

## Anesthesia in French-speaking Sub-Saharan Africa : an overview

Th. LOKOSSOU (\*), E. ZOUMENOU (\*), G. SECKA (\*), F. OURO BANG'NA (\*\*), B. LE POLAIN DE WAROUX (\*\*\*), F. VEYCKEMANS (\*\*\*), Ph. BAELE (\*\*\*) and M. CHOBLO (\*)

**Abstract :** The situation of Anesthesiology in Sub-Saharan Africa is unique in that nowhere else in the world has the absolute numbers of anesthesiologists *decreased* during the nineties. Most anesthesia services to the populations of these 17 poor countries are provided by nurse-anesthetists, either certified or trained on the job. Their mean age often exceeds 40, which leads to expect an acute shortage within fifteen years. Experienced anesthesiologists are now so few that, in most countries, the critical mass of knowledgeable specialists no longer exists to train new anesthesia professionals. This summary of local surveys provides a brief overview of current workforce, institutions, drugs and material constituting the daily environment of our colleagues. Challenges are outlined, with special emphasis on brain drain. Solutions are proposed, underlining the promising role of a few anesthesia schools, the need for young anesthesiologists to enter teaching, and the expectations they are supposed to meet.

**Key words :** Developing countries, Africa ; anesthesia, workforce ; anesthesia, teaching ; anesthesia, drugs.

### INTRODUCTION

The situation of the specialty of Anesthesia and Intensive Care in sub-Saharan Africa differs from that of all other specialties on the continent and from that of our own specialty in all other parts of the world : anesthesiology in sub-Saharan Africa represents the unique case of *negative* demographic trend, both in absolute numbers and in relation to the local population. Poverty and a lack of means are prevalent in all third world countries, but only Anesthesia in sub-Saharan Africa has reached the point where it fails to align a single anesthesiologist in one entire country, or even a single professional able to deliver an anesthetic in first line or district hospitals in entire provinces of several countries. As our discipline supports many other specialties, the current situation makes it impossible for a growing number of hospitals to comply with the minimal conditions of safety, and some hospitals have lately been forced to close their operating suites. This is a rather recent and very alarming aggravation, indeed. This article describes the conditions in

which anesthesia is now practiced in this area of the world, the demographic situation of our specialty in that region, and considers perspectives for improvement.

### GENERAL BACKGROUND

The state of anesthesia practice in Africa is still very much related to the context of under development which characterizes the continent in its sub-Saharan part. There are 17 French-speaking countries in sub-Saharan Africa, 16 of which qualify as poor countries ; officially the Ivory Coast still qualifies as an '*intermediate income*' country. Health care remains a weak link of these societies. Budgets granted to health care are small in absolute terms as well as per capita, and never reach the 30 US\$ per capita/per year proposed by most international agencies as the minimal standard for health care. In a comprehensible way, prevention remains the priority along with primary health care. Secondary care and surgery only come later. Generally speaking, however, in the curative sector anesthesia has not been granted attention in proportion with operative specialties, which leads to unacceptable situations as regards peri-operative safety.

Thomas LOKOSSOU, M.D. ; Eugene Zoumenou, M.D. ; Gad Secka, M.D. ; F. Ouro Bang'na, M.D. ; Bernard le Polain de Waroux, M.D. ; Francis Veyckemans, M.D. ; Philippe Baele, M.D. ; Martin Chobli, M.D., Ph.D.

(\*) Unité d'Enseignement et de Recherche en Anesthésie et Réanimation de la Faculté des Sciences de la Santé de l'Université d'Abomey-Calavi, Cotonou, Bénin.

(\*\*) Service d'Anesthésie-Réanimation, CHU Tokoin, Lome, Togo.

(\*\*\*) Service d'Anesthésiologie des Cliniques Universitaires Saint-Luc, Université Catholique de Louvain, Bruxelles, Belgium.

