

Surgery under Extreme Conditions in the Aftermath of the 2010 Haiti Earthquake: The Importance of Regional Anesthesia

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Abbreviations:

NGO = non-governmental organization
TIVA = total intravenous anesthesia
UM = University of Miami
UMMH = University of Miami Hospital
Haiti
UN = United Nations

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Abstract

The 12 January 2010 earthquake that struck Port-au-Prince, Haiti caused >200,000 deaths, thousands of injuries requiring immediate surgical interventions, and 1.5 million internally displaced survivors. The earthquake destroyed or disabled most medical facilities in the city, seriously hampering the ability to deliver immediate life- and limb-saving surgical care. A Project Medishare/University of Miami Miller School of Medicine trauma team deployed to Haiti from Miami within 24 hours of the earthquake. The team began work at a pre-existing tent facility in the United Nations (UN) compound based at the airport, where they encountered 225 critically injured patients. However, non-sterile conditions, no means to administer oxygen, the lack of surgical equipment and supplies, and no anesthetics precluded the immediate delivery of general anesthesia. Despite these limitations, resuscitative care was administered, and during the first 72 hours following the event, some amputations were performed with local anesthesia. Because of these austere conditions, an anesthesiologist, experienced and equipped to administer regional block anesthesia, was dispatched three days later to perform anesthesia for limb amputations, debridements, and wound care using single shot block anesthesia until a better equipped tent facility was established. After four weeks, the relief effort evolved into a 250-bed, multi-specialty trauma/intensive care center staffed with >200 medical, nursing, and administrative staff. Within that timeframe, the facility and its staff completed 1,000 surgeries, including spine and pediatric neurological procedures, without major complications. This experience suggests that when local emergency medical resources are completely destroyed or seriously disabled, a surgical team staffed and equipped to provide regional nerve block anesthesia and acute pain management can be dispatched rapidly to serve as a bridge to more advanced field surgical and intensive care, which takes longer to deploy and set up.

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Introduction

The humanitarian disaster in Haiti began decades before the earthquake of 12 January 2010. According to the Pan-American Health Organization (PAHO), basic sanitation, clean water supply, access to healthcare and education, nutrition, and all other basic societal infrastructure systems were severely deficient prior to the earthquake. The leadership of Project Medishare (www.projectmedishare.org), a non-governmental organization (NGO) headquartered in Miami, Florida, in partnership with the University of Miami Miller School of Medicine Global Institute responded immediately to news of the devastating earthquake. This was due to long-standing ties between Medishare and Haitian physicians and community. Also, in December 2009, a member of the Haiti disaster relief team participated in the performance of

Haiti's first successful living-donor kidney transplant. These previous activities created a network of contacts of physicians in Miami and Haiti, and enhanced the team's knowledge of the region and its healthcare system, which served to facilitate the establishment of a medical disaster relief network, shortly after the earthquake. However, one member of the team had experience in earthquake disasters of this magnitude, and the University of Miami School of Medicine never before had engaged in a humanitarian disaster relief operation on such a large scale.

This report presents the perspective of an academic department of anesthesia, whose faculty participated in relief activities that were organized, implemented, and financed by Project Medishare. The primary focus is to critically evaluate this experience to determine whether there are any important lessons to be learned that could be applied to future disaster relief operations.

Pre-Event Health Status

The Haitian population of nine million people lived with continual exposure to vector-borne diseases. This exposure ranged from endemic malaria to dengue, high prevalence rates of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) (5.2%), and tuberculosis (TB) (35/100,000); more than half of the infants lacked vaccination for diphtheria, pertussis, and tetanus (DTP); 40% of the population lacked access to basic healthcare; had chronic malnutrition, grossly inadequate sanitation; and only 54% of the population had access to clean water. Infant and under-five-year mortality rates were among the highest globally, 59.7/1,000 and 76/1,000 respectively, due to poverty, deficiencies in the health system, infectious diseases, and the impact of the AIDS epidemic. The leading causes of death for infants and children were acute diarrheal diseases (12.1%), infections during the peri-natal period (10.2%), malnutrition (9.1%), and acute respiratory infections (6.9%). Population density in Haiti is among the highest worldwide with 361.5 persons per square kilometer.¹ There were 371 health posts, 217 health centers, and 49 hospitals in Port-au-Prince before the earthquake. Healthcare sector human resources were inadequate, with approximately one doctor for every 7,180 inhabitants and one nurse per 2,290 persons. Hospital beds averaged one per 2,000 persons.

