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Acute ocular chemical injury: a descriptive assessment and management review at St. John Eye Hospital, Jerusalem, Palestine

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ABSTRACT

BACKGROUND: The purpose of the study was to assess caregivers' compliance with the management protocol for chemical injury at St. John Eye Hospital, Jerusalem.

MATERIAL AND METHODS: Charts of all new chemical injury patients who presented to St. John Eye Hospital, Jerusalem, between January and December 2019 were retrospectively reviewed. Data categories collected included: Presentation, age, sex, injury, irrigation, lids, visual acuity, slit-lamp examination (SLE), management plan, and medications given. Data were stored and analysed using Excel.

RESULTS: Patients' presentation date and time, sex, and age were recorded in over 90% of cases. The mechanism of injury and type of offending chemical were recorded in 65% of cases. The irrigating solution was identified in 50% of cases. Corrected visual acuity was recorded in both eyes in almost 50% of cases. Limbal ischemia was documented in 45% of cases, and intraocular pressure (IOP) was recorded in 25%. The management plan and explanation of the condition to patients were documented in less than 50% of cases. Antibiotics and steroids (drops/ointment) were prescribed in 92.5% of cases.

CONCLUSIONS: The results of this study reveal that our documentation needs improvement for several parameters. Several recommendations were formulated:

1. Emphasize to caregivers that irrigation must be done first.
2. Corrected visual acuity should be attempted for both eyes in all cases, and reasons for not recording it should be documented.
3. It is important to document and record limbus details, iris details, and IOP in all cases.

KEY WORDS: chemical injury; protocol; assessment, management, Palestine

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INTRODUCTION

Alkali or acid chemical injury of the conjunctiva and cornea is a severe ophthalmic emergency and needs immediate attention. Chemical injuries can cause extensive damage to the anterior segment of the eye and lead to visual loss and deformity. The severity of chemical eye damage is related to the type of chemical, the volume and concentration

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(pH) of the solution, and the duration of chemical exposure [1]. This potentially blinding condition needs early detection and treatment to secure the best possible outcome.

Immediate irrigation is of utmost importance after chemical or thermal burns until the pH of the ocular surface is normalized [2–4].

A complete ophthalmic examination (which includes visual acuity) follows irrigation and is used to evaluate the extent and depth of injury. At St. John Eye Hospital (SJEH), we use the Roper-Hall classification [5], which is based on the degree of corneal involvement and limbal ischemia.

During the initial examination, the palpebral fissures should be assessed, and the fornices should be cleaned. Trapped particulate matter can cause permanent damage, even with irrigation. The intraocular pressure (IOP) should also be documented, as alkali injuries have been found to cause acute and chronic elevation of IOP [6].

Most authorities recommend a graded approach depending on the severity of the injury. Mild burns (Roper-Hall grade I and II) respond well to medical treatments, which include topical antibiotic ointment, topical cycloplegics, artificial tears, and steroid drops. In more severe burns, more intensive medical therapies and surgery is necessary [7].

According to McCulley, the clinical course of ocular chemical injury can be classified into four phases: immediate, acute, early reparative, and late reparative [8].

The immediate management protocol adopted at SJEH, which reflects the protocols published by the American Academy of Ophthalmology [9] and Royal College of Ophthalmologists [10], is as follows (done for both eyes):

1 — topical anesthesia;
2 — lid retraction using hooks or eye retractors (Desmarres);
3 — irrigation with at least 1 L of saline;
4 — check pH regularly with universal indicator paper until a pH of 7.0 is achieved;
5 — document age, sex, patient's presenting date and time, attending caregiver presenting time, injury (which eye), mechanism, place and time of injury, offending chemical, irrigating solution type, amount and duration of irrigation, and pH;
6 — perform eyelid eversion and double eversion and remove the offending material;
7 — perform debridement;
8 — document lid eversion and debridement. The attending physician must sign the examination sheet.
9 — take visual acuity (VA) for both eyes (presenting and corrected using pinhole). Document VA for both eyes and reason for not measuring VA. The attending caregiver must sign the examination sheet;
10 — perform a slit-lamp examination (SLE) and document degree of corneal, conjunctival, limbal involvement, intraocular pressure, lid injuries, and lens status. Attending physicians must sign the examination sheet;
11 — document the grade of injury according to Roper-Hall (modified Hughes) classification, explanation of the condition to the patient, plan of action, and follow-up. The attending physician must sign the examination sheet.
12 — document treatment prescribed (according to the type of the offending agent (acid or alkali) and grade of injury. Document the advice given to the patient.