**Correspondence address :** Ph. Baele, Service d'Anesthésiologie des Cliniques Universitaires Saint-Luc, Université Catholique de Louvain, avenue Hippocrate, B-1200 Bruxelles, Belgium. E-mail : baele@anes.ucl.ac.be

This paper will often take the republic of Benin as an example (24). Benin is a typical country along the Gulf of Guinea, with a per capita Gross Domestic Product (GDP) of 1,124 US dollars (expressed in current US\$), which converts to 456 US\$ if one expresses it in constant 1995 dollars. Health expenditures reached 16 US\$ per capita in 2001. The 3 to 4% annual growth of per capita GDP may look considerable but it is almost totally absorbed by the demands of a heavy demographic growth which remains around 2.5% (i.e. 5 live births per woman), a slight but significant decrease when compared with more than 3% (almost 7 births per woman) recorded until the beginning of the nineties. Since 1970 the birth rate has decreased from 50 to 38 annual births per thousand inhabitants. Life expectancy at birth, after a constant increase from 1960 to 2001, tends to plateau or even regress around 53 years. From two million inhabitants in 1960, Benin had increased to over 8.4 million today. The country shares with many African countries a past of socialist allegiance but it has been spared the ordeals of war, political violence, and tyranny. It managed to change several times its governing majority through free elections and without bloodshed.

Its total health expenditure accounts for 4.5% of GDP, the public share representing a little more than 2.1% of GDP, the remainder being provided by the private sector ; these figures are in constant growth. In spite of that, the number of hospital beds per thousand inhabitants fell from 1.5 to 0.23, reflecting a total absence of growth in hospital infrastructure whereas the country experienced its demographic explosion during the last forty years. The lack of increase in surgical activity of the main hospital of Cotonou reflects this stagnation : from 2003 to 2005 the number of surgical procedures decreased from 3,608 to 3,221. In the same town, the maternal hospital (HOMEL) built 50 years ago to accommodate 1,000 births a year now admits 7,500 in a strictly unchanged structure. If there were more than 7 doctors per 100 000 inhabitants at the beginning of the eighties, there are currently barely 6, despite all the efforts of the country to train new specialists.

The number of anesthetics per annum and per million of inhabitants is difficult to establish, for lack of statistics concerning the number of surgical and/or obstetrical operations.

The number of physicians specialized in anesthesiology and intensive care per million inhabitants is extremely small throughout the sub-region. Benin is relatively privileged with 15 specialists practicing

in the country in 2006 (up from 8 in 2001), while at the other extreme Chad counts only one indigenous anesthesiologist (plus one expatriate) for over 8 million inhabitants, and the Central African Republic (8.9 million inhabitants) recently lost its last specialist, deceased in 2006. Sub-Saharan Africa is the only area of the world where the number of physicians specialized in anesthesia and intensive care decreases, which led the World Federation of Societies of Anesthesia (WFSA) to ring the alarm in 2004. For all practical purposes the school of Abidjan has been closed since the beginning of the civil war affecting the Republic of Ivory Coast, which further worsens the situation. However, an international program has been started in 1996 in Cotonou, Benin, and early on opened its doors to candidates from the whole sub-region ; on average there are five graduates per annum. The program is fully accredited by the *Conseil Africain et Malgache pour l'Enseignement Supérieur* (CAMES), the organization coordinating the university-level teaching for 17 (mostly) French-speaking countries : Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo (Brazzaville), Gabon, Guinea-Bissau, Guinea-Conakry, Ivory Coast, Madagascar, Mali, Niger, Rwanda, Senegal and Togo. Its output has already made it possible to reinitiate a modest increase in the number of specialists in some countries like Benin (from 8 to 15), Togo (from 3 to 7), Niger (from 5 to 7), Burkina-Faso (from 8 to 12), Guinea-Conakry (from 2 to 3), and Djibouti (from 1 to 2)... Moreover, about thirty future specialists originating from eleven different countries are currently in training : Benin, Burkina Faso, Cameroon, Chad, Congo, the Democratic Republic of Congo, the Ivory Coast, Gabon, Niger, the Republic of Central-Africa, and Togo. Other countries (Mali, Guinea) have asked to send candidates. Stability and predictability of results has led the government of Burkina Faso to send one or two candidates every year, on public funds. Such initiatives have the potential to reverse the trend, but put a new burden on the host structures for which new solutions will have to be found. Only Abidjan, Cotonou and Dakar train significant numbers of anesthesiologists. Bujumbura, Kigali, and Kinshasa nominally possess anesthesia schools, but these are merely one-teacher initiatives (some retired from active practice) graduating but a few specialists of questionable value, and whose programs – and hence graduates – are still to be accredited by the CAMES. The school of Yaounde also fails to provide a steady supply of at least a couple graduates every year.

