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An in-country humanitarian neurosurgical services as model for low-and-middle-income countries: The case of Cote d' Ivoire

Esperance Broalet [a], Landry Konan [b,*], Raissa Diaby [b], Igor Nitcheu [b], Wilfried Meuga [b], Aderehime Haidara [a]

[a] Department of Neurosurgery CHU Bouaké, UFR Sciences Medicales Bouaké, University Alassane Ouattara, Cote d'Ivoire
[b] Department of Neurosurgery CHU Yopougon, UFR Sciences Medicales Abidjan, University Felix Houphouet Boigny, Cote d'Ivoire

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1. Introduction

The term « humanitarian » was coined around 1835 meaning "for the good of humanity" (Lapierre, 2007).Humanitarian surgery refers to medical procedures performed in response to a humanitarian crisis or disaster situation, such as natural disasters, conflict, or epidemics. The aim of humanitarian surgery is to provide immediate and essential surgical care to affected individuals who would otherwise not have access to it. Surgical interventions are often performed in resource-limited environments, such as field hospitals or makeshift clinics, and are carried out by teams of medical professionals who volunteer their time and skills to provide aid. These teams may be affiliated with international organizations such as the International Committee of the Red Cross (ICRC), Médecins Sans Frontières (MSF), or local healthcare providers. Humanitarian surgery plays a critical role in saving lives and restoring health to vulnerable individuals such as women and children (Flynn-O'Brien et al., 2016).

The African continent has a long history of political upheavals and natural disasters that lead to precarious health conditions for countless children. Children below 15 years old comprise almost one-third of the human population but are concentrated in regions where healthcare resources in general, and neurosurgery especially, are the most limited. As exemplified in 2020 UNICEF data, the mortality rate among children and youth aged 5–24 worldwide is the highest in sub-Saharan Africa (~40°/$_{00}$), especially in west and central Africa (UNICEF, 2020).

In the case of neurosurgery, humanitarian services involve a variety of surgical interventions, including emergency and elective surgeries that may require heavy equipment such as microscopes, computerized tomography scanners, and intensive care units. This peculiarity of neurosurgery may explain why despite countless humanitarian medical aids in sub-Saharan Africa, neurosurgical care is still left behind. Nonetheless, several NGOs among which CURE and FIENS have managed to do humanitarian neurosurgery in sub-sahara Africa with actions non-limited to surgical care but associated with education and gift of equipment (Bagan, 2010).

In Ivory Coast, a West African country of 29 million inhabitants, neurosurgery has been introduced and practiced for almost four decades (Broalet et al., 2020). Recently, local neurosurgeons and non-profit organizations started an in-country humanitarian neurosurgical outreach for pediatric patients in the country.

In this paper, we describe the early experience of this outreach program and discuss the practical challenges encountered. We hope this in-country humanitarian model may serve as a template for replication in neighboring countries in West Africa.

* Corresponding author.
E-mail address: landrix07@gmail.com (L. Konan).

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2. Material and methods

2.1. Data collection

Humanitarian neurosurgery activities in Ivory Coast started in 2019 and have provided free neurosurgical healthcare to sick children below 15 years old. The authors retrospectively collected demographic and therapeutic data from patients operated on from January 2019 to December 2022. Additionally, the authors gathered information about stakeholders and the coordinating organization that manage humanitarian neurosurgery in the country.

3. Results

3.1. Ivory coast: case study

3.1.1. Socio-economic background

The country's estimated population is 27 million with a birth rate of 32.4‰ and a risk of infantile mortality of 52‰ (The World Bank, 2022). Nearly 11.4% inhabitants live below the threshold of poverty and 53% of its urban population lives in blighted areas. Thirty one percent of the population has no access to electricity (Institut National Statistique Abidjan, 2022).

So far, there is no national data about the rate of neural tube defects or hydrocephalus among neonates. Nonetheless, pediatric neurosurgical conditions encountered in hospitals are dominated by hydrocephalus and neural tube defects followed by brain tumors. Neurosurgical care is available in three main cities: Abidjan (six million inhabitants), Bouaké (1.5 million inhabitants) and Yamoussoukro (approximately 800 thousand inhabitants). The cost of neurosurgical procedures in sick children varies between $1000 (for myelomeningoceles) to $6000 (for brain tumors). This cost is largely covered by the children's family followed by private health insurance structures which are available for only ten percent of the working population. Yet, with an average monthly income of $700 in the middle-class population, few patient's families can afford their treatment.

