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Short-term surgical missions in resource-limited environments: Five years of early surgical outcomes

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ABSTRACT

Outcomes of short-term surgical missions (STSMs) hosted in developing countries are underreported, raising quality concerns. This study aims to analyze early outcomes of one humanitarian surgical organization to show that safe essential general surgery can be provided in the context of STSMs.

Records from 6 STSMs to Sierra Leone and Ghana were reviewed for early complications and analysis performed to identify associated factors. Missions performed elective, general surgery on low risk patients, with adherence to patient safety protocols.

No perioperative mortality occurred from 372 procedures, most frequently inguinal hernia repair (54%). Seventeen surgical (5%), 3 infectious (1.2%), and 6 anesthesia (2%) complications were reported. Only younger age was significantly associated with complications.

Essential general surgery can be performed safely on STSM assuming careful patient selection, avoidance of high-risk cases, and adherence to patient safety protocols. Data collection is feasible and should be undertaken to improve the quality of care.

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Introduction

The Lancet Global Surgery 2030 Report[1] and the Disease Control Priorities Volume 3[2,3] have highlighted the disproportionate share of the global burden of surgical disease carried by low and middle income countries (LMICs), with only 3.5% of all surgical procedures provided to the poorest one-third of the population.[2–5] The underlying reasons for this are complex and multifactorial, but often result from too few surgical and anesthesia providers combined with numerous infrastructural challenges in LMICs.[1–5] One approach employed by a growing number of Non-governmental organizations (NGOs) to fill this gap in access to surgical care, are short-term surgical missions (STSMs).[5–8] Depending on the organization, these missions can vary widely in scope and size. The unifying theme is a team of volunteers spending limited time on the ground providing direct surgical care, while relying on partnerships with local healthcare providers for much of the preoperative and follow up care.[5]

Though there are myriad NGOs doing such work, the output of STSMs, the quality of care provided, and their impact has so far been poorly defined.[6,8] This is due to difficulties in documenting follow up care and collecting meaningful data in resource-limited environments. Many NGOs providing care are not academic in scope, and thus there is a lack of publications from these organization on their activities and outcomes. Confounding the problem is the heterogeneity of the "Global Surgery" community. A significant proportion of the data provided by surgical NGOs has come from organizations focusing on subspecialty care, e.g. cleft palates.[9,10] This degree of specialization leaves a question of generalizability of their results to patients requiring general surgery. Reported increases in complications from STSMs when compared to similar operations in high-income countries (HIC) has drawn criticism aimed at those performing STSMs.[5] NGOs have been encouraged to track outcomes to ensure safety and efficacy of their STSMs and ensure that quality improvement measures can take place to best approximate the standard of care in HIC.[7,8]

The International Surgical Health Initiative (ISHI), a 501(c)3 organization based in the United States (US), performs 1–2 week

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humanitarian surgical missions in several LMICs including the African nations of Ghana and Sierra Leone. The organization was founded by academic general surgeons whose initial goal was to bring safe surgery to LMIC and subsequently began to study the outcomes and results of their work. The aim of this study is to describe and analyze short term surgical outcomes and complications from surgical care delivered over 5 years in the context of six ISHI STSMs to West Africa. We hypothesize that essential, general surgical procedures can be performed safely with low immediate complications and mortality on STSMs in resource-limited environments.

Material and methods

Mission locations

Between 2011 and 2015, ISHI performed six STSMs to West Africa, three each at Kabala Government Hospital (KGH), Kabala town, Sierra Leone and Tetteh Quarshie Memorial Hospital (TQMH), Mampong, Ghana.

KGH is a 100-bed district hospital in the rural Koinadugu district of Sierra Leone serving a population of approximately 325,000. At the time of the missions, surgery at KGH was performed almost exclusively on an emergent basis by one non-surgeon physician in one operating room. This same physician managed the hospital with a small team of community health officers. Electricity was not reliable enough to support electrocautery. There was limited availability of running water. Oxygen was available only by generator dependent oxygen concentrator.

TQMH is a 123-bed district hospital serving a rural population of approximately 120,000. TQMH had one surgeon available and was mainly staffed by family medicine residents under the direction of a medical superintendent. Surgery was provided on both emergent and elective basis though at low volumes in two operating rooms with a dedicated recovery area. Electricity and running water were readily available at TQMH, though electrocautery only sometimes available.

