

Emergency Department Ophthalmology Consultations in a Tertiary Care Hospital

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Abstract

Objective The main objective of this article is to characterize ophthalmology consultations in the emergency department (ED) of a tertiary care hospital and identify specific ways to modify the curriculum for ophthalmology and emergency medicine residency programs to train residents to effectively manage eye-related consultations.

Design This is a retrospective chart review study of ED encounters between January 1, 2008 and January 1, 2017 during which ophthalmology was consulted.

Setting Single-center urban tertiary care center.

Participants All adult patients who were seen by the ophthalmology consultation service in the ED during the study time period.

Main Outcome Measured We identified the reason for and timing of ophthalmology consultation; diagnoses made in the ED and follow-up ophthalmology clinic visit; procedures resulting from consultation; and communication with a senior resident, fellow, or attending.

Results We identified 3,583 consecutive ED encounters with an ophthalmology consultation over a 9-year period. About 51.1% of patients were female and mean age of patients was 49 years. Blurry vision/vision loss was the most common reason for consultation (24.8%) and posterior vitreous detachment was the most common diagnosis made in the ED by the ophthalmology team (11.0%). Of the patients with documented follow-up ophthalmology clinic visits, 96.7% of diagnoses made at the first ophthalmology clinic visit were the same as those determined in the ED. About 12.7% of visits resulted in a procedure with the most common being eyelid laceration repairs, pars plana vitrectomy, and laser retinopexy. Overall, 40.4% of visits required communication with a senior resident, fellow, or attending. The frequency of residents seeking assistance from more senior ophthalmologists decreased over the course of the academic year ($p < 0.0001$).

Conclusions This study provides data that ophthalmology residency training programs can use to more effectively prepare residents for consultations in the ED. Furthermore, identifying the reasons for consultation and subsequent diagnoses can guide the education of emergency medicine physicians to improve their ability to diagnose and triage ophthalmologic presentations.

Keywords

- ▶ ophthalmology consults
- ▶ residency
- ▶ emergency department

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Eye-related visits comprised 1.5% of all emergency department (ED) visits in the United States in 2010.¹ Channa et al found that 41.2% of eye-related ED visits were diagnosed as urgent conditions,² whereas Stagg et al deemed 22.6% of eye-related ED visits as urgent.³ The most common urgent ophthalmologic conditions included corneal abrasions, eyelid lacerations, external foreign bodies, open globes, contusion, and orbital fractures. One longitudinal study from 2007 to 2012 found that ophthalmology consultations accounted for 1.3% (8,179/6,28,259) of all consultations in the ED in a single large teaching hospital.⁴ Consultation services are an important component of any ophthalmology residency training program and the ED is one of the main settings of consultation. In this study, we set out to evaluate the nature of ophthalmology consultations in the ED and make recommendations based on these findings to optimize training and curricula for emergency medicine and ophthalmology residents.

Methods

This is a retrospective study of ED ophthalmology consultations at a tertiary care hospital between January 1, 2008 and January 1, 2017. The study protocol was approved by the Institutional Review Board of Northwestern University and this research followed the tenets of the Declaration of Helsinki. Data was extracted from the Northwestern Medicine Enterprise Database Warehouse (NMEDW), an integrated database of Northwestern Medicine's electronic health records.

Northwestern Memorial Hospital (NMH) is an 894-bed tertiary care hospital serving the city of Chicago as a level one trauma center including an ED and serves as the primary teaching hospital for the Northwestern University Feinberg School of Medicine. At this institution, ophthalmology consultations are performed by junior residents with the opportunity to call a senior resident, fellow, or attending ophthalmologist on-call. The NMEDW was queried for all patients 18 years of age or older with encounters in the NMH ED that included an ophthalmology consultation designated by an ophthalmology consultation note.

Extracted data from each of these encounters included the ED note, ophthalmology consultation note, procedure notes, and imaging reports. The NMEDW was then queried for the first outpatient ambulatory clinic follow-up appointment in the ophthalmology department within 3 months of the ED visit. We analyzed the reason for consultation by the ED physicians, the diagnosis made by the ophthalmology service (known as diagnosis made in the ED), and the diagnosis made at the first outpatient ophthalmology visit. After-hour consultations were defined as those received during weekdays from 5 PM to 8 AM and weekends.