The number of nurses or midwives with specific training in anesthesia reaches one per 100,000 inhabitants in Benin and Togo, but it is only half that number in Chad. A school opened for these professionals in Cotonou, and celebrated its second class graduation in October 2006. Other schools exist in the sub-region, but their survival depends in a crucial way on their capacity to recruit anesthesiologists as teachers. Fortunately a large proportion of the recently trained anesthesiologists accept teaching duties ; this is true for those who practice in the public sector as well as for those active in the private sector.

### 1. Structures in which anesthetics are given

In sub-Saharan French-speaking Africa, health care providers are organized in a hierarchical web of hospital and health stations (dispensaries, often referred to as 'Centres de Santé'). Anesthesia is primarily practiced in public hospitals, academic or not. Hospitals are organized in three levels : academic centers, regional (or departmental) hospitals, and district hospitals.

Some Countries only have one university hospital, e.g. Benin, Burkina Faso, Niger... Others have several university centers, like the Ivory Coast, Togo and Gabon...

Then come Regional or Departmental Hospitals (one hospital for a given geographic area). A regional hospital usually shelters all the general services : General Practitioners, Pediatrics, Maternity and Surgery and often feature the common technical departments : laboratory, radiology, pharmacy, and an operating suite. Some also give access to surgical specialized care such as ophthalmology, ENT or even functional rehabilitation.

The third level of anesthesia care is represented by district hospitals, at least when they are equipped with a surgical antenna. The district hospital is the first medical structure being able to give complete care to the populations at the peripheral level. The district hospital usually includes two pairs of twinned services : medicine with pediatrics on the one hand, and maternity with surgery on the other hand. All services share the same operating facilities and the laboratory is less sophisticated.

In addition to this State structure Confessional Hospitals also exist in various countries. They often feature well equipped operating theatres and may undertake important surgical activities. They are often established far from the main cities or even close to international borders, so as to serve remote regions extending sometimes over two or three

adjacent countries. Examples of the latter are the hospital of Affagnan in Togo and the hospital of Tangyeta in Benin.

A majority of countries also have private clinics of variable capacity ; they are often managed by insurance trusts or are sometimes subsidized by foreign co-operation initiatives such as those from France and Canada. More recently, private institutions created by local physicians have entered the market.

Hospitals are financed by the State but there is no National Health Insurance refunding the patients. Thus the patient or his family must pay all hospital expenses, drugs and medical acts.

A few Mutual Health Insurance companies have appeared in various countries but they currently count very few members (a few thousand at best) and the coverage they can ensure is restricted to few services, mainly expenses at the level of the 'Centre de Santé', plus the costs of cesarean sections (in a hospital) when needed. The factor limiting their expansion is, of course, the purchasing power of their affiliates.

Access to health care will remain very unequal until these countries can afford to set up some sort of Social Security at the national level. To reach that point it would be necessary to be able to devote a larger proportion of the GDP to health care, probably more than 10%. This may be the price to be paid for equipping the curative health services, like surgery and its environment. Most international agencies support primary health care services and exclude other services. Such policy rapidly reaches its limits as even the best health care services at the basic level would lack sense without good reference structures.

