Humanitarian surgical care provided by a French Forward Surgical Team: ten years of providing medical support to the population of the Ivory Coast

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keywords: forward surgical team, medical support to the population, humanitarian medicine, advance course for deployment surgery, surgical skill set, military deployment
Abstract

INTRODUCTION: The aims of this study were as follows: first, to quantify and review the types of surgical procedures performed by military surgeons assigned to a Forward Surgical Team (FST) providing medical support to the population (MSP) in the Ivory Coast (IC); and second, to analyze how this MSP was achieved.

METHODS: Between 2002 and 2012, all of the local nationals operated on by the different FSTs deployed in the IC were included in the study. The surgical activity was analyzed and divided into surgical specialties, war wounds (WWs), non-war emergency trauma (NWET), non-trauma emergencies (NTEs) and elective surgery (ES). Demographics, circumstances of healthcare management, wounded organs and types of surgical procedures were described.

RESULTS: Over this period, surgeons operated on 2315 patients and performed 2556 procedures. ES accounted for 78.7% of the surgical activity, NTEs accounted for 12.7%, NWET accounted for 8%, and WWs accounted for 0.6%. The main surgical activities were visceral (43.8%) and orthopedic (including soft tissues) surgeries (38.5%).

CONCLUSION: The FSTs contributed widely to MSP in the IC. This MSP required limited resources, standardization of the procedures and specific skills beyond the original surgical specialties of military surgeons to fulfill the needs of the local population.

Key Words: forward surgical team, medical support to the population, humanitarian medicine, advance course for deployment surgery, surgical skill set, military deployment
INTRODUCTION

In September 2002, responding to an attempted coup in Abidjan, Ivorian legal authorities required the implementation of the Ivorian-French Defense Agreements and UN Resolution 1528. Despite a reconciliation government initiative agreed upon in France (the Linas-Marcoussis agreement of 2003), a fierce civil war ensued. The 2011 presidential election was the starting point of progressive normalization of the political situation in the country, allowing for a decrease in the French military presence.

Despite the evolution in the French-Ivorian cooperation agreement into a defense partnership, the missions of the Force Licorne remained unchanged: to train and reinforce the Ivorian Army and to protect French nationals in the Ivory Coast (IC).\(^1\) French Forward Surgical Teams (FSTs) were deployed from the beginning of Operation Licorne to provide medical and surgical support to the troops. In addition to the medical support provided to the military forces in agreement with French military medical doctrine,\(^2\) these FSTs also provided medical support to the population (MSP). Other countries have also proposed humanitarian aid, most often over short periods of time, such as the humanitarian civic assistance mission to the Americas\(^3\) or humanitarian aid to local nationals in Afghanistan.\(^4\) The French Army has a long tradition of military and political presence in Francophone Africa. The actions of the French Health Force Service, resulting from this tradition that dates from colonial times, are unique, and the French Army remains the only force to provide sustainable MSP in Francophone Africa (in Operation Épervier in Chad, for example\(^5,6\)).

The first aim of this study was to quantify and review the types of surgical procedures performed by military surgeons assigned to FSTs providing MSP, according to encountered surgical pathologies, logistic capacities and capabilities. The second aim of this study was to
analyze how MSP was achieved in order to translate past lessons learned into teaching tools to improve the manner in which we deliver MSP in isolated situations in Africa.

PATIENTS AND METHODS

Study design

Between September 2002 and August 2012, 2559 patients were treated by a French FST (NATO role 2) deployed in the Ivory Coast for surgical care. All operation reports of all FSTs were entered from the battlefield into the French Opex Datasystem (File Maker Pro 2008, File Maker Inc., Santa Clara, California, USA). All of the operating theater records from this study period were transferred to a prospectively maintained database and were retrospectively analyzed. Among the 2559 patients prospectively recorded, 244 were French military personnel (9.5%), and 2315 were local Ivorian nationals (90.5%), all of whom were eligible for this study and enrolled in a multicentric observational study.