The purpose of the study was to determine whether the procedures implemented for chemical injury patients attending St. John Eye Hospital (SJEH) by our caregivers and physicians during the immediate phase follow accepted standards and protocol and whether those procedures were documented. Data collection included: immediate management, injury, irrigation, debridement, visual acuity, SLE, management and medication, proper documentation of all procedures done, and signatures. Figure 1 shows the chemical injury protocol adopted by the SJEH governance committee and is placed in all the hospital clinics. All practising ophthalmologists and caregivers at the hospital are encouraged to follow the protocol for all chemical injury patients.

MATERIAL AND METHODS

Design

A cross-sectional descriptive observational design was used to evaluate compliance with chemical injury protocol at SJEH, Jerusalem, Palestine.

The charts of all new chemical injury patients who presented to the Emergency Department at SJEH, Palestine, between January and December 2019 were retrospectively reviewed. The total number seen was 40 patients. Ethical approval for the study was obtained from SJEH Ethics Committee. The confidentiality of the study was maintained

CHEMICAL INJURY PROTOCOL

Ophthalmic Chemical injury is an ophthalmic EMERGENCY.
Almost any chemical can cause ocular irritation; serious damage generally results from either strongly basic (alkaline) compounds or acidic compounds. Alkali injuries are more common and can be more damaging. Chemical injuries can have far reaching medico-legal consequences especially in regard to poor immediate treatment, proper documentation and suboptimal removal of the chemical agent.
It is important to adhere to the protocol.

HISTORY: Must record name of substance, whether particulate or liquid, if work-related, the time of injury, the time of attendance to eye hospital, and if irrigated before attendance.

EXAMINATION	Grade I	Grade II	Grade III	Grade IV
Cornea	No opacity	Hazy	Hazy	Opaque
Iris details and pupil	visible	Visible	Obscure details	No view
Limbus	No ischemia	Ischemia < 1/3	Ischemia 1/3 - 1/2	Ischemia > 1/2
Proximal conj & sclera	No ischemia	No ischemia	No ischemia	Ischemic necrosis
Prognosis	Excellent	Good	Guarded	Dismal

IMMEDIATE Rx	1. **ANESTHESIA**: G. Benoxinate 2. **IRRIGATION**: even if already been irrigated before attending. At least 30 minutes (Normal saline, Lactated ringer, BSS) until pH returns normal (7). Consider rechecking pH after a further 15-30 minutes for lime and other particulate chemicals 3. **EVERT /DOUBLE EVERT LIDS** and remove particulate matter. If unable to remove particulate matter, consider general anaesthesia 4. **DEBRIDEMENT**: Necrotic corneal epithelium, necrotic conjunctival & sub-conj tissue. 5. **Do not patch** 6. **ANALGESIA:** paracetamol/codeine 7. **IMMEDIATELY INFORM SENIOR DOCTOR ON-CALL** for Grade II, III, IV (consider also for Grade I, if in doubt) 8. **TAKE Visual Acuity FOR BOTH EYES** (with correction, unaided and pinhole)	
Slit lamp	**GRADE I**	**GRADE II / III / IV**
ACUTE PHASE (DAY 0 - 7) ***Do not use Vit. C in non-alkali burns***	• G. Pred Forte X 8 • Consider Oral Diamox 250 mg X 4 if IOP difficult to take • G. Ofloxacin X 4 • G. Cyclopentolate X 3 • G. Blink X 8	• G. Pred Forte X 8 • Oral Diamox 250 mg X 4; ± G. Timolol 0.5% X 2 • G. Cyclopentolate X 3 • G. Blink X 8 • Topical Vit. C 10% X 6 • Oral Vit. C 2 Gm/d • Oc. Tetracycline X 4 • Doxycycline 100mg X 2 • Consider rodding (if symblepharon likely)
EARLY REPAIR (DAY 7 – 21)	**Complete re-epithelisation** • Stop G. Cyclopentolate • Decrease / stop Diamox • Decrease + stop steroids by day 10 • Decrease / stop antibiotics • G. Blink X 6	**Failure or partial failure to re-epithelise** • Stop G. Cyclopentolate • Decrease / stop Diamox • Decrease + stop steroids by day 10 • Decrease + stop local and systemic antibiotics • Decrease + stop local and systemic Vit. C (except Grade IV) • G. Voltaren 0.1% X 4 • G. Blink X 6
LATE REPAIR (DAY > 21)	• Decrease + Stop G. Blink	• G. Voltaren 0.1% X 4 • G. Blink X 6 for long periods • Surgical options in cases of absent re-epithelization: - Stem-cell transplant, followed by PK - Amniotic membrane graft