In terms of hazard-risk analysis, Haiti is a known earthquake zone. Mannaker *et al*² and Mann *et al*, both in 2008,³ forecasted that due to accumulated strains along a boundary between tectonic plates, a region including Haiti, Jamaica, and the Dominican Republic was due for an earthquake on the order of magnitude 7.2. It is in the context of this fragile social infrastructure and lack of preparedness, despite known seismic risk, that the impact of the earthquake was so profound and absolute.

Event

On 12 January 2010 at 16:53 hrs local time, a 7.0 magnitude (Richter scale) earthquake (located at 18.457°N, 72.533°W along the Enriquillo-Plaintain Garden fault line separating the Caribbean and North American plates), struck the Haiti region—15 miles WSW of Port-au-Prince

(population 1,235,000), with a duration of 10 seconds, that caused widespread damage.

Damage

The earthquake destroyed or disabled most major health centers in Port-au-Prince (Figure 1). Among them, were the UN clinic at the Christopher Hotel (collapsed), the 45-bed Médecins sans Frontières (MSF)-sponsored Martissant Trauma and 15-bed Maternity Center (damaged and unstable), the Solidarite Maternity Hospital (severely damaged), the 60-bed Trinite Trauma Center (severely damaged), the 700-bed University Hospital (damaged), the 60-bed New Hospital on Delmas (damaged), 120-bed Petits Frères et Soeurs Hospital (damaged), and the 45-bed Eliazard Germaine Hospital (damaged).^{4,5} Data on the number of beds in the remaining facilities were not available. However, those facilities that remained standing could not resume patient care due to the interruption of lifelines (gas, electricity, water, transportation, and communications) or they were evacuated for fear of collapse from presumed structural damage or aftershocks. Compounding the devastation, the country was left without functioning government and the international organizations that had supported and coordinated its basic societal infrastructure for so many years. It quickly became apparent that this was a disaster without precedent in the western hemisphere.

Relief-Response Phase

This involvement in relief efforts began after a five-person Project Medishare/University of Miami medical team assembled by the Medishare founder and University of Miami Miller School of Medicine professor, arrived at the Port-au-Prince airport on 13 January from Miami via corporate jet (travel time between Miami to Port-au-Prince = 1 hour 30 min).⁶ Immediately upon arrival, they encountered 225 severely injured Haitians housed in two open storage tents at the United Nations compound at the airport. The injuries included open and closed long-bone fractures, suspected pelvic and spinal fractures, complex open wounds, and crush injuries, as well as severe dehydration. Approximately 30% of the casualties were infants and children. In addition to providing initial resuscitative care, this team was able to establish lines of communication with key disaster coordinators in Haiti. The next day, a logistics team in Miami was convened to coordinate with the ground team. Through this ground-level planning, the Miami logistics and coordination team could maintain a responsive supply chain of appropriate medical supplies and staff as needs arose or changed daily in the field. The effort drew resources from the entire University of Miami community.

The scope of surgical fieldwork in Haiti evolved over four periods as determined by types of injuries, available anesthesia and surgical staff, available supplies and equipment, and conditions on the ground, each with its capabilities and capacities to perform anesthesia and surgical interventions.

Morbidity and Mortality

Pan-American Health Organization (PAHO) officials estimate that approximately 217,000 people were killed out of a total population of 3.7 million in Port-au-Prince, for a crude mortality rate of 59 per 1,000 inhabitants. Hundreds