Encounters were excluded if there was not a completed ED ophthalmology consultation note. A single author (MJH) evaluated all outpatient visits with discordant initial and follow-up diagnoses to verify that the outpatient visits were follow-up due to the ED visit. The initial and follow-up diagnoses were then compared with determine if they were the same or discordant.

A chi-square test of independence (categorical variables) was performed to examine the change in number of con-

sultations over the academic year as well as the change in accuracy of diagnoses made in the ED compared with follow-up over the academic year. The academic year was divided into quarters beginning with July through September to allow for comparison. Degrees of freedom were defined as $(r-1)(c-1)$, where r = number of rows and c = number of columns. Significance was set as $p < 0.05$.

Results

A total of 3,583 consecutive patient encounters in the NMH ED with an ophthalmology consultation were identified over the 9-year period. About 51.1% of patients were female (1,831/3,583). The mean age of patients was 48.9 ± 17.7 and the range was from 18 to 98 years old (►Table 1). There were 36 unique reasons for consultation categories identified in the ED. The most common reasons for consultation were blurry vision/vision loss (24.8%, 889/3,583), eye pain (17.0%, 609/3,583), and flashes/floaters (16.7%, 598/3,583) (►Table 2). There were 63 unique diagnosis categories identified from the consultations in the ED. The most common diagnoses made in the ED included posterior vitreous detachment (PVD) (11.0%, 394/3,583), orbital fracture (9.2%, 330/3,583), and normal eye examination (7.5%, 269/3,583) (►Table 2). About 50.0% of the consultations occurred after-hours (1,792/3,583).

Senior Assistance

A senior resident, fellow, or attending was contacted regarding the examination and/or plan by the junior resident for 40.4% of all consultations (1,448/3,583). In the first 3 months of the academic year, the rate of the junior resident on-call consulting with a senior resident, fellow or attending was 56.2% (545/969). This rate decreased each consecutive quarter and was 26.7% during the last quarter of the academic year (237/889). The difference in these rates was statistically significant ($p < 0.0001$) (►Table 3). There was no significant change in the total number consultations between any of the quarters. The most common diagnoses made in the ED that involved a more senior ophthalmologist were retinal detachment (82%, 96/117), retinal tear (81%, 27/33), and angle closure glaucoma (76%, 16/21) (►Table 4).

Follow-Up

About 86.4% of patients had follow-up recommended at the end of the ED encounter. About 63.8% of patients who were

Table 1 Patient demographics

| Gender | Number | Total (%) |
|--------|--------|-----------|
| Female | 1,831 | 51.1 |
| Male | 1,752 | 48.9 |
| Age | | |
| <30 | 720 | 20.1 |
| 30–50 | 1,136 | 31.7 |
| 51–65 | 1,045 | 29.2 |
| 66–80 | 525 | 14.7 |
| 81+ | 157 | 4.4 |

Table 2 Common reasons for ophthalmology consultation and diagnosis in the emergency department

| Reason for consultation | Number (%) |
|---------------------------|-------------|
| Blurry vision/vision loss | 887 (24.8) |
| Eye pain | 609 (17.0) |
| Flashes/floaters | 597(16.7) |
| Blunt trauma | 392 (10.94) |
| Orbital fracture | 243 (6.78) |
| Red eye | 198 (5.5) |
| Rule out zoster | 104 (2.9) |
| Papilledema | 94 (2.6) |
| Foreign body | 75 (2.1) |
| Corneal abrasion/ulcer | 63 (2.8) |
| Diagnosis in the ED | |
| Vitreous detachment | 393 (11.0) |
| Orbital fracture | 329 (9.2) |
| Normal eye examination | 268 (7.5) |
| Stable eye examination | 236 (6.6) |
| Corneal abrasion | 196 (5.5) |
| Vitreous hemorrhage | 119 (3.3) |
| Anterior uveitis | 117 (3.3) |
| Retinal detachment | 117 (3.3) |
| Corneal ulcer | 114 (3.2) |
| Eyelid injury | 87 (2.4) |

Abbreviation: ED, emergency department.