Also consider when deemed suitable:
- ***Cyanoacrylate adhesive (for perforation, followed by PK after 3 months)***
- ***Daily rodding of fornices (to prevent or relieve symblepharon)***
- ***Subconjunctival autologous blood (acts as chelating agent and spacer when difficult to remove chemical from conjunctiva)***
- ***Topical autologous serum (can be made up by nursing staff)***

FIGURE 1. Chemical injury protocol

by masking the names of patients. No patient with chemical injury was excluded from the study.

Dataset synthesis and analysis

A structured questionnaire form (Fig. 2) was developed as a research tool to collect data. Data categories collected included:

- presentation: time and date, the physician attending time, age and sex of patient;
- injury: which eye, mechanism of injury, time and place, type of chemical;
- actions taken first: irrigation or visual acuity;
- irrigation: type of solution, amount, duration, pH, a signature of irrigating person;

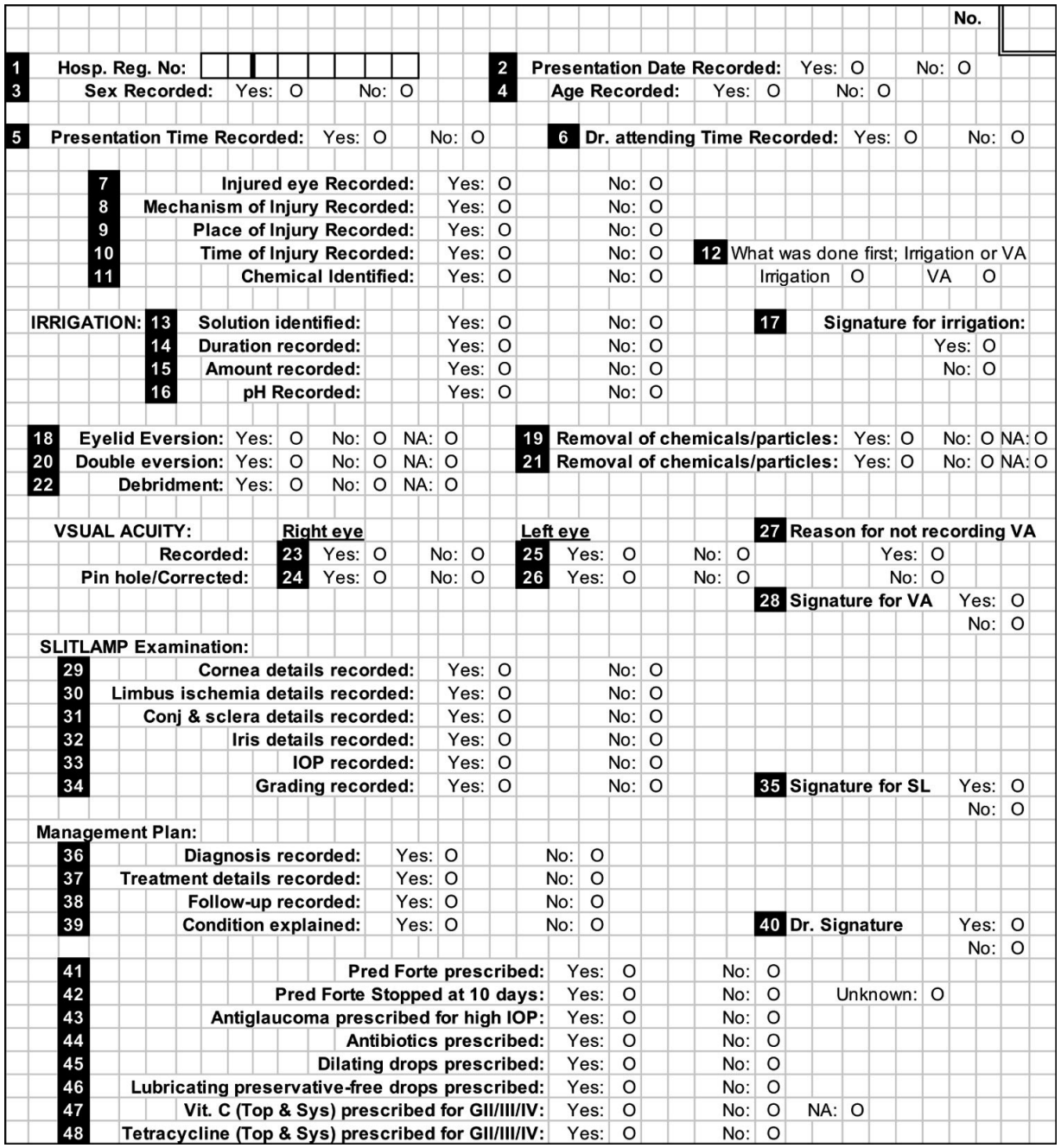

FIGURE 2. Structured questionnaire form

- lids: eyelid eversion, removal of chemical/particles, double eversion, debridement;
- visual acuity (VA): right and left eye VA and corrected VA, the reason for not recording VA, a signature of the person taking VA;
- slit-lamp examination (SLE): cornea details, limbus ischemia, conjunctiva and sclera details, iris details, intraocular pressure (IOP), grading, a signature of the person performing SLE;
- management plan: diagnosis, plan, follow-up, condition explained to the patient, attending physician signature;
- medication: steroid drops, information if a patient was advised to stop steroids at 10 days, anti-glaucoma drops for high IOP, antibiotic drops, dilating drops, lubricating drops, vitamin C (topical and systemic) for grades II/III/IV acid injury prescribed, tetracycline (topical and systemic) for grades II/III/IV prescribed.

Questions had "yes" or "no" checkboxes. Data were stored and analysed using Excel charts.