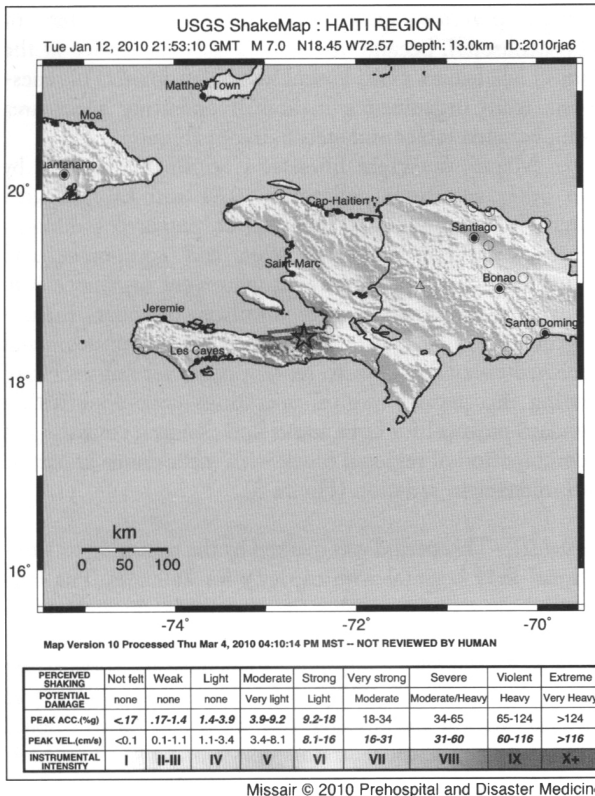


Figure 1—United States Geological Survey map of the 12 January 2010 earthquake in Haiti. The map shows areas of intensity and magnitude.

of thousands sustained injuries and 1.5 million remain without adequate shelter. Consistent with demographics a large proportion of the injured and killed were children, but no exact figures were available at the time of the study. In 24 hours, the Medishare team triaged hundreds of patients for care or to die. Lower extremity fractures were more prevalent than were fractures of an upper limb.

As observed in previous reports of injury and death following major earthquake disasters,⁷⁻¹⁰ crush injury was the most prevalent injury type and cause of death. Based on anecdotal, journalistic accounts and media reports, there also was high mortality during the first 24 hours, especially among critically injured victims trapped or pinned under rubble.

Search and Rescue

A total of 67 international search-and-rescue teams comprising 1,918 professional rescuers and 160 rescue dogs were involved in the search-and-rescue efforts. However, only 136 people were extricated alive from under rubble by professional search-and-rescue teams. The vast majority of live extrications occurred during the first 24–48 hours. These consisted of self-extrication of individuals trapped under light rubble or extrications performed by bystanders using their bare hands or improvised tools. The Haitian government declared the rescue effort over at 16:00h on 23 January. An 84-year-old woman and a 22-year-old man were the last to be extricated alive. There were several well-documented eyewitness accounts of deaths occurring shortly after extrication from under heavy rubble (crush-release

death). The mode of transportation of the injured and dying to still standing hospitals, clinics, and tent medical facilities was carried out primarily by relatives and friends of the injured in private vehicles or by whatever means possible.

Types and Mechanisms of Injury

The prevalent injury type and mechanism was crush from structural collapses. Casualties with severe crush injury of the head, chest, and abdomen already had died or were in the advanced stages of dying by the time the first relief medical teams arrived. The majority of seriously injured casualties that survived the first 48–72 hours had crush injury of the limbs and fractures of the long bones (humerus, femur, tibia-fibula), pelvic fractures, spine injuries, crush syndrome, extremity compartment syndrome, open fractures with infected and gangrenous wounds, burns, and/or sepsis. Less severe injuries included minor blunt head, chest, and abdominal trauma and lacerations, rib fractures, closed fractures of the extremities, burns, and facial and scalp lacerations.