French FSTs

French FSTs were deployed discontinuously at six different sites (Abidjan, Bouaké, Kokumbo, Korghini, Toumbokro and Yamoussoukro) (Figure 1), but with a minimum of 2 FSTs deployed at the same time until 2009 and only one since 2009 in Abidjan. The Yamoussoukro FST was equipped with a CT scanner. Over this period, all of the surgical procedures were performed by a team of 12 people (replaced every 3 to 4 months): an anesthetist, a general surgeon (specializing in digestive surgery, urological surgery or thoracic and vascular surgery), an orthopedic surgeon, 2 anesthetist nurses, a scrub nurse, 2 ward nurses, 3 assistant nurses and an administrative noncommissioned officer. Each FST had one operation room with fluoroscopy, an intensive care unit and material for bacteriological
analysis. However, no basic pathological examinations were available, osteosynthesis was limited to external fixation or internal fixation with K-wires or plates, rehabilitation was not possible, and plain radiography was the only imaging modality available, except during the short period when a CT scanner was present in Yamoussoukro. Mesh was not available for routine use, and its use depended on the amount that each surgeon brought during each mission. The number of available beds for MSP in wards was also a limiting factor because it rarely exceeded six beds per day. Operated patients are only discharged when the postoperative course remains simple regardless of the length of stay. The routine postoperative care of the wound is realized in daily outpatient clinics run by military nurses with supervision of the surgeons. When a reoperation is required, it is realized within the FST. The operated patients are not systematically reviewed in postop clinics but when postoperative surgical reviews are necessary, patients get outpatient appointment as often as required.

Variables and data sources

The patients were divided into 4 categories: war (battle) wounds (WWs), non-war (battle) emergency trauma (NWET), non-trauma emergencies (NTEs) and elective surgery (ES). Patients with WWs, NWET and NTEs presented directly at the FST. ES was provided to the local population in accordance with the French military doctrine of MSP.2

The patient demographics collected included age, with the patients divided into groups of adults and children (younger than 16 years old), sex, circumstances of wounds, encountered pathologies, and the types and number of operations performed. The breakdown of patients was determined by surgical specialty. We calculated the ratio, defined as the number of patients requiring surgery divided by the number of operative procedures performed, as a valuable marker of clinical effectiveness of MSP. Indeed, MSP must not impair the capacity
of the FST to support the French military Forces deployed. Ideally short surgical procedures, efficient and low-consuming equipment are intentionally selected. Therefore, a ratio close to one meets these requirements. A lower ratio shifts us away from the principles of good practice of MSP.

RESULTS

Patient demographics and circumstances
The patients’ demographics and circumstances are summarized in Table I. Briefly, among the 2315 patients included in this study, 1237 (53.4%) were male, 622 (26.9%) were female, and 456 were (19.7%) children. ES was performed for 1821 patients (78.7%), NTEs were treated in 294 patients (12.7%), NWET were treated in 185 patients (8%) and WWs were treated in 15 patients (0.6%). The ratio for ES was close to one (0.93), and as the seriousness of the circumstances of care increased, the ratio decreased to 0.84 for NTEs, 0.79 for NWET and 0.50 for WWs.

Global surgical activity
Between September 2002 and August 2012, 2315 patients were operated on in the different FSTs deployed in the Ivory Coast, and these patients required 2566 surgical procedures. The breakdown of procedures by surgical specialty is summarized in Table I. Briefly, the main proportion of surgical activity consisted of visceral and orthopedic (including soft tissues) surgeries (82.3%). General surgeons performed all of the surgical procedures for visceral surgery (43.8%), gynecology (9.3%), urology (5.6%), thoracic (0.2%) and vascular surgery (0.1%). Orthopedic surgeons performed all of the orthopedic and soft
tissues cases (38.5%). Head and neck cases (2.5%) were equally treated by a general or orthopedic surgeon.

**Breakdown of surgical activity by specialty**

- **Visceral surgery (Table II)**

ES represented the main activity, with 89.2% of all the digestive procedures, and among these surgeries, abdominal wall surgery accounted for 76.3% of all the visceral procedures. Briefly, 703 unilateral hernias (including 17 recurrent hernias) were repaired (83.7% of patients), 48 bilateral hernias (including 2 recurrent hernias) were repaired (5.7%), 28 cases of persistent patency of the processus vaginalis in children were closed (3.3%), and 56 umbilical and/or midline hernias (6.7%) and 5 incisional hernias (0.6%) were repaired. Herniorrhaphy, according to the Shouldice or Bassini technique, was the routine repair procedure chosen for 91.7% of the adult patients with inguinal hernias. Mesh was installed for all 19 recurrences and for the other 43 patients with large inguinal hernias (8.3% of all of the cases). One hundred twelve patients presented with thyroid disease, including 88 patients with endemic nontoxic goiter, leading to 60 subtotal thyroidectomies and 28 isthmolobectomies; furthermore, 24 patients with toxic goiter underwent 21 subtotal thyroidectomies and 3 isthmolobectomies. NTEs represented 10.3% of the visceral surgical procedures, 77.6% of which were for visceral infections: 52 surgical procedures were performed for appendectomies, 33 for peritonitis (8 for perforated duodenal peptic ulcers, 25 for typhoid peritonitis with small bowel perforation), 2 for perianal abscesses and 3 for anal fistulae. The cases of NWET consisted of 3 abdominal stab wounds requiring atypical hepatectomy with gastric sutures, one right colectomy and an explorative laparotomy without visceral lesions. The WWs consisted of 2 abdominal gunshot wounds with sigmoid perforation, requiring Hartmann’s procedure for one and small bowel resection and anastomosis for the other.
• **Orthopedic surgery (Table III)**

