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ORIGINAL ARTICLE

RING TOURNIQUET SYNDROME: A PROSPECTIVE STUDY ON PREDISPOSING FACTORS, TREATMENT TECHNIQUES AND OUTCOMES IN ETHIOPIA

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ABSTRACT

Background: *Ring tourniquet syndrome is not uncommon and patients will present with pain, swelling, ischemia, and finger wounds related to previous ring removal attempts. It may be due to application of undersized ring or related to swelling around a previously well-fitted ring.*

Objective: *This study aimed to describe epidemiologic features, predisposing conditions, and treatment outcomes of strangulated fingers.*

Methodology: *In this prospective observational study, we enrolled consecutive patients who presented to any of the three selected emergency departments at Tikur Anbessa Specialized Hospital, Alert trauma center and Hawassa University Comprehensive Specialized Hospital with ring tourniquet syndrome between January 01, 2017 and December 31, 2019. Data collected after getting ethical clearance.*

Result: *Among 33 patients enrolled, 52 % were female and the mean age was 24 (1.5 - 56) years. Eleven (33%) presented after wearing undersized ring, 7(21%) had trauma to the ipsilateral hand, wrist and/or forearm, and 7 (21%) were psychiatric. The mean duration of ring incarceration was 3 days (4 hours – 3 weeks). Thirty-one patients (93%) reported previous attempt of removal of the constricting agent. Twenty-two patients (69%) required destruction of the constricting object and 5 patients (15%) need ray's amputation of the finger. There were no reported major complications.*

Conclusion: *Ring tourniquet syndrome is not uncommon in our setting, and since most of the incarcerated rings required ring-destructive technique, the health personnel need at least ring or k-wire cutter to manage this condition.*

Key words*: strangulated finger, ring incarceration, Tourniquet Syndrome, ring devices,*

INTRODUCTION

Incarceration of rings or other circumferential metal objects on fingers is not an uncommon complaint in the emergency department(1). Patients may present with finger pain, swelling, ischemia, and wounds related to previous ring removal attempts. Ring incarceration may be the result of application of an undersized ring or related to swelling around a previously well-fitted ring. Previously reported conditions associated with ring incarceration include trauma to the ipsilateral hand or wrist, edema secondary to a pregnancy or another general medical condition, deforming arthritis, and psychiatric illness (2–5). Finger necrosis due to incarcerated rings has been reported (5).

Treatments for incarcerated ring may be classified as ring-preserving or ring-destroying. Ring-preserving techniques may be preferred by patients due to sentimental or financial ring value and include elevation, lubrication, cold compress, and string and rubber-band techniques (6–10).

Ring-destroying methods include the use of a specialized ring or wire cutter or pliers (6,11). Pain, iatrogenic lacerations, and embedding of foreign materials have been reported with these techniques (2,3,12–14).

The conditions associated with ring incarceration, timing of patient presentation, approaches to incarcerated ring removal and, and outcomes of the treatment have not been described in an Ethiopian population. This study aimed to describe epidemiologic features, predisposing conditions, and treatment outcomes of strangulated fingers- otherwise known as ring tourniquet syndrome caused by rings and small ring-shaped devices. Additionally, we present our preferred approach to the management of incarcerated rings.

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PATIENTS AND METHODS

This is a prospective observational study of consecutive patients who presented with rings or other ring-like metallic objects incarcerated on a finger between January 01, 2017 and December 31, 2019 to the emergency department of one of the three selected hospitals in Ethiopia: Tikur Anbessa Specialized Hospital (TASH), Hawassa university Comprehensive Specialized Hospital (HUCSH) and Alert Trauma Center (Addis Ababa). There were no exclusion criteria. Ethical approval was obtained from the departmental research committee, and informed consent for data collection was obtained from all participants themselves or family/guardians (for pediatric and psychiatric patients) including for use of their strangulated fingers' picture for further study and educational purposes.