Mission description

A typical ISHI mission starts with the triage of 100–150 patients pre-screened by the local healthcare teams. The goal of each ISHI mission is to perform safe surgery and maintain US standards for perioperative care. Triage is performed by surgical residents and attending surgeons and all cases are approved by one of the senior surgical attendings. Careful consideration is placed toward patient selection; any case deemed questionable is discussed between the senior surgical and anesthesia staff and those deemed as high-risk surgical or anesthesia candidates are not offered surgery. Any senior surgical or anesthesia provider can veto any case if the risk is considered prohibitive. After triage, 5–7 operative days ensue consisting of 8–16 elective operative cases daily, with occasional emergent cases performed as necessary.

Patient care

All patients received perioperative antibiotics according to US guidelines for prevention of surgical site infection. A standard timeout checklist procedure was completed prior to incision for all cases. Over the course of the study, surgical care was provided by teams ranging from 13 to 20 (mean 16 ± 3) US-trained, surgeons, anesthetists, surgical residents, nurses, and technologists with support from logistics personnel. Local healthcare workers (MD, RN, CRNA, etc.) were involved in patient care at various levels whenever possible and appropriate. Patients often presented with indications for multiple procedures such as multiple hernias (e.g. inguinal and umbilical) or a hernia with associated hydrocele; as such, some patients underwent more than one surgical procedure. For patients who underwent more than one procedure, a primary and secondary procedure was listed; the operation deemed more urgent based on symptoms was classified as primary. Mesh repair was performed for the majority of inguinal hernias, unless specifically contraindicated. Post-operative care was provided by the ISHI team with support from the local hospital staff. Patients were admitted overnight and observed by the surgical team for a range of 1–7 days.

Data collection, analysis, and IRB approval

Case logs and patient charts generated during missions for all adult patients receiving an operation from the ISHI team on the six missions to West Africa were reviewed for short term surgical and anesthesia complications. Associated demographic and clinical data such as anesthesia type or performance of a secondary procedure was also reviewed.

Surgical complications were classified according to the Clavien-Dindo score (Fig. 1).[9] Statistical analysis was performed to identify factors associated with immediate complications via student's t-test for continuous variables and Chi Square analysis and Fischer's exact test analysis for categorical variables. . This study was approved by the Institutional Review Board at Rutgers New Jersey Medical School.

Results

In total, 372 procedures were performed on 327 adult patients during the six missions to West Africa. Demographics are listed in Table 1. The most common primary procedures were inguinal hernia repair (54%) and soft tissue mass excision (15%). Forty-five patients (14%) underwent secondary procedures at the time of initial operation, most commonly contralateral inguinal hernia repair (51%), and hydrocelectomy (18%). Six operative cases were classified as emergent, including two perforated ulcers and one strangulated inguinal hernia. Anesthesia was provided as seen in Table 1, with the majority (75%) being spinal anesthesia.

No intraoperative or perioperative death occurred in the 327 patients receiving operations. Six anesthesia complications (1.8%) were reported including 2 cases of urinary retention, 1 aspiration, 1 spinal headache, 1 minor allergic reaction, and 1 intra-operative self-extubation. Seventeen early surgical complications (5%) were reported: 5 Clavien-Dindo grade 1, 5 grade 2, 7 grade 3. Of the 7 complications requiring re-operation, 4 were for bleeding complications, 2 technical complications, and 1 wound infection. Four wound infections (1.2%) requiring treatment were reported. Zero complications occurred in the emergent cases.

No significant differences were found in complication rates when comparing gender, mission location, anesthesia type, or the performance of a secondary procedure at time of initial operation (Table 2). Patients with complications were significantly younger (38 ± 11 years vs. 45 ± 14 years; $p = 0.04$) compared to those without complications.

When comparing the two mission locations, age and procedure types were similar. Female patients (52% vs. 15%) and the use of general anesthesia (20.4% vs. 2.5%) were more common at TQMH (Ghana), whereas complications were more frequent (3.0% vs. 6.7%) at KGH (Sierra Leone). However, these differences were not significant.

Grade	Definition
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions
	Allowed therapeutic regimens are: drugs as antiemetics, antipyretics, analgetics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications
	Blood transfusions and total parenteral nutrition are also included
Grade III	Requiring surgical, endoscopic or radiological intervention
Grade IIIa	Intervention not under general anesthesia
Grade IIIb	Intervention under general anesthesia
Grade IV	Life-threatening complication (including CNS complications)* requiring IC/ICU management
Grade IVa	Single organ dysfunction (including dialysis)
Grade IVb	Multiorgan dysfunction
Grade V	Death of a patient
Suffix "d"	If the patient suffers from a complication at the time of discharge (see examples in Table 2), the suffix "d" (for "disability") is added to the respective grade of complication. This label indicates the need for a follow-up to fully evaluate the complication.