The distribution between planned surgery and emergency surgery was similar, constituting 51% and 49% of activities, respectively. Regarding non-urgent pathologies, infectious diseases and tumor excision (mainly considered benign) represented the most frequent surgeries, constituting 40.8% and 25.4% of cases, respectively. Buruli ulcer was the most important infectious disease (141 patients), with most of the patients receiving conservative treatment (94%). Cases of extremity trauma sequelae (89 patients) were dominated by septic or non-septic non-unions (46 patients), malunions (13 patients), and burn sequelae (12 patients). Clubfoot talipes equinovarus (22 patients) and polydactily (7 patients) represented the congenital malformations. The patient/surgical procedure ratio of congenital diseases (0.66) was the lowest, followed by trauma sequelae (0.76), infectious diseases (0.78) and tumors (0.98).

Regarding emergencies, the WW (13 patients) number was very low compared with NWET (171 patients) and infectious emergencies (120 patients). Among the 42 fractures, 27 were stabilized by internal fixation (29 interventions), 10 by external fixators (20 interventions) and 5 by plaster (6 interventions). Of the 9 dislocations, all were reduced under general anesthesia, but 3 required reintervention (1 elbow and 2 hips) for early dislocation relapses.

• **Gynecologic surgery (Table IV)**

The details of the gynecologic surgical procedures are summarized in Table IV. Briefly, 204 patients (86.8%) were operated on electively. Elective hysterectomies (total and subtotal with or without adnexal preservation) were by far the most frequent operations, with 148 surgical procedures for symptomatic myomas. Adnexal pathology represented 20.5% of the cases. There were 38 adnexectomies for ovarian cysts or hydrosalpinges and 11 adnexectomies for
salpingitis or torsion. Breast pathology consisted of 5 total mastectomies, 11 lumpectomies for tumors, and 5 drainages of abscesses.

- **Urology (Table V)**

  Surgery on the external genitalia of male patients was the most frequent urological surgery, and scrotal surgery accounted for the majority of interventions. Hydrocele testis treatment resulted in the performance of 92 surgical procedures for partial resection of the hydrocele sac and 5 for plication of the hydrocele sac. There were also 2 treatments of cryptorchidism, 10 orchiectomies for testicular atrophy, and resection of 9 epididymal cysts; 4 patients underwent varicocelectomy by Ivanisevic’s technique because of symptoms with exercise or due to infertility. The NTEs consisted of 3 orchiopexies for testicular torsion and 7 incisions of scrotal abscesses.

- **Miscellaneous**

  Oral maxillofacial cases represented 64 procedures (2.5%), including 17 abscesses drained and 36 excisions of tumors or cysts. There were six thoracic procedures: two postero-lateral thoracotomies for thoracic stab wounds, one pericardial drainage for a tamponade, and three decortications for empyema. Two vascular procedures were performed: one arterial limb obstruction and one aorto-iliac approach for an aortic dissection, which was responsible for bilateral inferior limb ischemia.

**DISCUSSION**

**Quantitative analysis of the activity**
Over this studied period of 10 years, 2566 surgical procedures were performed for 2315 local national-patients. From 2002 to 2008, three FST were systematically deployed simultaneously in IC and performed 1951 procedures (with an average of 93 procedures/FST/year). From 2009 to 2012, only one FST was deployed in IC (Abidjan) and realized 615 procedures (138 procedures in 2009, 127 in 2010, 161 in 2011 and 189 in 2012). Similar data were reported by an American FST in Afghanistan, with 65 surgical procedures over 7 months. However, these figures should be interpreted with caution because the Ivorian conflict has expanded over time and space and has alternated between periods of acute crisis (without any possibility of MSP) and stable periods with a greater possibility for MSP. French FSTs were initially established in tactical areas, where healthcare resources were destroyed, and free access to a surgical facility was an opportunity. In recent years, the Ivory Coast has significantly invested in healthcare structures, such as rural polyclinics, where the standards of care are higher, thus marginalizing local traditional medicine. However, global local medical healthcare provision has been limited. In a few major towns, teaching hospitals or private healthcare organizations are available, but both systems charge the patients for care. Therefore, only a limited proportion of the population can afford the costs, explaining why, even in “peacetime”, residents continue to benefit from FSTs. War-wounded patients only represented 0.6% of all local nationals operated on, in contrast to 44.8% of war-wounded Afghan civilians over a period of 18 months in the French lead role 3 in Kabul. This low level of war casualties demonstrated that local nationals had no access to FSTs during periods of fighting. Compared to other countries, such as Afghanistan, women and children represented 46.6% of patients, reflecting that female patients (26.9%) accepted male healthcare providers and were confident in the FSTs.