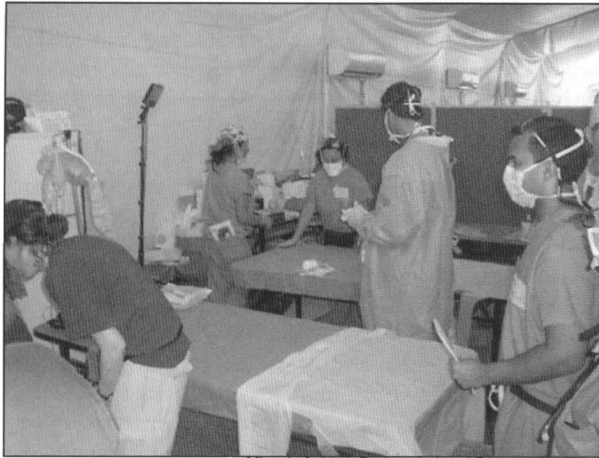
Types of Surgical Interventions

The types of medical activities and surgical interventions throughout the four periods of disaster relief consisted of the following: triage, basic and advanced trauma life support, airway management, improvised medical record keeping, expectant care, first aid, fracture management, placement of intravenous lines, fluid resuscitation and re-hydration, antibiotic and tetanus prophylaxis, orthopedic surgery (amputations), open wound and burn care, wound debridement, spine and neurological surgery, disposal of amputated limbs, regional anesthesia and pain management, general anesthesia, critical care, and preparation and transport of critically ill patients to hospitals in Miami and South Florida.

Period I—The first five-person Project Medishare/University of Miami (UM) Medical Relief Team arrived in Port-au-Prince 20 hours after the earthquake impact on a donated corporate jet with limited medical supplies and equipment. It was comprised of three surgeons, one anesthesiologist (EP), and one Cardiologist/Associate Dean of the Medical School.⁶ Elizabeth Cohen, a senior CNN medical correspondent, accompanied the team to Port-au-Prince.

As mentioned above, upon arrival, the team was immediately taken to the UN compound at the airport where they encountered 225 critically injured Haitians lying in two open storage tents. The team was not prepared to provide general anesthesia. The following supplies were hand carried: antibiotics (dicloxacillin), tetanus toxoid, narcotic (morphine sulphate; 30 mg tablets for children and 60 mg tablets for adults), 5 vials of ketamine (50 mg/cc), 6 vials of propofol (10 mg/cc), 3 vials of succinylcholine (20 mg/cc), 32 small vials of Ketorolac, one manual bag-valve ventilation bag, intravenous supplies and sterile saline bags, and dressing changes, all of which were rapidly depleted.

Despite these limitations, in the next 72 hours, this Team attended to these patients under extreme conditions, without access to food, sleep, readily available sanitary facilities, hygiene, or shelter. A few urgent amputations were done without anesthesia, which formed the basis of the first



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Figure 2—Makeshift operating room in the Medishare/University of Miami Field Hospital, Haiti

media reports transmitted worldwide from Haiti, describing “civil war anesthesia”. [“Expect Gettysburg”: Elizabeth Cohen CNN Senior Medical Correspondent (<http://pagingdrugupta.blogs.cnn.com/2010/01/15/expect-gettysburg>)]. During the first 72 hours, the team witnessed several deaths that may have been prevented had there been the capability to perform thoracic or neurosurgical procedures and one patient died for lack of chest tube drainage (no vacuum available). Nevertheless, the team provided valuable resuscitative care, found time to perform and communicate needs assessments information back to Miami concerning the situation at the airport, and established contacts with local Haitian authorities and US Army and Air Force personnel who took the lead role for coordination and control of air traffic at the airport and later for the overall relief effort during the early stages of the response.

Period II—Based on these initial reports, there was no expectation for immediate improvement and the decision was made to prepare to send more staff and equipment to set up a field hospital. An anesthesiologist with experience in disaster relief operations was appointed “Haiti Disaster Relief Coordinator” (EAP, Jr.) by the Chair of Anesthesia (DL) to direct the overall effort on behalf of the Department of Anesthesia. After a review of the situation on the ground, which indicated a need for immediate extremity surgery, primarily amputations, the Disaster Relief Coordinator decided to send experienced regional anesthesia-trained personnel to Haiti. The first to be dispatched was the Chief of the Division of Regional Anesthesia (RG), the most experienced regional anesthesiologist in the Department, who was also familiar with anesthesia for combat casualty care. The primary indication for amputation was an infected or gangrenous crushed limb in a patient with signs of sepsis.

The regional anesthesia supplies sent consisted of local anesthetics (mepivacaine 1.5% and ropivacaine 0.5%), nerve stimulators, nerve block needles, 44 vials of ketamine and midazolam, all packed in suitcases and hand carried bags. The UM Regional Anesthesiologist, three attending anesthesiologists, and two resident anesthesiologists from a

private practice group (Anesthesia Associates of Massachusetts), became the first anesthesia service at the Project Medishare Haiti Field Hospital in Haiti. This anesthesia team organized a makeshift operating room area using wooden tables and sterile drapes (Figure 2).