Data was collected using a structured data extraction checklist prepared by the principal investigator from previously done researches and picture of all strangulated finger was taken. Patient and ring characteristics, timing of presentation, previous treatment attempts, predisposing conditions, and treatment methods were recorded by the treating orthopedic surgeon or residents. .

Two-week, 3-month and 6- month outcomes focusing on pain, stiffness, tendon injury, infection, and ischemia were assessed either in the outpatient clinic or by telephone encounter with the study team. Descriptive statistics were reported

RESULTS

Sociodemographic characteristics:

There were 33 eligible patients encountered at the study sites during the study period, all of whom agreed to participate and were enrolled. Seventeen (52%) patients were treated at Tikur Anbessa Specialized Hospital (TASH); 9 (27%) at Alert Trauma Center; and 7 (21%) at Hawassa University Comprehensive Specialized Hospital (HUCSH). Seventeen (52%) patients were female. The mean age was 24 (1.5 to 56) years, and 4 (12%) patients were younger than 10 years of age. The left hand was affected in 23 patients (70%), and the affected digits were the ring 20 (61%) followed by index 7 (21%) and middle finger 5 (15%). The incarcerated ring was an undersized ring in 13 (39%) cases, an engagement or wedding ring in 12 (37%) cases, and a ring - like metal object in 8 (24%) cases **(Table 1)**

Table 1: Socio-demographic characteristics of patients with ring tourniquet syndrome at three Ethiopian Hospitals (TASH, HUCSH and Alert Hospital) 2017 - 2019

Characteristics		**Frequency (N=33)**	**Percentage (%)**
Age groups (years)	<10	4	12
	11 - 18	7	21.3
	19 - 30	12	36.4
	31 - 45	8	24.3
	>45	2	6
Sex	Male	16	48
	Female	17	52
Side involved	Right	10	30
	Left	23	70
Digit involved	Ring finger	20	61
	Index finger	7	21
	Middle finger	5	15
	Little finger	1	3
Hospital	TASH	17	52
	HUCSH	7	21
	Alert Trauma centre	9	27
Types of rings incarcerated	Small (undersized)	13	39
	Engagement or wedding	12	37
	Ring - like metal object	8	24

Among the 8 patients with ring shaped object incarceration, 5 of them were difficult to remove with ring destruction techniques and ultimately required ray's amputations (**Figure 1a & 1b).**

Figure 1a: 32 year old psychiatric patient who presented 2 weeks after placing a ring - shaped object on to his little finger and required a ray's amputation.

Figure 1b: 25 year old psychiatric patient who presented 1 week after placing a ring - shaped object on to his third finger and required a ray's amputation.

Figure 1c: 3 year old child who presented 3 hours after placing a ring- shaped object on to his third finger. The ring was removed using ring destructive techniques.

Clinical presentation and predisposing factors:

The mean patient-reported duration of ring incarceration prior to presentation was 3 days (4 hours to 3 weeks); with 18 patients (54.5%) presenting within 24 hours and 5 patients (15.2%) presenting more than a week after incarceration. Most patients (93%) reported multiple attempts at ring removal prior to presentation to one of study sites, performed by either the patient, a family member at home, or a health care provider at another health care facility.

The most common predisposing factors for ring incarceration were use of an undersized ring, which occurred in 11 patients (33%) followed by psychiatric illness and ipsilateral hand, wrist and/or forearm injury, each accounting 21% of cases. Swelling around a previously well-fitted ring occurred in 6 pregnant patients (18%) (**Table 2)**

Table 2: Clinical presentation and predisposing factors for ring tourniquet syndrome at three Ethiopian Hospitals (TASH, HUCSH and Alert Hospital) 2017 to 2019.