Table 3 Consultations requiring assistance from senior resident, fellow, or attending by quarter

| Months | Number requiring backup (%) | Total consultations (%) |
|------------|-----------------------------|-------------------------|
| July-Sept | 545 (37.6) | 969 (56.2) |
| Oct-Dec | 414 (28.6) | 958 (43.2) |
| Jan-March | 253 (17.5) | 767 (33.0) |
| April-June | 237 (16.4) | 889 (26.7) |

given this recommendation presented for follow-up at NMH within the 3-month time period. About 96.2% (1,899/1,974) of the diagnoses made during these follow-up encounters were the same as the initial diagnosis made in the ED (► **Table 5**) and there was no change in rate of concordant diagnoses over the course of the year ($p = 0.838$). There was no significant difference in the rate of concordance in consultations performed by a junior resident alone compared with those with input from a senior resident, fellow, or attending ($p = 0.866$). In 75/1,974 encounters, the follow-up diagnoses in the ophthalmology clinic were discordant with the diagnoses by the consulting ophthalmology team in the ED. The most common discordant follow-up diagnoses were retinal tear (18.7%, 14/75), anterior uveitis (10.7%, 8/75), and retinal detachment (9.3%, 7/75) (► **Table 6**). Notably, scleritis was

Table 4 Most common diagnoses requiring assistance in the ED

| Diagnosis in the ED | Number of total diagnoses (%) | Number of those requiring assistance (%) |
|--------------------------------------|-------------------------------|--|
| Retinal detachment | 117 (3.3) | 96 (82.1) |
| Open globe | 41 (1.1) | 41 (100) |
| Retinal tear | 33 (0.9) | 27 (81.8) |
| Acute angle closure glaucoma | 21 (0.6) | 16 (76.2) |
| Endophthalmitis | 15 (0.4) | 11 (73.3) |
| Neovascular glaucoma | 12 (0.3) | 12 (100) |
| Giant cell arteritis | 12 (0.3) | 9 (75.0) |
| Conjunctival laceration | 10 (0.3) | 8 (80.0) |
| Anterior uveitis | 6 (0.2) | 5 (83.3) |
| Secondary glaucoma (non-neovascular) | 4 (0.1) | 4 (100) |

Abbreviation: ED, emergency department.

Table 5 Accurate diagnosis in the emergency department compared with follow-up outpatient visit

| Month | Correct diagnosis compared with follow-up | Number of follow-up visits | Correct diagnoses (%) |
|--------------|---|----------------------------|-----------------------|
| July-Sept | 514 | 531 | 96.8 |
| Oct-Dec | 506 | 528 | 95.8 |
| Jan-March | 412 | 428 | 96.2 |
| April-June | 467 | 487 | 95.9 |
| Total | 1635 | 1974 | 96.2 |

either an initial or follow-up diagnosis for nine of these discordant cases.

Discordant Diagnoses

Given this number of patients with discordant initial and follow-up diagnoses, we further evaluated the most common discordant follow-up diagnoses (► **Table 6**). Of the 14 patients who had a discordant follow-up diagnosis of retinal tear, five had an initial diagnosis of PVD, three were initially diagnosed with vitreous hemorrhage, and two were initially diagnosed with hemorrhagic PVD. Two of the remaining three patients were initially presenting for evaluation after trauma with normal dilated posterior eye examinations noted. There were seven patients diagnosed with retinal detachments at their follow-up visit. The most common corresponding ED diagnoses were two with PVD, two with vitreous hemorrhage, two with stable eye examinations, and one with a retinal tear. Of the eight patients who had a follow-up diagnosis of anterior uveitis, three were initially diagnosed with scleritis and two with keratitis.

