmológico supra-terciario en Puerto Rico. Métodos: Se realizó una revisión retrospectiva de los registros médicos de pacientes sometidos a enucleaciones, evisceraciones o exenteraciones entre enero de 2015 y junio de 2020. Los datos fueron analizados para generar un perfil descriptivo de características demográficas de los pacientes, indicaciones clínicas, complicaciones quirúrgicas y diagnóstico histopatológico según cada procedimiento. Resultados: Se removió un total de 118 ojos mediante enucleación, evisceración o exenteración durante el período de estudio. La edad media de los pacientes fue de 64 ± 17.5 años y el 63.8% fueron varones. El procedimiento de extirpación del ojo realizado con mayor frecuencia fue la enucleación (73.7%), seguido por evisceración (18.6%) y exenteración (7.6%). Las principales indicaciones clínicas de las enucleaciones y evisceraciones fueron procesos infecciosos, principalmente panoftalmitis, endoftalmitis o úlceras corneales perforadas que fracasaron a tratamiento médico. En exenteraciones, el diagnóstico clínico e histopatológico más común fue el carcinoma espinocelular. Las complicaciones postoperatorias en nuestro cohorte de pacientes fueron mínimas. Conclusiones: En nuestra institución predominan los procedimientos de enucleación sobre los de evisceración. Los estudios retrospectivos publicados en los últimos años han mostrado un mayor porcentaje de evisceraciones en comparación al nuestro. Dado que éste es el primer estudio de esta naturaleza en nuestra institución, puede fomentar una reevaluación de las indicaciones de evisceración versus enucleación en nuestra población de pacientes.

Acknowledgments

This study was supported by the UPR School of Medicine Endowed Health Services Research Center, with grants 5S21MD000242 and 5S21MD000138 from the National Center for Minority Health and Health Disparities of the National Institutes of Health (NCMHD-NIH). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NCMHD or the NIH. We thank Dr. Enid Garcia for her contribution to the accuracy of the statistical data analysis.