4. Coordinating organization

4.1. Different humanitarian activities

These activities comprise educational campaigns, free patient screenings and free neurosurgical procedures (Fig. 1). Educational campaigns aim at increasing awareness about neural tube defects among the population. In fact, there is a lack of knowledge about myelomeningoceles and hydrocephalus in the population. Generally, sick children with neural tube defects frequently presented late to neurosurgeons. Partially, since these patients come from remote areas in the country where basic healthcare is almost absent and access to healthcare information is scarce. In fact, so far, few people are informed about the necessity to initiate folate and iron fortification prior to conceiving and fail to recognize neural tube defects in neonates. Some cultural beliefs still refer to hydrocephalus or spina bifida children as mystical or evil creatures leading parents to conceal their babies. On the other hand, we found that midwives who deliver most of babies lack referral information to neurosurgeons. Hence, educational campaigns are carried out outside big cities and target vulnerable populations and healthcare workers. During those educational campaigns, children with suspected neural tube defects or neurological conditions are offered free screenings followed, medications, and surgery when indicated. Educational campaigns are organized annually since 2019.

4.2. Participating partners

In addition to volunteering healthcare professionals, two local NGOs and three hospitals have been identified as stakeholders in humanitarian neurosurgery in Cote d'Ivoire: NGO Hope Esperance, NGO Ephrata, Don Orione hospital, Moscatti, and Nouvelle Esperance Clinic (Fig. 2). The two NGOs are involved in advocacy campaigns, patient recruitment, and organize fundraising for the treatment of children with congenital neural tube defects. The three hospitals offer their operating theatres and surgical equipment free of charge. Don Hospital has specialized physical therapists who offer rehabilitative therapies for children with neurodevelopmental conditions. Volunteering local neurosurgeons and residents, nurses, and anesthesiologists perform clinical evaluations, surgeries, and post-operative care. These non-profit organizations have helped these humanitarian missions since their beginning.

4.3. Statistics of humanitarian neurosurgical aid

Since 2019, four educational campaigns have been performed. During these campaigns, 213 patients were screened of whom 109 patients underwent surgeries (Fig. 3). Although these activities receive all children, surgery was only offered to patients with the diagnosis neural tube defects. The sex ratio male/female were 1.15 and the mean age was 15-month-old (range: 6-month to 6-year-old). The surgical procedures were performed by senior neurosurgeons and residents acted as surgical assistants. It consisted predominantly of VP shunts followed by endoscopic third ventriculostomy (ETV) and myelomeningocele repair. The short-term outcomes were uneventful. The mean postoperative follow-up was 24.6 months with no long-term complications.

5. Discussion

5.1. Neurosurgical humanitarian aids in sub–Saharan Africa

The earliest record of humanitarian aid in sub-Saharan Africa comes from the Biafra war in Nigeria in 1967–1970. The suffering of the Biafran population was publicized and stimulated an influx of several international agencies to provide food and medicine (Phillips et al., 2022). Since then, humanitarian medicine in Africa has been performed during instances of war, famine, or infectious epidemics. When humanitarian

Fig. 1. Humanitarian neurosurgical activities in Ivory Coast (A–B) Sick children and parents coming for free screening; (C) illustration of a patient who underwent repair of myelomeningocele after a Ventriculo-peritoneal.

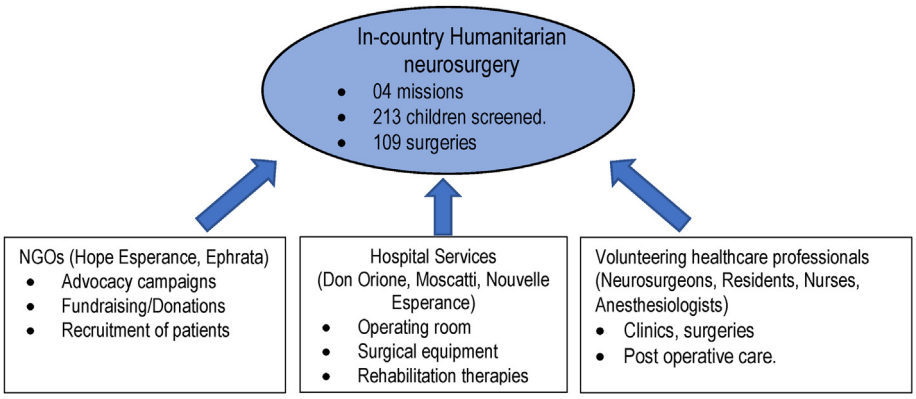

Fig. 2. Role of partners involved in these local humanitarian missions.