*Brain hemorrhage, ischemic stroke, subarrachnoidal bleeding, but excluding transient ischemic attacks.
CNS, central nervous system; IC, intermediate care; ICU, intensive care unit.

Fig. 1. Clavien-dindo classification of surgical complications.

Table 1
Demographics, anesthesia, and procedures.

	Total (n = 327)	TQMH[a] (n = 132)	KGH[b] (n = 195)
Age (Mean ± SD years)	45 ± 14	47 ± 15	43 ± 13
Sex n (%)			
Male	215 (66)	64 (48)	151 (77)
Female	97 (30)	68 (52)	29 (15)
Unrecorded	15 (4)	0 (0)	15 (8)
Anesthesia n (%)			
General	33 (10)	28 (21)	5 (2)
Spinal	245 (75)	72 (55)	173 (89)
Local	49 (15)	32 (24)	17 (9)
Primary procedure n (%)			
Inguinal Hernia Repair	182 (56)	52 (39)	130 (67)
Mass Excision	48 (15)	33 (25)	15 (8)
Hydrocelectomy	40 (12)	3 (2)	17 (9)
Ventral/Umbilical Hernia Repair	30 (9)	24 (18)	6 (3)
Hysterectomy	16 (5)	16 (12)	0 (0)
Other	11 (3)	4 (3)	7 (3)
Secondary procedure n (%)	47 (14)	8 (6)	39 (20)

[a] Tetteh Quarshie Memorial Hospital.
[b] Kabala Government Hospital.

Table 2
Comparison of patients with and without complications.

	Complications, n (%)		p-value
	No, n = 310 (95)	Yes, n = 17 (5)	
Age (Mean ± SD years)	45 ± 14	38 ± 11	*0.04*[a]
Male	203 (65)	12 (71)	*0.21*
Anesthesia type			*0.36*
General	30 (10)	3 (17)	
Spinal	232 (75)	13 (77)	
Local	48 (15)	1 (6)	
Primary procedure			*0.55*
Inguinal Hernia Repair	172 (55)	10 (59)	
Mass Excision	47 (15)	1 (6)	
Hydrocelectomy	37 (12)	3 (18)	
Ventral/Umbilical Hernia Repair	29 (9)	1 (6)	
Hysterectomy	14 (5)	2 (12)	
Other	11 (4)	0 (0)	
Secondary procedure	43 (14)	4 (24)	*0.13*
Location			*0.15*
TQMH	128 (41)	4 (24)	
KGH	182 (59)	13 (76)	

[a] Statistical significance ($p < 0.05$).

Discussion

Given the enormous scope of untreated surgical disease globally, STSMs remain one viable approach towards immediately alleviating some of this burden. However, STSMs are only an acceptable solution provided safe surgical care is being delivered and good outcomes are obtained. NGO surgical output is generally underreported and has been mainly limited to a few the larger groups such as Operation Smile[10–12] and Médecins Sans Frontières.[13] This data is not necessarily representative of the myriad smaller NGOs working globally.[6]

This study demonstrates that given proper case selection and maintaining HIC standards, desperately needed surgical care can be provided to LMIC with low morbidity and mortality. The overall immediate surgical complication rate from ISHI's 6 STSMs was 5.1% with zero operative mortality. This is well within an acceptable range when comparing to elective surgery in the US[14] and other efforts in similar settings. Gil et al. 2010[15] also reported complications comparable to those in HIC when comparing inguinal hernia repair performed in Cameroon and Mali by international cooperatives versus hernia repair in the context of a multi-center

Spanish hernia trial. Despite the challenges of maintaining sterile conditions, infectious complications remained acceptable at 1.2%, and only 0.5% for patients undergoing inguinal hernia repair. Anesthesia complications were also acceptable at 1.8% and accounted for 26% of the total complications in our series.

Our operative mortality of zero matches a larger series showing low operative mortality in across 17 humanitarian surgical programs in 13 LMICs and provides further support that safe surgery can be performed in resource-limited settings.[13] This same study associated mortality with emergency conditions, abdominal surgical procedures, hysterectomy, and ASA class 3 to 5. While hysterectomy was performed by ISHI (5% of cases in this series), emergent procedures represented less than 2% of the cases. ISHI typically declines high risk operations that would require longer anesthesia and recovery times, post-operative care that is beyond the providing hospital's capacity, or patients with untreated comorbidities and high anesthetic risk.

