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Upper Extremity Trauma in Costa Rica - Evaluating Epidemiology and Identifying Opportunities

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Abstract

Background: Traffic accidents and musculoskeletal injuries represent a major cause of morbidity and mortality in Costa Rica. To inform capacity building efforts, we conducted a survey study of hand and upper extremity (UE) fellowship-trained surgeons in Costa Rica to evaluate the epidemiology, complications, and challenges in care of UE trauma.

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Methods: Aiming to capture all hand and UE trained surgeons in Costa Rica, we compiled a list of nine surgeons and sent a survey in Spanish using Qualtrics. Assessment questions were developed to understand the burden, complications, practice patterns, challenges, and capacity associated with care of UE trauma. Questions were designed to focus on opportunities for future investigation. Questions were translated and adapted by two bilingual speakers. Data were reported descriptively and open-ended responses were analyzed using content analysis.

Results: Nine (100%) surgeons completed the survey. Distal radius fractures, hand and finger fractures, and tendon injuries are the most frequently noted conditions. Stiffness and infection are the most common complications. About 29% of patients are unable to get necessary therapy and 13% do not return for follow-up care with monetary, distance, and transportation limitations being the greatest challenges.

Conclusions: The burden of UE trauma in Costa Rica is high. Identifying common conditions, complications, challenges, and capacity allows for a tailored approach to partnership and capacity building (e.g. directing capacity building and/or research infrastructure toward distal radius fractures). These insights represent opportunities to inform community-driven care improvement and research initiatives, such as Delphi consensus approaches to identify priorities or the development of outcome measurement systems.

Keywords

Costa Rica; epidemiology; hand and upper extremity; multi-center; orthopaedic trauma

Introduction:

Injury secondary to trauma (e.g. road traffic accidents) is a leading cause of morbidity and mortality worldwide, accounting for an estimated 1.2 million deaths and 50 million injuries[1–4]. In Costa Rica, traffic accidents represent a major cause of injury and mortality[5–7]. Countries in Latin America and those defined by the World Bank as middle-income and low-income countries (LMICs) are disproportionately impacted by this burden as they have a greater number of deaths per capita compared to high-income countries[2]. Hand and upper extremity injuries are no exception and account for a large number of injuries sustained across the world[8–10].

Despite this burden, little is known about the epidemiology of such injuries in Costa Rica. Similarly, even less is known about the complications and challenges of treating these injuries. This limits the ability to understand the burden of musculoskeletal conditions impacting the country and further, the ability to design clinical and educational initiatives to improve capacity building and care. Furthermore, research related to orthopaedic trauma has been limited; between the years 1988–2013, 1% of orthopedic research articles originated from a Latin American country[11,12]. In order to improve care in a sustainable manner for patients with hand and upper extremity injuries and appropriately allocate resources in Costa Rica and other countries, an understanding of clinical conditions, complications, and capacity is needed. A similar understanding is needed to build research capacity and inform research priorities that are guided and identified by the needs of the local community.

A multitude of approaches exist to understand the clinical burden and begin research in LMICs. In a seminal paper published in 2000, Costello and Zumla advocated for the discontinuation of the current, semi-colonialist approach to conducting research in LMCs[13]. They laid forth four principles to help foster cooperative research partnerships that include: 1) Mutual trust and shared decision making, 2) National ownership, 3) Emphasis on getting research findings into policy and practice, and 4) Development of national research capacity. Despite this, much research conducted in LMICs does not follow these princples[14]. In this manuscript, we detail a mixed-methods approach to achieve these principles by creating research collaborations and involving multiple stakeholders to evaluate the epidemiology, complications, and challenges in care of upper extremity trauma in Costa Rica.

Methods:

Capacity Assessment:

We created a self-administered assessment designed to understand the incidence of upper extremity traumatic conditions, associated complications, current practice patterns, challenges, and capacity (Appendix). The assessment was designed by upper extremity surgeons from the United States and Costa Rica and was based upon epidemiologic principles and the World Health Organization and qualitative investigation principles[15–17]. The questionnaire was reviewed by bilingual (Spanish and English) investigators for content, comprehension, and context. The associated complications, challenges, and capacity questions were formulated through literature review as well as the authors' experiences[8,18–20]. The assessment was completed electronically through Qualtrics (Provo, Utah).