References

1. Ababneh OH, AboTaleb EA, Abu Ameerh MA, Yousef YA. Enucleation and evisceration at a tertiary care hospital in a developing country. BMC Ophthalmol. 2015;15:120. Published 2015 Sep 11. doi:10.1186/s12886-015-0108-x
2. Roelofs KA, Aghazadeh H, Cheema M, Weis E, Badilla J. Enucleation and evisceration: an analysis of indications, histopathological findings, and surgical trends over 23 years at a tertiary care hospital in western Canada. Can J Ophthalmol. 2019;54(1):106-110. doi:10.1016/j.jcjo.2018.02.026
3. Brackup AB, Carter KD, Nerad JA, Folk JC, Pulido JS. Long-term follow-up of severely injured eyes following globe rupture. Ophthalmic Plast Reconstr Surg. 1991;7(3):194-197. doi:10.1097/00002341-199109000-00008
4. du Toit N, Motala MI, Richards J, Murray AD, Maitra S. The risk of sympathetic ophthalmia following evisceration for penetrating eye injuries at Groote Schuur Hospital. Br J Ophthalmol. 2008;92(1):61-63. doi:10.1136/bjo.2007.120600
5. Zheng C, Wu AY. Enucleation versus evisceration in ocular trauma: a retrospective review and study of current literature. Orbit. 2013;32(6):356-361. doi:10.3109/01676830.2013.764452
6. Eagle RC Jr, Grossniklaus HE, Syed N, Hogan RN, Lloyd WC 3rd, Folberg R. Inadvertent evisceration of eyes containing uveal melanoma. Arch Ophthalmol. 2009;127(2):141-145. doi:10.1001/archophthalmol.2008.543
7. Nakra T, Simon GJ, Douglas RS, Schwarcz RM, McCann JD, Goldberg RA. Comparing outcomes of enucleation and evisceration. Ophthalmology. 2006;113(12):2270-2275. doi:10.1016/j.ophtha.2006.06.021
8. Shah RD, Singa RM, Aakalu VK, Setabutr P. Evisceration and enucleation: a national survey of practice patterns in the United States. Ophthalmic Surg Lasers Imaging. 2012;43(5):425-430. doi:10.3928/15428877-20120725-01
9. Kiratli H, Koç İ. Orbital exenteration: Institutional review of evolving trends in indications and rehabilitation techniques. Orbit. 2018;37(3):179-186. doi:10.1080/01676830.2017.1383466
10. Sagili S, Malhotra R. Orbital exenteration: indications, techniques and complications. Expert Rev Ophthalmol. 2016;11(3):201-213. https://doi.org/10.1080/17469899.2016.1186544
11. Yousuf SJ, Jones LS, Kidwell ED Jr. Enucleation and evisceration: 20 years of experience. Orbit. 2012;31(4):211-215. doi:10.3109/01676830.2011.639477
12. Chan SWS, Khattak S, Yücel N, Gupta N, Yücel YH. A decade of surgical eye removals in Ontario: a clinical-pathological study. Can J Ophthalmol. 2017;52(5):486-493. doi:10.1016/j.jcjo.2017.02.025
13. Su GW, Yen MT. Current trends in managing the anophthalmic socket after primary enucleation and evisceration. Ophthalmic Plast Reconstr Surg. 2004;20(4):274-280. doi:10.1097/01.iop.0000129528.16938.1e
14. Arellano-Ganem MG, Zuazo F, González M, et al. Evisceration surgery in a highly specialized center in Mexico: A retrospective study of 7 years of experience. Cirugía de evisceración ocular en un centro de alta especialidad en México: estudio retrospectivo de 7 años de experiencia. Arch Soc Esp Oftalmol. 2017;92(2):58-62. doi:10.1016/j.oftal.2016.07.009
15. Fu R, Childs J, Nunery W, Timoney P. Surgical preferences in the management of recalcitrant endophthalmitis. Orbit. 2018;37(5):315-320. doi:10.1080/01676830.2017.1423340
16. Green WR, Maumenee AE, Sanders TE, Smith ME. Sympathetic uveitis following evisceration. Trans Am Acad Ophthalmol Otolaryngol. 1972;76(3):625-644.
17. Hui JI. Outcomes of orbital implants after evisceration and enucleation in patients with endophthalmitis. Curr Opin Ophthalmol. 2010;21(5):375-379. doi:10.1097/ICU.0b013e32833b7a56
18. Tripathy D, Rath S. Evisceration with Primary Orbital Implant in Fulminant Endophthalmitis/Panophthalmitis. Orbit. 2015;34(5):279-283. doi:10.3109/01676830.2015.1078366
19. Ozgur OR, Akcay L, Dogan OK. Primary implant placement with evisceration in patients with endophthalmitis. Am J Ophthalmol. 2007;143(5):902-904. doi:10.1016/j.ajo.2006.11.029
20. Holmes CJ, McLaughlin A, Farooq T, Awad J, Murray A, Scott R. Outcomes of ocular evisceration and enucleation in the British Armed Forces from Iraq and Afghanistan. Eye (Lond). 2019;33(11):1748-1755. doi:10.1038/s41433-019-0480-5
21. Novais EA, Fernandes BF, Pacheco LF, et al. A histopathologic review of undiagnosed neoplasms in 205 evisceration specimens. Ophthalmic Plast Reconstr Surg. 2012;28(5):331-334. doi:10.1097/IOP.0b013e31825ca5d8
22. Chiu SJ, Tan JHY, Currie ZI. To implant or not to implant: emergency orbital eviscerations with primary orbital implants. Eye (Lond). 2021;35(11):3077-3086. doi:10.1038/s41433-020-01382-0
23. Rasmussen ML. The eye amputated - consequences of eye amputation with emphasis on clinical aspects, phantom eye syndrome and quality of life. Acta Ophthalmol. 2010;88 Thesis 2:1-26. doi:10.1111/j.1755-3768.2010.02039.x
24. Martel A, Hamedani M, Lagier J, Bertolotto C, Gastaud L, Poissonnet G. L'exentération orbitaire a-t-elle encore sa place en 2019? [Does orbital exenteration still has a place in 2019?]. J Fr Ophtalmol. 2020;43(2):152-174. doi:10.1016/j.jfo.2019.04.021