Consultations Leading to Procedures

Overall, 461 of the 3,583 patients (12.7%) had some type of procedure done by the ophthalmology service (► **Table 5**). Of

Table 6 Most common discordant initial and follow-up diagnoses

| Diagnosis in the ED | Diagnosis at follow-up visit | Number |
|---|-------------------------------|--------|
| Posterior vitreous detachment | Retinal tear | 5 |
| Vitreous hemorrhage | Retinal tear | 3 |
| Hemorrhagic posterior vitreous detachment | Retinal tear | 2 |
| Normal eye examination (post-trauma) | Retinal tear | 2 |
| Traumatic iritis | Retinal tear | 1 |
| Scleritis | Anterior uveitis | 3 |
| Keratitis | Anterior uveitis | 2 |
| Elevated intraocular pressure (unknown cause) | Anterior uveitis | 1 |
| Primary open angle glaucoma | Anterior uveitis | 1 |
| Exposed suture | Anterior uveitis | 1 |
| Posterior vitreous detachment | Retinal detachment | 2 |
| Vitreous hemorrhage | Retinal detachment | 2 |
| Stable eye examination (history of BRAO) | Retinal detachment | 1 |
| Normal eye examination | Retinal detachment | 1 |
| Retinal tear | Retinal detachment | 1 |
| Episcleritis | Scleritis | 2 |
| Carotid cavernous fistula | Scleritis | 1 |
| Elevated intraocular pressure (unknown cause) | Scleritis | 1 |
| Vitreous hemorrhage | Posterior vitreous detachment | 1 |
| Vitreous syneresis | Posterior vitreous detachment | 1 |
| Normal eye examination | Posterior vitreous detachment | 1 |

Abbreviations: BRAO, branch retinal artery occlusion; ED, emergency department.

these procedures, 188 were performed in the operating room (40.8%), 164 in the ED (35.6%), 109 in the outpatient clinic (23.6%), and 4 in the inpatient setting at the bedside (0.86%). The most common procedures done overall were lid laceration repairs (21.5%), pars plana vitrectomy (14.6%), and laser retinopexy (12.6%) (–Table 7). In our study, 329 patients were diagnosed with an orbital fracture and 73 (22.2%) of those patients underwent a repair procedure, most often by services other than ophthalmology.

Discussion

Subspecialty consultation provides timely, expert recommendations and treatment, as well as learning opportunities for both consulting and consulted trainees. The most common

Table 7 Most common procedures by the ophthalmology service in the ED, OR, and clinic

| ED (164) | OR (188) | Clinic (109) |
|------------------------------|---------------------------|-------------------------|
| Eyelid repair—91 | Pars plana vitrectomy—68 | Laser retinopexy—59 |
| Foreign body removal—34 | Open globe—41 | Laser iridotomy—14 |
| Vitreous tap and injection—8 | Eyelid repair—11 | Foreign body removal—5 |
| Canthotomy cantholysis—4 | Cataract surgery—10 | Peripheral retinopexy—5 |
| Corneal debridement—3 | Orbital fracture repair—7 | Suture removal—2 |

Abbreviations: ED, emergency department; OR, operating room.

reasons for consultation were blurry vision/vision loss, eye pain, and flashes/floaters (–Table 2). The most common diagnoses made in the ED included PVD, orbital fracture, and normal eye examination (–Table 2). We recommend early training of ophthalmology residents in the examination techniques required to evaluate and diagnose these common problems, and that appropriate equipment to be available in the ED to perform an examination. We found a significant decrease in the rate of assistance sought by junior ophthalmology residents from the first 3 months compared with the last 3 months of the academic year (37.6%, 545/969 vs 16.4%, 237/889).

Consultations Leading to Procedures

This study also provides information about the types of procedures that originate in the ED with 12.7% of all consultations leading to procedures (461/3583). Ophthalmology residents can expect to perform eyelid laceration repairs frequently (2.54%, 91/3583) when they receive a consultation from the ED, as well as foreign body removals, vitreous tap and injections for endophthalmitis, laser retinopexies, and laser iridotomies. Thus, an early focus should be placed on teaching ophthalmology residents how to recognize the need for and how to perform these procedures under supervision. Other common procedure types (pars plana vitrectomy, repair of open globe) require a fellow or an attending. However, ophthalmology residents should be trained to identify the diagnoses prompting these procedures to appropriately call for backup in a timely manner.