Data collection:

We first compiled a list of all known hand and upper extremity trained surgeons in Costa Rica. These surgeons are identified by members of the GrUpo de estudio por extremidad Superior Traumatología y Orthopedico (GUSTO) consortium[21]. The survey was sent via email to all nine hand and upper extremity trained surgeons in Costa Rica on February 3 ,2022. One follow-up email was sent to ensure survey completion.

Data analysis:

Questionnaire responses were aggregated and reported in a descriptive manner. Numerical responses were averaged across participants and reported. Open-ended responses were analyzed using content analysis and frequencies of answers were reported.

Results:

Survey Cohort:

Nine (100%) of participants completed surveys. Their mean age is 43 years, six (67%) are male, and respondents have been in practice for a mean of 12 years. Other demographic information is listed in Table 1.

Distal radius fractures, hand and finger fractures, and tendon injuries are the most frequently noted conditions (encountered 16, 15, and 11 times a month per surgeon on average). Traffic

accidents are most common mechanism of injury. About 7% of all fracture present open. Table 2 illustrates the incidence of specific conditions, the percent of such conditions that present open, and the utilized treatment strategies. Stiffness and infection are the most common complications (Table 3).

About 70% of patients are able to return to their prior level of work. Ten percent of patients need soft tissue coverage. About 29% of patients are unable to get necessary hand therapy and 13% do not return for follow up care with monetary, distance, and transportation limitations being the greatest challenges. Tables 3 and 4 further illustrate complications, practice patterns, challenges, and available capacity.

Discussion:

Musculoskeletal trauma, particularly of the upper extremity results in substantial morbidity, especially in LMIC. Addressing such injuries through collaborative partnerships, educational initiatives, and research infrastructure requires an understanding of the injury patterns, challenges, and current capacity of a specific site, region, or country. We identified distal radius fractures, hand and finger fractures, and tendon injuries as the most commonly treated conditions in Costa Rica. Stiffness and infection comprise the most common complications, while the difficulty in follow-up represents the greatest challenge in providing high-quality care. Obtaining epidemiologic data is an important first step in designing educational and research initiatives to build hand surgery capacity in Costa Rica.

While the purpose of this work is not to compare exactly to practice patterns in the United States, there are some notable similarities and differences that can illustrate the importance of understanding local context. For example, while the rate of open fractures in Costa Rica is similar to that in the United States[22], the rate of treatment with external fixation devices is higher in Costa Rica[23]. While these are results are limited by being surgeon-reported, differences in treatment patterns, especially when driven by availability of implants for example, highlight the importance of tailoring capacity building educational initiatives to the appropriate context. For example, given the higher rate of external fixation, instead of focusing education on topics surgeons already have available, it may be beneficial to focus on the application of external fixation devices or the use of alternative treatments for similar injuries, such as bridge plating. In this way, tailored education can be placed within the local context and address the needs of the learners.

From a health policy and resource allocation standpoint, the majority of injuries are noted to occur secondary to motor vehicle accidents. This is similar to other LMIC countries, yet different from epidemiologic patterns in the United States[24,25]. As such, policy and allocation efforts can be tailored to address this specific mechanism (e.g. primary prevention efforts via road traffic safety). Similarly, a lack of physical and human resources (e.g. implants, anesthesiologists) was a less noted barrier, which is critical to understand in allocating resources and avoiding ‘implant graveyards.’ Notable barriers to the delivery of high-quality care, that may be a more impactful use of resources, included issues with patient follow-up primarily related to patient transportation and monetary resources. These barriers have been described in many other studies related to care in LMIC[18], yet represent

opportunities for improvement. The development and implementation of tools for remote follow-up (to mitigate many of the described barriers) have increased in HIC, yet the application of such is limited in LMIC, arguably, where their implementation may have greater impact.