Method of literature search

The literature search was performed using the online electronic PubMed. The keywords searched included: "eye burns", "ocular burns", "ocular chemical burns", "ocular chemical injuries", "chemical injuries of eye", "chemical injuries of ocular surface". Combinations of these terms were used as well. Relevant articles were reviewed. All English-language articles published between 2000 and 2020 were included.

All reported studies discussed chemical injury management. We found no studies related to the actual review of the assessment of emergency procedures and documentation. To the best of our knowledge, our study is the first to address this issue.

RESULTS

Demographic data

We found that the presentation date and time for patients were recorded in more than 90% of cases, and the attending time of the caregiver was recorded in 90% of cases. Sex and age for patients were recorded in 97.5% of cases.

Injury data

The injured eye (right or left) was recorded in 95% of cases. The mechanism of injury was recorded in 65% of cases. The time and place of injury were recorded in 55% and 10% of cases, respectively. The type of offending chemical was identified in 65% of cases.

Irrigation data

The amount of irrigating solution used was not recorded in any case, while the irrigation duration was recorded in 55% of cases. The irrigating solution was identified in 50% of patients, while pH was recorded in 52.5% cases. From the records, we could not determine if irrigation was performed before VA was taken.

Debridement data (eversion, removal of particulate matter, and debridement)

The eyelid eversion/double eversion procedures were recorded in 5% and 2.5% of cases, respectively. Removal of chemical or particulate matter and debridement were recorded in 15% of cases. It is presumed that these procedures were not performed because they were not recorded, and there was no documentation that the procedures were not required.