Characteristics		Frequency (N=33)	Percentage (%)
Duration from ring incarceration to hospital arrival	< 1 day	18	54.5
	1- 3 days	7	21.3
	4 – 7 days	3	9
	>7 days	5	15.2
Previous attempt to remove the ring before hospital arrival	Yes	31	93
	No	2	7
Predisposing factors for ring incarceration	Psychiatric illness	7	21
	Pregnancy	6	18
	Injury to hand, wrist and/or forearm	7	21
	use of small (undersized) ring	11	33
	Child	2	6

Techniques of ring removal

Ring-preserving removal techniques including lubrication with KY jelly and compression with string or rubber band were successfully only for 6 patients (18.2%). The rest 22 (66.7%) patients needed ring-destructing technique using a ring or K-wire cutter (**Figure-1c**), and the remaining 5 patients (15.1%) ultimately required ray amputation of the finger with embedded ring due to the difficulty of removing the ring with ring destructing techniques **(Figure-1a, 1b, and 2).**

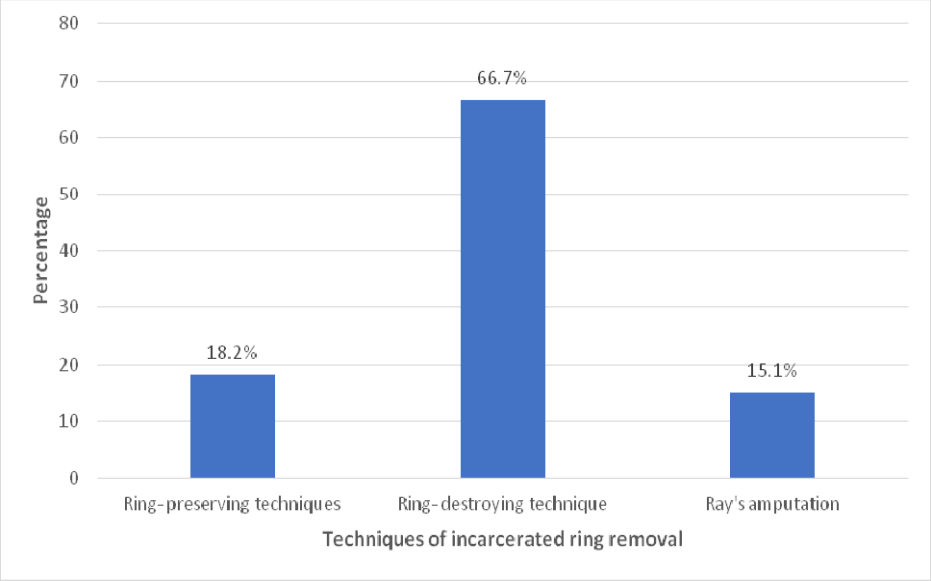

Figure 2: Distribution of techniques for ring removal among patients with ring tourniquet syndrome at three Ethiopian hospitals (TASH, HUCSH and Alert Hospital) 2017 - 2019.

Post ring removal management and patient follow up:

Patients were not hospitalized for the Ray amputations or any other ring removal techniques; all procedures were done as an outpatient. Ray amputations were performed under regional anesthesia using a wrist block. After ring removal, all patients were put on oral analgesics and first - generation cephalosporine or cloxacillin for 5 to 7 days based on the wound condition.

Two - week follow up data was collected at outpatient clinic visits and subsequent 3- and 6 - month follow up data was collected either in person or by phone interview. Thirty-two patients (97%) were completed their follow up until 6 months and one psychiatric patient was lost from follow up after 3rd month of his follow up.

There was no incidence of ischemia, tendon injury, range of motion impairment, or persistent pain; and all patients whose finger were preserved reported full function of the affected finger. Those patients for whom ray's amputation performed were also return back to their activity without any limitation. Nearly all patients (97%) were discharged from further follow up at 6 months.

DISCUSSION

Epidemiology, Treatment, and Outcomes

In this prospective observational study of ring incarceration, we aimed to describe the epidemiologic features and treatment outcomes of ring incarceration in our patient population. The patient characteristics and predisposing factors to incarcerated ring in our population were similar to those reported in other series (1,3,12,15); however, our cohort included a higher proportion of patients who presented after application of an undersized ring. This may be related to a trend among female students buying rings at nearby market and putting it to their finger without precautions. In order to prevent these unnecessary complications, youngsters should be counselled about the complication of wearing an undersized ring.