While educational initiatives are important avenues by which to learn and provide knowledge, research and improvement efforts represent a mechanism by which to build capacity. The goal of outreach focused on capacity building should be that such efforts are internal, driven by relevant questions, and able to be answered utilizing available infrastructure[26,27]. Our results provide the foundation for understanding what is relevant to the community and what resources are available to answer such questions with the goal of building independent clinical research capacity within the local community. For example, if one wanted to study the use of bridge plating for distal radius fractures, it may be difficult and/or less practical given that few fractures are treated in this manner. On the other hand, as stiffness was noted to be a common complication and many constructs are utilized for the treatment of hand and finger injuries, surgeons in Costa Rica may be interested in studying the differences in outcomes between intramedullary devices and plates for metacarpal fractures in the context of their young, working population. Notably, however, the difficulty in obtaining follow-up, as noted in the survey, may limit sample sizes needed for investigation. Our investigation demonstrates a method by which to obtain baseline epidemiologic data and build mutual trust in a manner that ensures national ownership of the results. These results then inform efforts to develop research capacity and integrate findings into practice and policy.

The primary limitation of this study is that while nine hand and upper extremity-fellowship trained surgeons participated, they likely do not represent all of those surgeons in Costa Rica treating upper extremity traumatic injuries (e.g. general orthopaedic surgeons). There are undoubtedly surgeons without specific upper extremity training treating such injuries, however it is not likely that there are enough of these surgeons with practice patterns variable enough to skew the results substantially. Second, a self-administered questionnaire may introduce bias (e.g. reporting bias, recall bias) into the results. While an ethnographic study may increase accuracy of how many cases are performed over a month, the feasibility of conducting such study is limiting. Similarly, while a review of case logs may improve accuracy, such reporting is limited in LMIC and may similarly be inaccurate.

Despite such limitations, we were able to capture country-wide, epidemiologic data of clinical conditions and practice patterns of traumatic hand and upper extremity injuries in Costa Rica. Accompanying complications, challenges in care, and capacity were investigated in a manner in which we could identify future opportunities for investigation. This work serves as an example to guide future capacity building efforts and is an important first step the development of community-driven educational initiatives, research agendas, and resource allocation towards capacity building.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Statement of Informed Consent:

Informed consent from all survey participants was obtained through consent forms approved by our institutional review board. Patients have a right to privacy that was not infringed and all identifying information will not be published.

Statement of Human and Animal Rights:

The authors have complied with the ethical standards as detailed in 'Instructions to the Author' set forth by *Current Orthopaedic Practice*. The authors were in accordance with the ethical standards of the responsible committee on human experimentation at Stanford and with the Helsinki Declaration of 1975, as revised in 2008.

Table 1.

Demographics of survey participants

Domain	Response
Age	43, 3 [mean in years, (standard deviation)]
Sex	Male: 6
	Female: 3
How many years have you been in practice?	12, 5 [mean in years, (standard deviation)]
Are you fellowship-trained?	Yes: 9
	No: 0
If you are fellowship-trained, in what specialty? *	Hand and upper extremity (9), brachial plexus (1)
In what country was your fellowship? *	Spain (3), Chile (2), Costa Rica (2), Venezuela (2), Mexico (1)
What is your practice environment?	Community clinic/primary center (0)
	District/secondary center (2)
	Central or referral hospital/tertiary center (7)

* Numbers do not add up to nine as some surgeons were trained in multiple specialties and/or countries.

Table 2.

Incidence of conditions, percentage of fractures that are open, and corresponding treatment strategies utilized*.