Visual acuity data

Visual acuity was recorded in both eyes in almost 90% of cases, while corrected VA was recorded in both eyes in nearly 50% of cases. The reason for not recording VA was recorded in 7.5% of cases.

Slit-lamp examination data

Details of cornea, conjunctiva, sclera, and iris details were recorded in 100% of cases. Limbal ischemia was documented in 45% of patients, and intraocular pressure was recorded in 25%. Grading was recorded in 77.5% of cases.

Management plan data

The diagnosis was recorded in 100% of cases, while the management plan was recorded in 95% of cases. Explanation of condition to patients was documented in 45% of cases, and follow-up time was recorded in 67.5% of cases.

Medication data

Antibiotics and steroids (drops/ointment) were prescribed in 92.5% of cases. Advising the patient to stop steroids on the 10th day was recorded in 15% of cases. Anti-glaucoma medication was not prescribed in any case. Lubricating drops were documented in 95% of cases, and dilating drops were prescribed in 7.5% of cases. Vitamin C and tetracycline medications for grades II, III, VI were prescribed in 12.5% and 7.5% of cases, respectively.

Signatures

Irrigation procedure signatures were recorded in 20% of cases, and visual acuity measurement signatures were documented in 100% of cases. Slit-lamp examination signatures were recorded in 75% of cases, and management plan signatures were documented in 95% of cases.

Figure 3 shows a clustered bar chart of all data collected in this study, including demographic data, injury, irrigation, debridement, VA, SLE, management plan, and medication.

DISCUSSION

The descriptive analysis of this study showed that the documentation for demography and VA parameters were not 100% for all parameters. Our