Qualitative analysis of the activity by specialty
The breakdown of procedures realized for the Ivorian people showed that a broad variety of pathologies were treated, covering many surgical specialties. All of the surgical emergencies for infection (soft tissue, bowel disease, gynecology and orthopedic) were obviously beneficial.

In elective digestive surgery, hernia repairs (under local anesthesia and as outpatient surgery when possible) and thyroidectomies were extremely frequent, with good results despite few resources. There was no mesh among the FSTs’ resources, so its use does not exceed 10% in our study, corresponding to the mesh that some surgeons were able to bring with them. It is the policy of the French Health Force Service not to provide mesh to FSTs because they lack the optimal hygienic conditions in their operating rooms. In cases of giant inguinoscrotal hernias and in the absence of mesh, as previously described,\textsuperscript{10} herniorrhaphy, followed by leaving of the distal sac in the scrotum, was preferred to limit the occurrence of complications, such as seroma, hematoma or scrotal skin trophic difficulties. We now favor subtotal thyroidectomies to ensure patient survival if replacement therapy is not available.

Cancer case management was closely discussed because the vast majority of the patients did not have access to pathology or any further oncologic treatment because it was not available or too expensive. Only the symptomatic cancer cases, for which a predictable complete removal of the tumor was possible, were submitted to surgery. Therefore, colorectal cancer management was limited to occlusions.

In the MSP setting, the management of extremity pathologies depended on the available technical and human resources. Soft-tissue procedures were predominant in this cohort, considering the variable hygiene of the operating rooms and/or the lack of osteosynthesis methods available. Bone surgery must be limited in austere conditions. Fractures should be stabilized by plaster, skeletal traction or an external fixator that has been properly sterilized.\textsuperscript{11} Surgical management of closed fractures should be considered without exposure, by per-
cutaneous pining or elastic nailing, only if strictly sterile conditions and fluoroscopy are available. This type of treatment is particularly suitable for the management of fractures in children. Conversely, management of open fractures and/or closed fractures of long bones in adults was particularly challenging: the former required serial surgical procedures and extended hospitalization, and the latter are best managed by sophisticated internal fixation means that were not available in or suitable for FSTs. The large number of procedures per patient emphasized the challenge of non-union and malunion treatment. If soft tissue coverage could be performed in deteriorating conditions, achieving bone reconstruction was much more complicated for several reasons: the difficulty of administering appropriate and prolonged antibiotic treatment, the unavailability of specific surgical materials, and the impossibility of closely monitoring patients during the postoperative period. Thus, we strongly believe that patients with infected fractures and septic non-unions must not be treated in the FST and must be referred to local higher echelon of care because of the high rate of repeated surgical procedures, the high rate of complications and the extensive use of resources. Finally, the lack of physical therapy is another main issue that should limit bone and joint surgery.

Debridement of burn wounds remains a very time- and material-consuming activity that must also be referred to local higher echelon of care since the high rate of repeated surgical procedures finally impairs the ability of the FST, as evidenced by the low patient/surgical procedure ratio (0.35).

In gynecology, hysterectomies for symptomatic uterine fibroids responsible for pain and/or anemia, cystectomies and salpingo-oophorectomies for symptomatic ovarian cysts were beneficial. A subtotal hysterectomy is a valid alternative to total hysterectomy for a surgeon who is not a specialist in gynecology. It is quicker, it incurs fewer risks to the ureters, and it is particularly adapted to the surgical management of myomas. Similar to digestive pathologies, the management of cancer cases in gynecology was controversial and was strictly limited to
mastectomies for infected breast cancers when surgery could improve the dressings and the quality of life, which was extended to breast lumpectomies for some patients. The urology activity was relatively low (5.6% of surgical procedures) and was directly related to the presence of a general surgeon specializing in urological surgery in the FST. Over this 10-year period, the general surgeons were mostly specialists in digestive surgery, so they focused their consultations according to their expertise. Thus, it was not surprising that surgery on the external genitalia of male patients accounted for the majority of interventions. At the same time, no prostatectomies were performed, whereas prostatic adenoma represented up to 50% of the reasons for hospitalization in a urology department in Abidjan. In thoracic surgery, only recent pleural effusions were treated, so lung resections for sequelae of infections were performed very occasionally, only when a thoracic surgeon was deployed.