In Miami, the Haiti Disaster Coordinator, assisted by two other anesthesia colleagues (AM and LC), secured donations to support the relief effort, prepared a donated list of anesthesia drugs, supplies, and equipment, and recruited a roster of volunteers, who were organized into rotating teams of two or three anesthesia providers, including certified nurse anesthetists (CRNA). A fresh team was deployed every five days to replace those serving in Haiti. During this period, surgical operations were done with a standard protocol for both adults and children consisting of a combination of regional block with intravenous ketamine and midazolam sedation (Figure 3).

Period III—This period was marked by the transition to a traditional field hospital with capacity for 250 cots. The field hospital was set up at another site, also nearby the airport (1.5 miles from the original tent within the UN compound), and required a temporary interruption in medical and surgical care due to the transfer of >200 patients. The arrival of additional medical, surgical and nursing staff, more and varied surgical supplies, oxygen concentrators, oxygen tanks, anesthesia machines, and other essential anesthesia equipment all shipped from Miami allowed the evolution of anesthesia services from an exclusively regional block service to more conventional general anesthesia consisting of four fully functional operating rooms equipped with two Narkomed anesthesia machines (Narkomed, Draeger Medical Inc., Telford, PA), pressurized oxygen (E tanks), four oxygen concentrators, 16 portable Carina mechanical ventilators (Narkomed, Draeger Medical Inc., Telford, PA), fluoroscopy (C-arm), and four monitors. However, no laboratory or blood banking services were available during this time. This transition facilitated more advanced definitive surgical care of adults and children, such as open reduction and internal fixation of more complex fractures, placement of external fixation devices, spine surgery, the establishment of more specialized treatment areas, including a fully staffed pediatric operating room in conjunction with a Miami Children’s Hospital surgical team, a Post-Anesthesia Care Unit, and an Intensive Care Unit.

Regional Anesthesia Management

By the end of Period III, the field regional anesthesia service had completed a total of 63 upper (axillary and interscalene) and 473 lower extremity single shot nerve blocks (femoral and sciatic) for a total of 312 procedures in which regional anesthesia was used (Table 1). Lower extremity cases almost always required combined femoral/sciatic nerve blocks. No catheters were placed for fear of infection. The vast majority of these patients were categorized as American Society of Anesthesiologists (ASA) 1 or 2.

Blocks were performed using nerve stimulation (Stimuplex, B. Braun Medical Inc., Bethlehem, PA) and insulating needles (Stimuplex, B. Braun Medical Inc., Bethlehem, PA). The local anesthetics, ropivacaine (0.35%–0.5%) and mepivacaine (1.5%), were used exclu-



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Figure 3—Regional anesthesiologist performing a single shot interscalene nerve block at the UM field hospital in Haiti

sively combined with intravenous midazolam/ketamine sedation. In 48 minor debridement or wound care cases, sedation with midazolam/ketamine alone was used.

Prior to placement of regional blocks, patients were transported on stretchers to the “operating room area”, placed on draped wooden tables, then sedated with ketamine and midazolam, which was supplemented during the procedure, as needed. The procedures were completed pain-free and safely on spontaneously breathing patients, in the absence of a formal sterile operating room, general anesthetics, endotracheal intubation, mechanical ventilators, and supplemental oxygen (Figure 4).

Monitoring

The available monitoring modality for the first 105 cases consisted of one manual blood pressure cuff and one small portable finger pulse oximeter (Onyx 9500, Nonin Medical Inc., Plymouth, MN), both shared between patients as needed, and a transport pulse oximeter (Nellcor N-200, Covidien-Nellcor, Bolder, CO). A non-invasive automatic blood pressure monitoring device became available later for the remaining 33 cases. All of the cases were performed without oxygen, laboratory data, or blood on sedated spontaneously breathing patients. The single pulse oximeter and a manual blood pressure cuff were shared between patients.