Condition:		
Proximal humerus fractures		
How many do you treat a month?		9
What percentage of these fractures are open?		2%
Of those you treat, what percent do you treat with:	Non-operative, no immobilization	0%
	Non-operative, immobilization	19%
	Surgical, pin fixation	0%
	Surgical, plate and screws	46%
	Surgical, replacement	2%
Humeral shaft fractures		
How many do you treat a month?		7
What percentage of these fractures are open?		3%
Of those you treat, what percent do you treat with:	Non-operative, no immobilization	0%
	Non-operative, immobilization	4%
	Surgical, external fixation	4%
	Surgical, plate and screws	41%
	Surgical, nails	22%
Elbow Fractures/Dislocations		
How many do you treat a month?		8
What percentage of these fractures are open?		6%
Of those you treat, what percent do you treat with:	Non-operative, no immobilization	1%
	Non-operative, immobilization	11%
	Surgical, external fixation	6%
	Surgical, plate and screws	44%
	Surgical, replacement	3%
Both Bone Forearm Fractures		
How many do you treat a month?		9
What percentage of these fractures are open?		10%
Of those you treat, what percent do you treat with:	Non-operative, no immobilization	4%
	Non-operative, immobilization	6%
	Surgical, external fixation	8%
	Surgical, pin fixation	4%
	Surgical, plate and screws	62%

Condition:		
Distal Radius Fractures		
How many do you treat a month?		16
What percentage of these fractures are open?		7%
Of those you treat, what percent do you treat with:	Non-operative, no immobilization	5%
	Non-operative, immobilization	15%
	Surgical, external fixation	9%
	Surgical, bridge plate	4%
	Surgical, pin fixation	6%
	Surgical, plate and screws	53%
Carpal Fractures/Dislocations		
How many do you treat a month?		5
What percentage of these fractures are open?		3%
Of those you treat, what percent do you treat with:	Non-operative, no immobilization	0%
	Non-operative, immobilization	0%
	Surgical, external fixation	2%
	Surgical, pin fixation	30%
	Surgical, plate and screws	50%
Hand/Finger Fractures/Dislocations		
How many do you treat a month?		15
What percentage of these fractures are open?		16%
Of those you treat, what percent do you treat with:	Non-operative, no immobilization	8%
	Non-operative, immobilization	14%
	Surgical, external fixation	4%
	Surgical, pin fixation	13%
	Surgical, plates and screws	12%
	Surgical, intramedullary nail or screw	18%
Tendon injuries		
How many do you treat a month?		11
Nerve Injuries		
How many do you treat a month?		9
Infections (not post-operative)		
How many do you treat a month?		4
Amputations/Partial Amputations		

Condition:		
How many do you treat a month?		8
Upper Extremity Compartment Syndrome		
How many do you treat a month?		1
Birth Brachial Plexus or Traumatic Brachial Plexus		
How many do you treat a month?		1
Upper Extremity Burns		
How many do you treat a month?		2

* Numbers may not add up to 100% as some surgeons chose fewer or more treatment options.

Table 3.

Results of Open-Ended Questions

Query	Results (n)
Most common complications	Stiffness (7) Infection (5) CRPS (3) Pain (3) Lack of strength (1) Non-union, pseudoarthrosis (1) Treatment failure (1)
Most common mechanism of injury	Traffic Accident (7) Work related (5) Falls (3)
Challenges impacting initial presentation:	Travel distances (3) Monetary limitations (3) Referral importance (by provider) (2) Referral importance (by patient) (2) Transportation challenges (2)
Challenges impacting follow-up:	Monetary limitations (4) Transportation challenges (3) Travel distances (2) Lack of awareness that follow up is important (2)
Lack of resource availability:	Therapy (2) Available Material/Implant (2) Surgeons (1) Hospital Staff (1) Hospitals/clinics (1) Anesthesia (1)

Table 4.

Practice Pattern of Physicians

Query	Percentage
Patients with open fractures who receive antibiotics within 24 hours from time to injury	83%
Patients with open fractures who receive antibiotics within 6 hours from time to presentation	72%
Number of patients able to return to work	70%
Patients with fractures who have concomitant nerve injuries	9%
Patients who need to be transferred to another hospital	10%
Patients who need soft tissue coverage	10%
Patients who are unable to get therapy when needed	29%
Patients who are unable to return to follow-up	13%