Diagnostic Accuracy

The rate of accurate diagnosis in the ED by the consulting ophthalmology resident compared with the final diagnosis made by the attending ophthalmologist at the first follow-up clinic visit was consistent throughout the academic year (98.3%, 952/969, July through September vs 97.8%, 869/889, April through June). Meanwhile, the rate of the junior resident requesting staffing of consultations with a senior resident, fellow, or attending ophthalmologist decreased significantly over the academic year (37.6%, 545/969, July through September vs 16.4%, 237/889, April through June). This is likely a reflection of the junior residents becoming more knowledgeable and proficient as the year progresses. The consultations that required the junior

ophthalmology resident to seek assistance were more likely to be rarer diagnoses and those requiring a procedure. However, the most common discordant initial and follow-up diagnoses (retinal tears, anterior uveitis, and retinal detachments) were among the most common diagnoses overall. We found that the rate of accuracy did not improve when looking only at those encounters that the junior resident sought assistance.

Educational Aims

Many of our findings provide guidance to design eye-related curricula for medical students, emergency medicine residents, and ophthalmology residents, particularly in the areas of evaluation, diagnosis, and performance of procedures in the setting of ED consultation. The disorders listed in ▶Table 2 suggest high yield topics to focus on the diagnosis and management of these common reasons for consultation and final diagnoses. Interpretation of our findings would also suggest emergency medicine residents being comfortable with the anterior segment slit lamp examination, including differentiating corneal abrasion, corneal ulcers, and anterior uveitis, given these being in the top 10 most common final diagnoses (▶Table 2). Ophthalmology residents performing consultations should be able to recognize, and in many cases, perform procedures either in the ED, the ophthalmology clinic, or operating room. The most common procedures in the ED were found to be eyelid repair, foreign body removal, and vitreous tap and injections for endophthalmitis; all of which are skills that should be taught early in an ophthalmology residency training program. Common procedures that were performed in the ophthalmology clinic were laser retinopexy and iridotomy. The most common surgery performed as a result of ED consultation was pars plana vitrectomy, followed by repair of open globe. Residency programs should ensure that residents performing ED consultations have a thorough knowledge of the examination skills and surgical indications for conditions requiring these procedures.

Given our findings of discordant follow-up diagnoses, a high level of suspicion should be maintained when making the diagnosis of PVD or vitreous hemorrhage, though most of these diagnoses were accurate. Furthermore, these diagnoses should prompt good follow-up and thorough counseling of patients on warning signs of an occult or subsequent retinal tear. Of note, our rate of retinal tears diagnosed only at the follow-up visit after initial diagnosis of PVD in the ED was 1.78% (7/393). The published rate of spontaneous retinal tear after initial diagnosis of PVD by attending ophthalmologists is 1.8% (range, 0.9–3.2%).⁵ This rate is similar to our discordant rate, suggesting many of the seven discordant diagnosed retinal tears represent the natural history of a small percentage of patients with PVD developing retinal tears.

This study has important limitations. Patients following up with ophthalmologists outside of our institution lowered the amount of follow-up ophthalmology clinic notes that are available for this study. However, a similar follow-up rate of 60.0% (compared with 62.8% at our institution) from eye-related ED visits was found in a prior study.⁶ Other studies have noted even lower follow-up rates (43.2%) and found that lack of insurance or lack of visual symptoms correlated with

poor rates of follow-up visits.⁷ Additionally, changes in the classification of consultation notes and ED encounters since the onset of EMR may have led to some missed patients. However, we worked closely with the NWEDW informatics analysts to collect as many patient encounters as possible.

Identifying the most common diagnoses for eye-related ED visits can be helpful to guide the education of both emergency medicine and ophthalmology trainees. By focusing on teaching common presentations earlier in the course of training, ophthalmology residents will be better prepared to handle these consultations. Furthermore, emergency medicine residents can be similarly prepared to triage and treat conditions with less reliance on the ophthalmology consultation service. Finally, using this information, medical schools can tailor their ophthalmology curricula to focus on diagnosis and management of the common ophthalmologic disorders seen in the ED.

Note

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Authors' Contributions

Authors M.J.H., S.K., D.G., S.A., S.E.E., P.J.B. had full access to all the data in the study. M.J.H. and S.K. take responsibility for the integrity of the data and the accuracy of the data analysis. P.J.B. made significant contribution in writing and editing.

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Conflict of Interest

None declared.

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