Transhumeral Amputations and Revisions	14
Forearm or Hand Amputations Revisions	11
Above-the-Knee Amputations and Revisions	27
Below-the-Knee Amputations and Revisions	78
Extensive Debridement and Wound Care Upper Extremity	38
Extensive Debridement and Wound Care Lower Extremity	119
External Fixation Placement	25

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Table 1—Surgical procedures performed through Phase III in which regional anesthesia was utilized (n = 312)

Complications

Under the regional anesthesia/sedation and acute pain treatment regimen described above no patient experienced pain or discomfort during surgery, or suffered a perioperative anesthetic complication. Nerve blocks were performed by fellowship-trained regional anesthesiologists with a success rate of approximately 90%. Perioperative mortality was zero. No neuroaxial (spinal or epidural) anesthesia was performed due to concern for hypotension and infection, in dehydrated, hypovolemic, and septic patients. However, as regional blocks dissipated and with repeated administration of post-operative anxiolytics and narcotics by multiple non-anesthesia practitioners on the “hospital wards” in the absence of accurate medicine administration records, a few patients experienced respiratory depression requiring manual ventilation during the first 36–48 hours.

Period IV—After two weeks, the establishment of two fully functional operating rooms and changes in the skill set of anesthesia staff due to replacement-personnel, the simplicity and safety afforded by an exclusively regional anesthetic service was completely substituted by a more conventional general inhalational and intravenous anesthesia delivery model. This transition required a much greater infrastructure, but at the same time, increased the capacity to perform more complex surgical procedures and of greater duration, including spine and neurological surgery. During this time-frame, the scope of medical attention shifted from the acute to the chronic and ongoing medical care.

The Project Medishare/University of Miami Hospital Haiti (UMMH), as it has become known, gradually assumed care of ongoing medical and trauma surgical needs for the surviving inhabitants of Port-au-Prince in the absence of a stable healthcare system. By 12 February, UMMH had performed 1,000 surgeries (an average of two procedures per patient) including pediatric neurological surgery, treated >1,500 patients, and after initial stabilization and emergency treatment, transferred hundreds of seriously injured patients to hospitals in Miami and South Florida.

Discussion

Project Medishare is a non-profit, non-governmental organization with extensive experience in the organization and



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Figure 4—UM surgical team performing surgery on a casualty under regional anesthesia. The patient is awake, sedated, and breathing spontaneously.

implementation of community health projects, whose presence in Haiti preceded the earthquake by more than a decade. This fact coupled with the geographic proximity of Miami, Florida to Port-au-Prince, Haiti facilitated the rapid arrival of foreign medical staff working under the Project Medishare tents. However, due to the extent of the devastation, which was compounded by scant pre-existing resources, the provision of adequate surgical care, especially during the first 72 hours by the initial medical relief team, was not possible despite rapid deployment, for several reasons. Among the challenges were the need to initiate medical relief activities in a tent designed for warehousing not medical care (not by design, but by default), and the unplanned encounter with 225 seriously injured patients awaiting emergency medical treatment and evacuation already in those tents. Also, because of the circumstances of rapid deployment, the team was not equipped or supplied to perform general anesthesia, especially under such conditions.⁶

Despite these challenges, the team provided resuscitative care to hundreds of casualties and performed some amputations, albeit without anesthesia. However, the psychological impact of the horrendous conditions encountered by this team in the early hours and days following the event left an indelible mark in the minds and hearts of those individuals who comprised the first UM relief team in Haiti.

After three days, the team was reinforced and resupplied with desperately needed staff, equipment, and supplies. Team capability shifted from primarily resuscitative and supportive care to surgical and trauma care, but operations were limited to emergency orthopedic procedures using regional block techniques for anesthesia and acute pain management. These procedures were conducted under extremely austere conditions, in the absence of basic surgical and anesthesia equipment or oxygen, on spontaneously breathing patients breathing ambient air.