The complication rates reported here are likely attributable to careful patient selection and patient safety protocols. Complications have been shown to arise with operative and patient complexity in similar settings.[5,10,11] Safety protocols are cited as an important reason for acceptable complication rates despite resource limitations and implementation is suggested for any STSM.[13,16] Furthermore, simple improvement measures such as earlier and more detailed planning and routine antibiotic use can reduce complications.[10] Indeed, ISHI routinely follows accepted protocols such as Surgical Care Improvement Project (SCIP) guidelines for perioperative antibiotics,[17] and timeout process based on the WHO surgical safety checklist.[18]

No significant associations were identified between immediate complications and procedure type, mission location, gender, anesthesia type, or the performance of a secondary procedure at time of initial operation. Our lack of significance may be due to a limited sample size and further prospective data collection may better elucidate factors associated with complications. Pooling data from multiple organizations may assist this endeavor. We did find a statistically significant association between surgical complications and younger age, which is difficult to interpret given that clinical variables, such as procedure type and anesthesia type were similar across age groups. In addition, given that stated ages may be unreliable in such settings, we believe this finding is clinically insignificant.

Comparing mission locations, the complication rate was higher at KGH (6.6%) versus TQMH (3.0%), though this was not statistically significant, possibly due to a Type II sample size error. This difference may be partially attributable to the overall surgical capacity of the two host hospitals. Though both are rural district hospitals, KGH is less equipped with ancillary services and infrastructure than TQMH. This is highlighted by greater local surgical volume at TQMH. This is consistent with North American studies showing larger hospital volume to be associated with improved outcomes.[19] NGOs must be cognizant of the unique challenges of each location visited and how they may affect outcomes, so that they may plan accordingly. Furthermore, the experience and volume of the organization may contribute to the difference in complication rates. Others have shown reduction in complications on repeat missions when a post-mission analysis is completed and changes are made bases on such analysis.[10] While ISHI performed no such discrete changes between missions to KGH (2011–2013) and missions at TQMH (2013–2015), operational knowledge gained likely led to many subtle changes from mission to mission. Using this data as a baseline, quality improvement measures can be undertaken and studied.

The limitations of this study are multiple and include its retrospective, observational nature, and the limited data set. This reflects the challenges of collecting information in the context of STSMs. Paper records, filled out by clinical volunteers may be incomplete in respect to certain data points preventing more extensive analysis. ISHI does not have the staff to focus on intensive data collection and monitoring on top of patient care. Outcomes in this study are limited to inpatient complications and do not elucidate the overall long-term complication rate. This is a single, young, volunteer-run organization's experience in two unique locations and cannot necessarily be generalized to all other organizations or mission locations.

Better efforts to collect data regarding outcomes and safety may be challenging but is necessary. NGOs must record and keep complications low for several obvious and important reasons: Complications are more difficult to manage in resource-limited settings, high complication rates on STSMs can burden the host facilities and patients to an unacceptable degree, and it can compromise the cost-effectiveness of STSMs and the prospects of long-term partnerships.[3] We agree with others[20] that some standardization of safety measures, follow up procedures, and data collection should be developed. Internal auditing of surgical outcomes by NGOs is not mandated but should occur so that improvements may take place in a timely manner and mistakes are not repeated in all phases of care. Prospective data collection, inclusive of multiple NGOs' experiences may better reveal specific clinical and institutional factors associated with surgical complications which may then inform future quality improvement. NGOs should furthermore be encouraged to collect *long-term* outcomes for quality assurance. Returning regularly to the same locations and engaging the host institution will facilitate such data collection.

Conclusion

Our data shows that essential general surgery can be performed by a humanitarian NGO successfully with an acceptable early complication rate and no mortality in resource-limited settings. Our complication rate is likely attributable to careful patient selection, avoidance of high-risk operative cases, as well as safety protocols and checklists to best approximate the US standard of care. Low complication rates are important not only for patient care, but for building trust with the local community to create sustainable partnerships, and maximizing cost-effectiveness. Data collection in such environments is challenging but feasible. Further data reporting from other active surgical humanitarian organizations is needed to further assess NGO sector's contributions towards reducing the global burden of surgical disease in LMICs. Development of consensus standards and universal safety protocols may allow for further quality improvement for the entire Global Surgery sector.

Conflicts of interest

We attest that no conflicts of interest exist among the authors of this paper. We have no financial disclosures and no grant support was used for the production of this research. Funding for this research came from internal departmental funding.

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