Concept of MSP

These 10 years of MSP have had no equivalent in other nations, and this study was the first, to our knowledge, to report such a long period of time in Africa. MSP is not humanitarian aid as is seen in cases of natural disasters; rather, it resembles the humanitarian civic assistance proposed, for example, by the USNS Comfort in Central and South America and Caribbean Basin (NATO role 3)\textsuperscript{3} or the humanitarian surgical care offered by FSTs or Combat Support Hospitals in Afghanistan.\textsuperscript{4, 12} Defined by a specific doctrine,\textsuperscript{2} MSP indicates all of the activities performed by the French Military Health Service, in addition to the Civilian-Military Co-operation (CIMIC), to improve the medical environment of the civilian populations among whom the force operates. For each mission, MSP is defined by the command that sets the level of civilian healthcare provided, according to the French doctrine. This doctrine dictates the principles of good practice of MSP so that it is effective, including the mastery of contributions (MSP must not impair the ability of the French Health Force.
Service to act for the benefit of the forces, and it must be immediately reversible), lack of competition with the local health system or with international organizations, and the realization of ideally unique, short and efficient surgical procedures (by favoring outpatient surgery), performed under strict conditions of medical ethics and good medical practices.

If the main objective of the MSP remains assistance to populations, maintaining staff motivation through regular activity, using the means of health support, is nonetheless a strategic objective. Furthermore, it allows for the technical and mental preparation of operational support forces, the development of teamwork, and the maintenance of staff motivation for missions, particularly during periods of low activity, when conflicts decrease in intensity. MSPs could also be considered a key strategic tool for improving the acceptance of the presence of armed forces and for convincing people that these forces can protect them, if needed. Over 10 years of the Ivorian conflict, France has played a significant political and military role on many occasions, sending troops at the very beginning of the conflict, providing assistance in establishing a national reconciliation government, assisting in the 2011 presidential election\(^1\) and establishing MSP, which has facilitated the acceptance of the French military troops. Additionally, we believe that MSP has participated in maintaining good relations with local nationals, to “win hearts and minds”\(^,13\) which is important in peacekeeping and stabilization missions without interfering with non-governmental organizations.\(^{14}\)

**CONCLUSION**

FSTs have a primary mission to support French military personnel, but they have widely contributed to MSP in the Ivory Coast because it represents their second responsibility.\(^7\) MSP requires limited resources (12 healthcare providers, a surgical, a post op, a basic biological
and radiological capability) but also standardization of the procedures to be reproduced by all surgeons. Pathologies with well-codified surgical indications and operations, requiring limited resources with predictable straightforward postoperative courses, must be always preferred. More difficult cases, such as cancers or burns, are so time- and material-consuming that doctrinal guidelines should be established to provide optimal care for these challenging patients. Restorative surgery for the limbs must be carefully considered, particularly when infection complicates a fracture. MSP requires specific skills beyond the original surgical specialty of military surgeons to fulfill the needs of local populations. As a result, in 2007, an Advanced Course for Deployment Surgery (Cours Avancé de CHIRurgie en Mission EXtérieure - CACHIRMEX) was established by the French Military Medical School to fulfill the needs of military surgeons prior to deployment regarding the provision of care to civilian populations in military healthcare facilities or in austere environments. It is divided into five modules over a two-years period: module one develops the organization of the French Medical Corps during abroad deployment, module five is specifically dedicated to the particular care of civilians as part of MSP (specificities of tropical digestive pathologies, gynecology, urology, management of orthopedic sequelae and ethical principles), the other three modules cover opened or closed trauma of the limbs, head, neck, thorax, abdomen and pelvis. In the future, developing collaborative mentoring schemes with local doctors should represent the positive evolution of military-civilian cooperation.
Legends of figure and tables:

Figure 1: Location of the deployment of six FSTs in Ivory Coast.

Table I: Summary of all of the surgical activity performed between September 2002 and August 2012, based on the sex of the person, circumstances of support and different surgical specialties.

Table II: Details of the activity of visceral surgery based on pathology and circumstances of support.

Table III: Details of the activity of orthopedic surgery based on pathology and circumstances of support.

Table IV: Details of the activity of gynecologic surgery based on pathology and circumstances of support.

Table V: Details of the activity of urological surgery based on pathology and circumstances of support.
**Conflict of interest statement:** The authors declare no conflict of interest.

The opinions or assertions contained herein are solely those the authors and do not necessary reflect the official policy or position of the French Army medical service.

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