### 2. Patients and surgical procedures

Patients are young : mean published ages are typically below 30 years old (2, 21). They represent nevertheless real challenges because of their nutritional status and the emergency.

Many patients are malnourished (15), in part because they try to support their families until they no longer can. In many cases also care is not sought until the needed money is found to enter the hospital.

Regardless of the type of practice (public or private) and the level of the institution, nowadays emergency procedures exceed programmed surgical activities. Emergency surgery typically accounts for 70% of interventions or more (2, 22), while really elective procedures barely represent 25% at best.

A typical surgical case-mix could break down as follows (2, 22) :

- Obstetrics and gynecology concern 40% of activities and sometimes more. Cesarean-section alone accounts for half of the ob-gyn activity.
- Visceral surgery and urology together concern a little less than 30% of activity ; they tend to recruit fewer patients than in the past, for reasons unknown. Hernia repair alone accounts for half of the activity in visceral surgery.
- Traumatology increases its activity because of motor vehicle accidents, to approach 10% of surgical patients. Neuro-traumatology is unavailable in most places and many patients die from extradural hemorrhage.
- ENT Surgery, Maxillo-Facial surgery and Ophthalmology are in progress.

The most frequent procedures are the following, in a typical order of decreasing frequency :

- Caesarean Section.
- Hernia or Hydrocele repair.
- Appendectomy, Laparotomy for peritonitis or occlusion.

Together, the above interventions account for nearly one-half of surgical activity in most hospitals.

- Osteosynthesis of femur, tibia or humerus.
- Hysterectomies, Myomectomies, Kystectomies ;
- Prostatectomy, Uretroplasty and cures of Urogenital Fistulae, Cystoceles and Ureterostomy.
- Uterine Revisions
- Wound care and sutures
- Thyroidectomy
- Amygdalectomy.
- Gastrectomy for cancer,
- Mammectomy.
- Operations for cataract or glaucoma.
- Laminectomy and other neurosurgical interventions.

Patient outcome is poor, despite the highly predictable case-mix (2, 9, 14, 21, 23, 27). Most epidemiological reports disclose peri-operative mortality rates between 1 and 3 %. Spinal anesthesia is remarkably safer than general anesthesia, especially when the latter is conducted without adequate protection of the airway (2, 14, 27). Poor understanding of the pharmacology of curare leads to frequent early postoperative deaths after successful surgeries.

In a prospective study of 137 anesthetics, Afagnihoun observed 95 complications (2).

Transient hypovolemic hypotensive episodes with tachycardia were the most frequent complications occurring during 18 of 32 spinal anesthetics. In contrast the 63 general anesthetics provided the most severe problems with aspiration, desaturation, delayed or abnormal awakening, and five cardiac arrests. There were four deaths, two of which occurred within half an hour after having left the OR after a general anesthetic for perforated appendicitis.

Patients who can afford the expense are still evacuated to European countries because many interventions in orthopedics, ophthalmology or neurosurgery cannot yet be performed in the concerned countries.

### 3. Human resources and anesthesia

Personal primarily includes nurses or midwives trained in anesthesia (called ISARs, which stands for *Infirmiers [et Sage-femmes] Spécialisés en Anesthésie et Réanimation*). The doctors-to-nurses ratio goes from 1-to-3 in Cameroon or Ivory Coast to 1-to-5 in Benin and Senegal (1, 19, 21).

Table 1 details the numbers of professionals present in a series of countries in the sub-region, in relation to the concerned populations. Data concerning ISARs are approximations, those concerning physicians specialized in anesthesiology are precise, but concern only the African specialists practicing in these countries, excluding expatriates. The nurse (or midwives) -anesthetists represent the bulk of the anesthesia work force actors in all these countries : they provide more than 80% of anesthesia care. One can see that in the best case the number of professionals in the field of anesthesia remains lower than 15 per million inhabitants ; as a comparison, Belgium counts more than 2,000 professionals (all doctors) for ten million individuals (3), i.e. a rate of 200 per million, and France which in the year 2000 counted nearly 9,000 specialists and over 7,500 ISARs reaches a combined rate of 275 per million (150 anesthesiologists plus 125 ISARs) (17, 20).