What lessons can be drawn from this experience? One of the major controversies in medical disaster responses has been the cost-benefits of establishing field hospitals in the aftermath of major disasters by governmental and NGOs

across borders. This is due to the fact that the delivery of foreign disaster assistance must overcome many diplomatic and logistical hurdles both before and during deployment, and rarely are teams able to provide care in a timely manner to have a major impact on lifesaving, especially among the critically injured. This is why some experienced and well-respected medical disaster relief experts believe strongly that the deployment of field hospitals from afar, is an exercise in futility, which serves political rather than a realistic lifesaving objective¹¹—the rationale being that it is nearly impossible for foreign teams to be dispatched, transported, set up, and able to initiate operations before 72 hours. In this vein, Rahardjo *et al* highlight, in great detail, the myriad of difficulties encountered in the coordination and delivery of international relief following the tsunami in Indonesia.¹² Similar and, perhaps, in some respects, even worse logistical problems were encountered in Haiti, but a detailed description of these failures is beyond the scope of this paper.

The priority, in the authors' experiences, was rapid entry into the field to deliver immediate medical relief. But in so doing, this approach inadvertently compromised full surgical capacity. Obviously, the latter was not intentional, but rather a consequence of the lack of information about the situation on the ground, inexperience of initial team members in disasters, as well as the unexpected severity and magnitude of the event, in terms of human and physical damage. A major advantage for the initial team was the geographic proximity of Miami to the disaster zone (90 minutes by air) and prior knowledge of the terrain. Despite the fact that the effort began haphazardly, with a minimally equipped medical relief team that was overwhelmed rapidly, and faced major challenges, the team was able to quickly re-focus, redirect its efforts, resupply, and accomplished a few major goals of disaster relief. Among them, resuscitative care, probiotic prophylaxis, and evacuation of severely injured casualties.

In hindsight, it is safe to say that had more information about conditions on the ground been available during the first 24 hours and had the first Medishare team taken the time to assemble more supplies and equipment, the effort could easily have been prepared to provide regional anesthesia from the onset, instead of at Day 3. Moreover, a reasonable argument can be made to suggest that the same results could have been obtained by using the anesthetic ketamine, alone or in combination with other intravenous agents—a total intravenous anesthesia (TIVA) approach. However, the authors disagree with this argument. Due to the lack of staff, no ventilators, oxygen, monitors, shortage of airway management and intubation equipment, and supplies, etc. in the first 72 hours, not even TIVA could have been administered in a safe and efficient manner. From this experience in Haiti, only regional block anesthesia fulfilled all the requirements in light of prevailing conditions and limitations. However, in the future, a surgical team that is better prepared and equipped to provide both regional anesthesia and total intravenous anesthesia, and combinations thereof, may be feasible without compromising on the rapidity of response.

Therefore, although not initially planned, the first UM field team bought time to prepare and implement a more

complete medical relief effort. It also bridged a gap in the early emergency medical response by providing urgently needed resuscitative care, which often is lacking in major disasters.¹³ The transition to a major field hospital occurred later, and only because there was a clear and urgent need in the affected community to do so. In fact, at the end of Period II, the team could just as easily have packed its bags and left, having accomplished the primary objective, as did some other foreign medical relief teams. In the future, rather than establishing field hospitals, disaster relief organizations and others may consider a “middle of the road” resuscitative and regional anesthesia surgical team approach as a more portable, rapid, cost-effective, and practical alternative. Furthermore, this experience proves that even a private academic medical institution in partnership with a small NGO can dispatch a surgical team to a disaster to provide lifesaving, cost-effective, resuscitative surgery in disaster.

Conclusions

Regional anesthesia-based surgical field teams are extremely portable, can be assembled and deployed rapidly, can ini-

tiate operations promptly, and can reach almost any corner of the world within a reasonable lifesaving timeframe. Undoubtedly, the exclusive use of regional anesthesia may limit the scope of surgical intervention. However, with some minor modifications in equipment and supplies, a more comprehensive surgical capability than the one described herein is possible. Regional block anesthesia techniques administered by experienced regional fellowship-trained anesthesiologists worked well on both adults and children, especially when combined with carefully titrated intravenous doses of ketamine and midazolam for sedation and analgesia, or general anesthesia. Another major advantage of this approach is that the relatively long duration of the single shot regional blocks, ranging from 2–6 hours, reduced narcotic use, and its side effects such as nausea, vomiting, and respiratory depression, thereby markedly limiting the need for post-operative monitoring and nursing care. Finally, the 2010 earthquake of Haiti is among the greatest disasters of the past half-century. Recovery efforts will likely continue for years, perhaps decades to come.

