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Challenges of pediatric and geriatric anesthesia in orthopedic surgery in a resource limited country. The case of Democratic Republic of Congo: perspective

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Keypoints

Children and elderly patients, already vulnerable due to their physiology, should not see their fragility compounded by systemic deficiencies.

Abstract

Anesthesia for orthopedic surgery represents a universal challenge, but these difficulties are amplified in resource-limited countries. In the Democratic Republic of Congo (DRC), two populations particularly illustrate this complexity: children and frail elderly patients. In children, anatomical, physiological, and psychological particularities require expertise that far exceeds the available technical means, while in the elderly, frailty and the prevalence of comorbidities transform every intervention into a high-risk procedure. The unavailability of appropriate equipment, essential medications, safe blood supplies, and specialized training further aggravates these vulnerabilities. This commentary highlights the main challenges and proposes realistic avenues for improvement within a context of systemic constraints and limited resources.

Keywords

Anesthesia, Orthopedic Surgery, Pediatrics, Geriatrics, Resource-Limited Settings

Introduction

In the Democratic Republic of Congo (DRC), orthopedic surgery occupies a particular place in the hospital landscape. The burden of road traffic accidents, fractures due to falls, and untreated orthopedic malformations has generated increasing demand in the face of limited supply. While the surgical act itself presents technical challenges, anesthesia emerges as a critical link. This is especially true for two groups at the extremes of life — children and frail elderly patients — whose physiology requires constant adjustments; even as technical and human resources remain scarce.

Challenges of Pediatric Anesthesia

In children, anesthesia is primarily characterized by the wide physiological variability inherent to growth. The anesthesiologist must manage patients ranging from 3 to 100 kg, with rapidly changing cardiovascular and respiratory parameters [1]. This variability makes any standardized approach hazardous and demands careful adaptation of dosages and techniques. Induction, often

performed by mask to avoid the pain of intravenous cannulation, exposes the child to a critical excitation phase marked by uncontrolled movements, tachycardia, and pharyngeal muscle relaxation that predisposes to airway obstruction. In a setting where pediatric ventilation devices are inconsistently available, this step can quickly lead to severe hypoxia, bradycardia, or cardiac arrest [1]. The anatomical features of young children — large tongue, hypertrophied soft palate, conical larynx — predispose them to airway obstruction. Because oxygen reserves are low, desaturation occurs rapidly during apnea. A classic study demonstrated that pre-oxygenated infants desaturate from 100% to 90% within two minutes, whereas it takes more than four minutes for children aged 3–8 years [2]. Endotracheal intubation, frequently performed with inadequate equipment in DRC, increases the risk of glottic edema and complicates management.

The high prevalence of viral respiratory infections among Congolese children exacerbates these risks. Even mild infections induce prolonged airway hyperreactivity, multiplying episodes of laryngospasm and bronchospasm [3]. European data indicate that the risk of peri-anesthetic cardiac arrest is three to ten times higher in infants than in older children [4]. In Europe, each additional year of pediatric anesthesia experience decreases the rate of severe complications [5]. In DRC, where the ratio of trained anesthesiologists is below one per 100,000 inhabitants, this level of expertise is systematically hindered by a chronic shortage of qualified personnel.

Blood loss management represents another major challenge. A 10-kg infant has a circulating volume of 800 ml; losing 200–300 ml may be life-threatening [1]. Major surgeries, such as scoliosis correction, can result in losses exceeding one-third of total blood volume [6]. In high-income countries, these procedures rely on transfusion, antifibrinolytics, and intraoperative blood salvage systems. In DRC, the lack of safe blood banks and the scarcity of antifibrinolytics make these procedures extremely high-risk. Postoperative pain management illustrates the paradox of resource-limited settings. Opioids are often unavailable or avoided due to concerns about side effects. Yet multimodal analgesia, combining general anesthesia with peripheral nerve blocks, reduces opioid consumption and improves postoperative comfort [7]. The development of ultrasound-guided regional anesthesia has dramatically improved the safety and efficacy of pediatric blocks in well-equipped systems [8], but such technology remains inaccessible in most Congolese hospitals. In this context, spinal anesthesia — sometimes used in neonates or adolescents for minor procedures — emerges as a pragmatic, low-cost alternative [1].