There are two types of incarcerated ring removal techniques. The first one is ring preserving which includes use of elevation and KY Jelly, string technique and rubber band techniques. This technique is the preferred for sentimental ring like promise or marriage ring. But it may not work for all incarcerated rings due to severe swelling or embedded nature of the ring. The second type of ring removal is ring destroying techniques reserved for those ring or ring like device which is difficult to remove with ring preserving techniques and it includes ring cutter, volt and k-wire cutter (1,3,4,6,7,9,12). In this study, ring-destroying techniques were required in the majority (83%) of incarcerated rings; we are not aware of any other data to compare these results. Compared to other studies, a smaller proportion of the patients presented within 24 hours after the onset of ring tourniquet syndrome. Previous study suggests that increased time to presentation and previous removal attempts are related to a higher likelihood of requiring a ring-destroying removal method which is also true in our setting (2,15).

No complications related to ring removal were observed in our cohort. Previously described factors associated with long-term outcomes after ring tourniquet syndrome include associated metacarpal or phalangeal fractures, severity of soft tissue injury, and flexor tendon laceration which is comparable with our study (14).

Unlike other studies, 8 (24%) of our patients presented so late after placing a ring -like metal devices on to their fingers, so that ray amputations were necessary. This ring- like device incarcerations were not commonly reported in the previous studies.

Authors' Preferred Technique

The choice of ring removal technique depends on several factors including: the nature of injury or strangulation, the status of the digit at the time of presentation (degree of swelling, presence of ischemia and soft tissue injury), degree of ring tightness, value of the ring, physical characteristics of the ring, and the patient's level of pain. It is advisable to administer either local anesthesia, conscious sedation, or another form of analgesia during incarcerated ring removal. When the affected finger has signs of ischemia (pain, capillary refill time >2secs, cyanosis or paresthesia), the ring should be removed urgently with a ring or k-wire cutter if available. Ring cutter, wire cutter, or pin cutter can be used to remove incarcerated rings, but it can be difficult to insert the cutter when a ring is deeply embedded in the skin of strangulated finger. When a ring is deeply embedded, it must be removed in pieces by cutting, and it may also be necessary to incise the skin bridge in the manner of a finger fasciotomy (3,6,12).

Some of our patients were presented too late after the ring tourniquet syndrome establishment and unnecessary multiple attempts to removing the ring in nearby health facility which leads to ray amputation of the strangulated digit as the only viable option to prevent further local and systemic infection. Wound dressing, antibiotics coverage, and tetanus prophylaxis should be administered after ring removal. Antibiotic duration depends on the nature of the wound, but generally we recommend at least 1 dose of intravenous antibiotics followed by 5 to 7 days of oral antibiotics. The drug of choice is first -generation cephalosporine or cloxacillin in order to cover the gram positive microorganisms which are the normal flora of the skin.

Limitations of the study: The sample size was modest, and the patients were enrolled at referral centers only, which may limit the generalizability of the findings. The number and types of ring-preserving removal attempts prior to use of a ring -destroying technique were not recorded, and no objective criteria were used to guide treatment plans.

Ring-removal techniques were chosen according to the judgment of the treating surgeon or resident physician and the preference of the patient. There was no specific functional outcome score used to assess patients' functional outcome during follow up time.

Conclusion

Ring Tourniquet Syndrome is not uncommon in our hospitals, and ipsilateral upper extremity trauma, pregnancy, use of small (undersized) rings and psychiatric illness are all associated with this condition. Evaluation of the patient's finger and understanding what type of ring is involved will be paramount when deciding the method of ring removal. The outcome after ring removal is good in our set up.

Recommendation

As most of the incarcerating rings -shaped object require destructive techniques of removal, treating facilities must be prepared for ring destruction set up before attempting ring preserving techniques.

Even with the destructive techniques, the incarcerated ring may be too difficult to remove and require a ray amputation so that is needs to prepare the tool and consult the patients.

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