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Editorial Comments—Surgery under Extreme Conditions in the Aftermath of the 2010 Haiti Earthquake

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The Special Report on “Surgery under Extreme Conditions in the Aftermath of the 2010 Haiti Earthquake: The Importance of Regional Anesthesia” by Andres Missair *et al* is providing much more information and material for thought than the mere use of regional anesthesia.

The authors’ rapid but pointed overview of all shortcomings of the health relief efforts is providing a clear picture of the overwhelming challenges faced in those rare and spectacular disasters.

This experience of the medical teams from the Medishare/University of Miami Miller School of Medicine stresses the most important features for effective assistance during mass-casualty incidents:

1. *The speed of the response*—It confirms that far away teams, however competent they may be, will not have the same effectiveness in saving lives as those local or nearby the impact. Miami’s proximity to and familiarity with Haiti health services were invaluable. Being on-site 12 hours after the impact is an accomplishment;
2. *The flexibility of an incremental approach*—The authors showed that starting with modest but rapid capacity and, as required, building it from an initial medical team into a field hospital is as effective as and definitely less costly than waiting for the most sophisticated ship or air-lifted hospital;
3. *Search for the most appropriate technology and procedures*—The promotion of a basic, some would say primitive, regional anesthesia as a main procedure is illustrative of this approach. Complex technological solutions too often failed in the Haitian context; and
4. *A powerful backup*—This report offers an excellent illustration of the need for medical teams to have the support of a large institution to out-grow the limitations of an initial five-person team without means.

The authors allude to the existing international guidelines on the use of foreign field hospitals. As was the case with guidelines on donations of medicines, they are widely ignored by relief actors pursuing their own objectives with limited coordination. This article and the unpublished experiences of others show that these guidelines must be reviewed to be better adapted to extreme disasters with total collapse of the health services. One size does not fit all. This review process will take place in an expert workshop early December.

It also is time to broaden the scope of international standards and guidance. Many actors sending medical/surgical teams do not meet the definition of foreign field hospital. This distinction is clearly presented in this special report, which distinguishes four periods in the Medishare/Miami University medical relief. Only Period 3 “was marked by the transition to a traditional field hospital”.

The number of amputations performed by the authors and all other actors far exceed those done following other earthquakes. Undoubtedly, most have been required considering the late medical response and the shortage of follow-up nursing facilities. Although procedures from most reputable groups were conservative, one cannot fail to note that the number of field amputations has become an indicator of heroic medicine by less experienced and professional

groups, too many of them being now operating in large, mediatized disasters. This can only give support to the growing and welcome pressure toward the international accreditation of medical teams for foreign disaster interventions.

The authors report that hundreds of patients have been transferred into facilities in Miami and South Florida. Medical evacuations are the subject of debates. Apart from the legal implications of referrals of minors, several medical and ethical issues were raised and never fully debated. Among them: How to select, register, and account for patients evacuated? How and when to return patients requiring intensive rehabilitative care? Reviews and publications of success and failure would be most welcome.

Finally, the observation by the authors of the very poor return in terms of victims extricated alive of foreign search and rescue (SAR) teams is noteworthy, but far from new. Sending SAR teams is now a political and public relation must. One can only show respect for a difficult and coura-

geous decision taken by the Swiss Cooperation NOT to send its well reputed Rescue Team. This decision based on the realization that the Swiss team would not be operational in time to save lives, has been criticized broadly by the public opinion and resented by the dog trainers and rescuers on standby at the airport. However, resources redirected towards medical assistance saved many more lives.

One observation remains deeply disturbing: The same special report could have been written following the tsunami response, the Pakistan earthquake relief, and will probably be written in 10 years following the next major catastrophe. Is our humanitarian and medical community unable to learn lessons and act upon them? Are we in such autopilot mode to respond to public opinion expectations generated by the mass media that we forget why we are responding in the first place?

This Special Report is encouraging in its critical outlook. I hope that it will provide the stimulus for reflection and action within the broad humanitarian community.