Psychological factors must also be considered. Preoperative anxiety, exacerbated by parental separation and the unfamiliar hospital environment, increases postoperative pain and may cause persistent behavioral disturbances [9]. Parental presence during induction, distraction techniques, conversational hypnosis, and oral premedication are effective strategies [10], but they are rarely implemented in DRC due to organizational and resource limitations. Though seemingly minor, these deficiencies can significantly impact the child's surgical experience.

Challenges of Geriatric Anesthesia

At the other end of the spectrum, geriatric anesthesia involves caring for frail patients with limited physiological reserves. The pharmacokinetics and pharmacodynamics of anesthetic agents are profoundly altered by age: reduced renal and hepatic clearance, increased cerebral sensitivity, and frequent drug interactions [11]. The balance is precarious between providing sufficient anesthesia for surgery and avoiding excessive depth that may cause hypotension, respiratory depression, or postoperative delirium.

Emergency procedures are common: after age 85, 20% of orthopedic anesthetics are performed in urgent conditions, twice the rate observed at age 50 [11]. Hip fractures, often requiring urgent intervention, epitomize the challenge of stabilizing a fragile patient in a short time. In DRC, the absence of comprehensive preoperative assessment further increases the likelihood of proceeding to surgery with undetected decompensations.

The literature shows that postoperative morbidity rises linearly with age, by approximately 0.7% per year, while mortality increases exponentially [12]. Postoperative infections, especially pulmonary and urinary, affect more than 10% of patients older than 60 [12]. Delirium, a frequent yet underestimated complication, may occur in up to one-third of very elderly patients undergoing orthopedic surgery [11]. In resource-limited contexts, the absence of standardized prevention protocols — including adequate pain control, maintenance of normothermia, and correction of dehydration — worsens these outcomes.

Systemic Constraints

Beyond patient-specific challenges, systemic constraints play a central role. In DRC, medical oxygen supplies are unreliable, multiparameter monitoring devices are scarce, and syringe pumps are often unavailable. Frequent power outages further undermine anesthetic safety. The absence of intensive care units for postoperative resuscitation of fragile patients eliminates an essential safety net. Each anesthetic procedure thus becomes a compromise between surgical necessity and life-threatening risk.

Perspectives and Recommendations

These realities should not, however, foster fatalism. Several realistic strategies exist. Accelerated training for nurse anesthetists, dissemination of simplified context-appropriate protocols, gradual introduction of regional anesthesia techniques, and the establishment of reliable supply networks for essential drugs represent short-term priorities. Implementing complication registries could also help identify priorities and strengthen advocacy with international partners. Finally, regional cooperation has the potential to facilitate skills transfer and logistical support.

Conclusion

Ensuring safe pediatric and geriatric anesthesia in orthopedic surgery within a resource-limited country is not merely a technical issue. It is an ethical imperative. Children and elderly patients, already vulnerable due to their physiology, should not see their fragility compounded by systemic deficiencies. The DRC, through its constraints, underscores to the international community that access to safe anesthesia is a fundamental right, inseparable from the right to surgery.

Conflict of Interest

The authors declare no conflicts of interest related to the publication of this article.

Author Contributions

- **P.K.**: initial draft, pediatric anesthesia perspective.
- **A.M.B.**: supervision, coordination, critical revision.
- **W.M.**: geriatric anesthesia perspective, manuscript revision.
- **K.A.**: discussion structuring, literature review, critical revision.
- **M.B.**: contextual contribution, manuscript preparation.
- **B.B.**: orthopedic perspective, final revision.

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