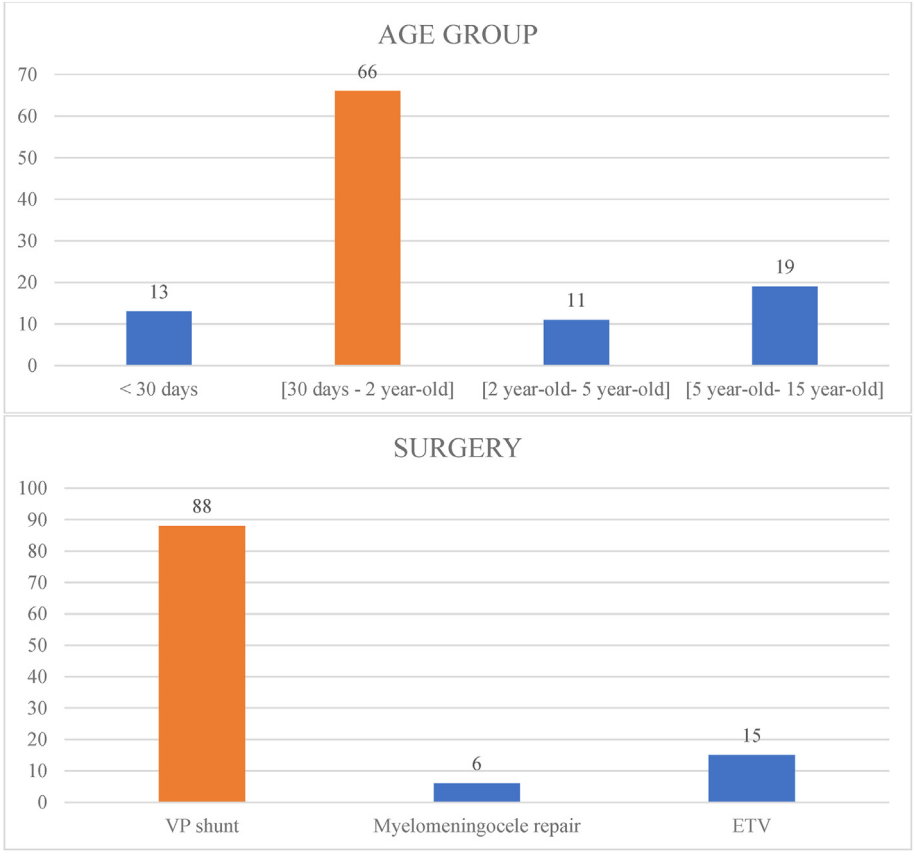

Fig. 3. Demographic and repartition of surgical procedures performed during humanitarian activities.

surgeries initially made their entry into the scene, neurosurgery was still considered a luxury care not significant in humanitarian context (Lapierre, 2007). Rather than wartime or catastrophe, humanitarian neurosurgery began in sub- Saharan Africa in an effort to provide modern neurosurgical care that was almost nonexistent in this part of the world. The goal was not only patient care but to provide neurosurgical education local physicians to develop their autonomy in Neurosurgery (Punchak et al., 2018). Non-profit organizations such as the Foundation for International Education in Neurological Surgery (FIENS) established in the United States in 1969 started in Accra, Ghana two decades later and subsequently extended their action in eastern african countries (Qureshi and Oluoch-Olunya, 2010). Likewise, European organizations such as “la chaine de l'espoir" established humanitarian neurosurgical aids in Togo and Senegal in the last two decades. Nowadays, besides NGOs, several individual neurosurgical hospitals in Europe, North America and China are partnering with sub-Sahara African hospitals to organize humanitarian missions punctually (Timothy et al., 2022; Dempsey and Nakaji, 2013).

The state of neurosurgery is very different from one area to another, with some regions being very well developed while others having almost no neurosurgical care. In this context, local physicians play a pivotal role in organizing humanitarian services. Because they understand the cultural, economic and technical environment, local physicians are best positioned to identify challenges and orient the services in an efficient and sustainable manner (Kinasha et al., 2012). Local neurosurgeons not only participate in the humanitarian missions but remain locally available for long-term follow-ups when international collaborators return to their countries.