African anesthesiologists are most often found in teaching hospitals or regional centers, where they are involved in training nurses and sometimes future anesthesiologists. For the last few years, one has seen anesthesiologists appearing in district hospitals in Benin, in the Ivory Coast, in Burkina-Faso and in Cameroon.

Nurse-anesthetists are usually responsible for all clinical anesthetic activities in district hospitals and in departmental hospitals. They prepare the

Table 1

Anesthesia Work Force in some countries of Sub-Saharan French-speaking Africa

Country	Anesthesiologists	ISARs (untrained)	Population	Professionals per 100,000 hab
Togo	7	60	4,861,000	1.38
Benin	16	70 (< 10)	6,720,000	1.28
Senegal	25	100	10,048,000	1.24
Ivory Coast	30	100	16,835,000	0.77
Burkina-Faso	12	80	12,109,000	0.76
Cameroon	24	100	16,087,000	0.75
Niger	7	75	11,762,000	0.70
Guinea Conakry	3	40	7,909,000	0.54
Chad	1	19 (22)	8,582,000	0.48
Total	121	665	94,913,000	0.83

Sources : personal contacts, plus references 2, 19, 21.

patients for the interventions and look after them at all peri-operative stages (1). In those hospitals, they usually practice anesthesia under the responsibility of the surgeon. In many countries their age distribution is skewed, with a majority of them being more than 40 year old ; their replacement before retirement has become an urgent matter. As an example, in Benin by 2013 three-quarter of nurse-anesthetist will reach retirement age (2). Another problem to be tackled is continuous education. For all those reasons creating new nurse-anesthetist schools has become an obvious priority, but this objective is confronted to the lack of anesthesiologists able or having the time to assume teaching and organizing duties. Not all countries have schools training nurse anesthetists. In the existing ones the offer by far fails to meet the demand : in Cotonou 25 candidates are accepted yearly, vs. 150 demands (CM, author, personal communication).

Some anesthesia-delivering personnel were trained on the job, but never enjoyed any theoretical education in anesthesia. In most countries they are a small part of the anesthesia workforce, and tend to be older and close to retirement (2). Needless to say, they may feel threatened by young better trained professionals. However, in some other countries they still represent up to one-half of the available anesthesia workforce and should not be discarded lest the whole system would collapse (21). Their census is notoriously difficult to perform as hospitals relying on their services are least likely to cooperate with attempts to evaluate existing personnel. They tend to escape existing continuous education initiatives. Upgrading them to the level of formally trained nurse-anesthetist may require changing local laws and setting up specific education programs. In table 1 professionals delivering anesthesia without formal education and title of

Nurse-Anesthetist are either not counted or appear under brackets.

In teaching hospitals responsibility is shared between the anesthesiologist and the nurse-anesthetist. The doctor deals with the organization of work ; preoperative check-up and consultations ; manages the operating theatre suite ; delivers anesthesia for complicated cases and manages the intensive care area. The ISAR remains the cornerstone of the operating theatre functioning and for monitoring patients during the post-anesthetic recovery.

The anesthesiologists also deal with the Centralized Emergency Rooms, new departments which appear today in many hospitals of the sub-region ; these entities often have their own operating room(s) and sometimes a shock-unit.