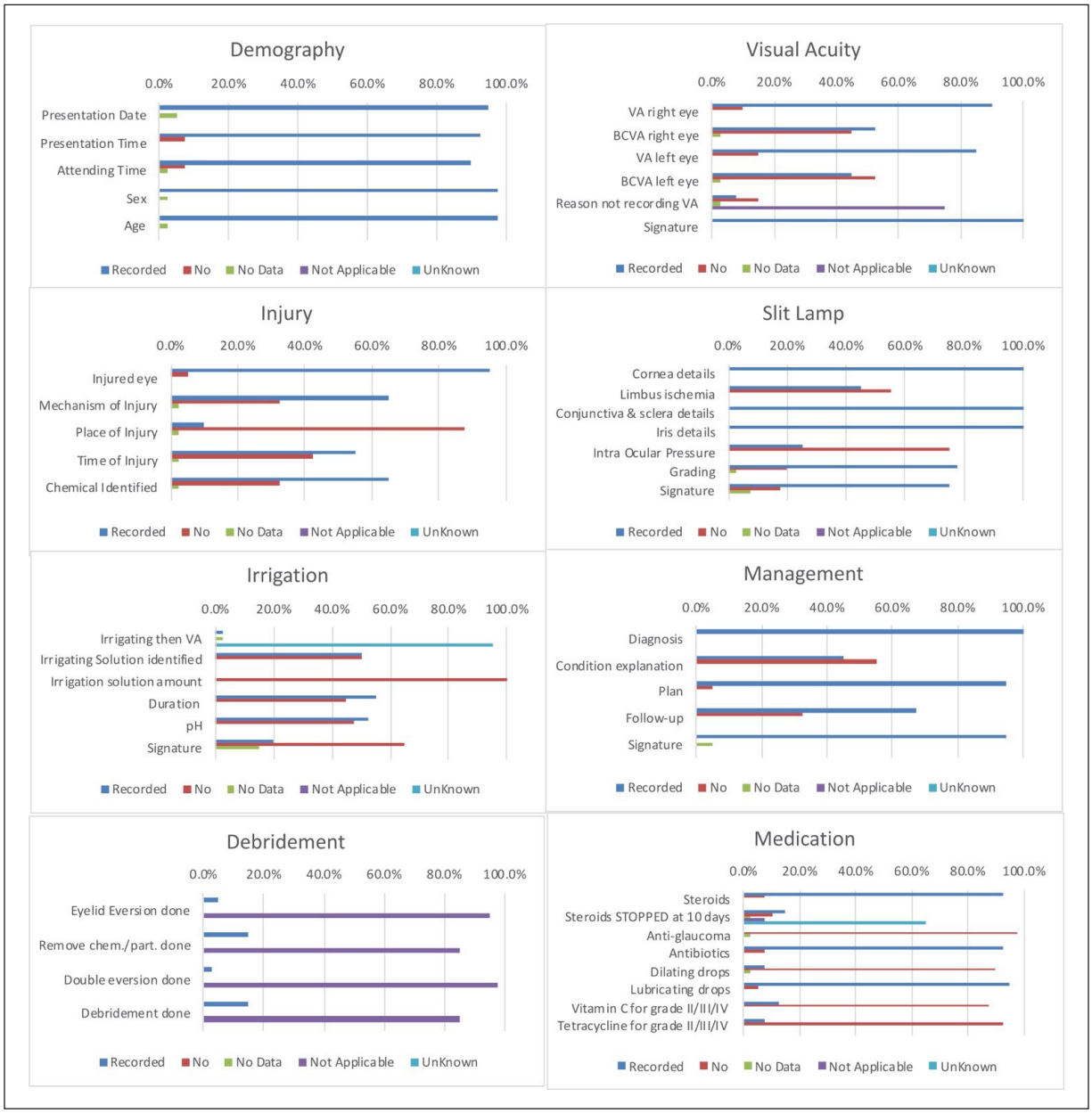

FIGURE 3. Results of the study

protocol calls for 100% documentation for all parameters. For each case where VA was not recorded, a reason should be documented. The same analysis was seen for the injury category, where none of the parameters were documented in 100% of cases. Our protocol calls for 100% documentation for all parameters.

With respect to the irrigation category, this study did not show caregivers' adherence to our protocol for chemical injury management. We could not tell which action was taken first, VA or irrigation. The type of irrigating solution, amount, duration of irrigation, and pH should be documented in each case.

Documentation of the debridement category showed nonadherence of caregivers to our protocol for chemical injury management. Lid eversion, double eversion, removal of chemical particles, and debridement should be performed on all chemical injury patients regardless of grade.

Regarding the SLE category, some parameters should be recorded in all cases. Such parameters include limbus ischemia details, intraocular pressure, and grading.

While documenting management showed that caregivers followed our protocol, it must be emphasized that caregivers should, in all cases, document

the explanation of the condition to patients and their follow-up.

The results indicate that our caregivers followed the chemical injury protocol for the medication category in most cases. One parameter that must be documented in more detail is the advice to patients to stop steroids on the 10th day. While the parameters of vitamin C, tetracycline, and anti-glaucoma medications were not filled in most cases, it is assumed that these medications were not needed nor prescribed.

Documentation of signatures showed that our caregivers must sign on all procedures implemented.

Documentation records patient management, which includes admission, diagnosis, treatment plan, and medications already dispensed. Medical records are essential for continuing care for the patient by all health providers. Patients may also seek treatment at other facilities for follow-up. Accurate medical documentation ensures that any health provider will treat the patient correctly and prevents incorrect treatment. A treatment plan helps in facilitating that the patient receives the treatment needed for a full recovery.

Good medical documentation is critical in emergencies. Doctors need to know about a patient's diagnosis and underlying conditions to ensure that emergency treatments offered don't cause harm to the patient.

Documentation helps the medical facility ensure that the quality of care offered is up to standards.

In addition to the clinical importance of medical records, they are also a legal document that acts as evidence of the care provided. An incomplete medical history can adversely affect the quality of care for patients and leads to errors. Incomplete medical records show that care was incomplete and exhibited non-compliance with organizational protocols and policies. These incomplete records may result in legal actions and can cause a loss of revenue.

CONCLUSIONS

The results of this study reveal that our documentation needs improvement for several parameters. Several recommendations were formulated:

Emphasize to caregivers that irrigation must be done first.

Corrected visual acuity should be attempted for both eyes in all cases, and reasons for not recording it should be documented.

It is important to document and record limbus details, iris details and measure intraocular pressure in all cases.

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