5.2. The ivoirian context

The history of modern neurosurgery in Cote d'Ivoire is recent. The earliest neurosurgical procedures started around 1990 in a partnership with a French academic neurosurgeon who trained local physicians in neurosurgery (Broalet et al., 2020). Rapidly after, the local neurosurgeons took the lead to develop neurosurgery. Although multiple humanitarian surgical aids happened in the country. Neurosurgery was left behind largely unknown by the population and the political authorities. From 1999 to 2011, the country underwent several political turmoils that lagged the development of the field and worsened the access of specialized care. The development of humanitarian neurosurgery in the country was stimulated by calls for help of neurosurgical pediatric patients through social media. Hence, social media favored an increased awareness of neurosurgical conditions among the population. A neurosurgical residency program opened in 2005 has produced over 20 local neurosurgeons ready to manage cases. Yet, the crucial issue of affordability limits access to neurosurgical care.

5.3. Challenges in running an in-country humanitarian neurosurgical service

Ethical consideration, funding strategies, advocacy, workforce capacity are among many challenges that stakeholders encountered when organizing in-country neurosurgical outreaches.

5.3.1. Ethical consideration

Ethical concerns may arise when performing pediatric neurosurgery missions. In fact, such missions need supervising ethic committee to ensure patient safety (Hughes and Jandial, 2013). It is legible that patients may be attracted by the offer of free surgery, but it is important that an informed consent be obtained after appropriate explanation of the service offered, expected outcomes and appraisal of the patient's expectation. Also, surgeons should refrain from performing futile or sub-standard surgeries (Sedney et al., 2014). In fact, during surgical missions, not all patients can be operated, and this raises the problem of patient selection. It was frequent to receive requests for surgery from patients who presented brain atrophy from congenital infections or cerebral motor palsy consecutive to perinatal cerebral ischemia. Additionally, children with diagnosis of brain tumors could not be included due to lack of appropriate equipment.

5.3.2. Fundraising strategies

Congenital neural tube defects are prevalent in indigent families where access to quality food and folate fortification are lacking. Access to neurosurgical care for these patients remains problematic. Local efforts have been made over the years to increase the affordability of surgical procedures. The cost of VP shunt procedures that was initially $2000 decreased to $700 using low-cost shunt. Yet, this cost remains unaffordable for many who divert to social media platforms for help. Social media has proved to be an effective way for fundraising where anonymous donators, politicians, NGOs and companies are easily reached. Hundreds of patients have been successfully operated using this strategy. Nonetheless, there are concerns about the sustainability of this strategy.

5.3.3. Educational campaigns and advocacy

Ivorian neurosurgeons organized in a professional society are advocating for the establishment of a national awareness day for hydrocephalus and neural tube defects. This initiative will support free screening campaigns, clinical research and help gather financial resources for our pediatric patients. Educational campaigns initially started in the three cities where neurosurgery is available and is reaching out to remote areas. In the areas, there is a prevailing local misconception and stigmatization regarding pediatric neurologic disability (Cadotte et al., 2010). Neurosurgical conditions affecting children are often attributed to be mystical spells. This explains the late presentation of patients to the neurosurgeons.

5.4. Perspectives

The future of humanitarian neurosurgery in Cote d'Ivoire depends on building a sustainable organization system and increasing capacity among the stakeholders. As mentioned in this paper, most hydrocephalus surgeries consisted of VP shunts. This is due to a lack of endoscopic equipment and training for ETV. Only one endoscopic device is available in the country, and this limits the practice and training of surgeon for this technique. Additional efforts are being made to recruit more volunteering nurses and train more neuro-anesthesiologists within the country. We envision at short-term to expand neurosurgical services to more advanced procedures such as pediatric brain tumor surgeries. This will require the acquisition of portable microscopes and endoscopic equipment and training of more local neurosurgeon in ETV. The Ivorian neurosurgeons will benefit from partnership with international organizations to support this initiative.

6. Conclusion

This study describes not only the efforts but discusses the challenges to overcome when initiating an in-country neurosurgery outreach for sick children with hydrocephalus and neural tube defects. Under this model, local healthcare professionals and non-profit organizations played a pivotal role in increasing access to neurosurgical care for underserved local communities. This initial experience may serve as a template to replicate such activities in other sub Sahara African countries.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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