Brain drain represents an acute and vital threat for sub-Saharan countries (4, 13). The phenomenon is caused by some European hospitals which employ African graduates often under illegal conditions to fill in their rosters, mainly for the least popular functions : emergency departments, SAMU ambulances, and night shifts in general. Each head-hunted professional creates a true humanitarian crisis in his country of origin, for a questionable benefit of comfort -or to alleviate an obvious lack of programming- in Europe. Training a specialized physician represents an enormous investment for third world countries. Prolonging specialization stays without formal consent from the faculty of origin is a frequent scenario robbing these countries of the fruits of their effort. The dishonesty of the process is obvious : near-graduates can provide the work of a European specialist for only a fraction of the cost, while their precarious 'contracts' put them at the mercy of their superiors. As these professionals bear no diploma, and no longer practice within the cooperation contract which bound their Faculty

to the European training hospital, they actually practice medicine illegally in the host country. In the event of a medico-legal problem, the authorities of the concerned hospitals are quick to reject them, leaving them alone to face the legal consequences of the situation. European countries suffer from a perceived shortage of anesthesia workforce and can easily absorb any foreign professional in the field. Recently the position expressed by French, British and European Union political leaders has shifted from tolerating them in subaltern positions to validating their foreign diplomas and experience in order to give them an authorization to practice in Europe (10, 11, 25). This is not specific to anesthesia nor to medicine. Some politicians crudely stated : “immigration of anybody holding a university degree will be encouraged” (5). Recent declarations of Mr. Barroso, president of the European Commission, declarations of Mr. Chirac, former president of the French Republic, and those of Mr Sarkosy while Minister of Interior, are at odds with the policy followed by Mr. Louis Michel, European Commissioner for Development ; unfortunately they leave little hope for actively supporting high level professionals when they chose to stay in less favored countries.

Some poorly enlightened policies by international institutions – or poor implementation of their demands – have yielded disastrous results. As an example, most West African countries have been summoned in 1999 by the International Monetary Fund to reduce the number of people on their State’s payroll, in order to make them re-eligible for international funding. Most complied by reducing their plethoric State apparatus in a linear fashion, affecting health workers in the same proportion as customs officers ; few sacrificed their army. For Cameroon, for example, the move came at the worst moment ; many students had been selected ten years before to go and study medicine in Europe ; half of them were in the final months of their specialty when the jobs they had been prepared for suddenly disappeared. A majority had no other choice but to stay in Europe, because their home country could no longer afford them : in addition to painful personal and familial situations, it provoked a cruel waste of talents and public money.

#### 4. Technical material available

Heavy equipment varies according to the level of the hospital (2, 8, 12, 21). The findings of a recent survey of peripheral hospitals are detailed in table 2. Teaching hospitals have some operating

Table 2  
Available material in 14 peripheral hospitals in 2002  
in Benin (2)

Material	N centers with equipment
<i>Respiratory Equipment</i>	
Anesthesia head	14
Intubation material	14
Ambu balloon	14
Pediatric masks and balloon	14
Aspiration device	8
Oral cannulae of various sizes	8
Ventilator	3
Single use endotracheal tubes	1
<i>Cardio-Vascular</i>	
Stethoscope	14
Oxygen	14
Sphygmomanometer	14
Pulse-oximeter	8
Blood pressure monitoring	7
Cardioscope	2
Defibrillator	2
Pediatric blood pressure cuffs	1
<i>Miscellaneous</i>	
Single-use IV catheters	14
Urine catheters	14
Naso-gastric tubes	14
Electricity generator	8
Central venous catheters	2

rooms equipped with modern respirators, but even there this is not the case in all the operating rooms. District hospitals and even departmental hospitals have operating rooms without respirators and the personnel must often work with a second hand respirator or a simple anesthesia head given by a partner from a developed country. Maintaining such material in working shape under tropical conditions is a challenge of its own. Trained technicians are also in short supply. At the very least one finds a simple anesthetic circuit connected to a source of oxygen (oxygen bottle or concentrator). Monitoring is often reduced to a stethoscope, a pulse-oximeter and a sphygmomanometer. Secka found that in 2002 oxymeters were available only in 4 of 24 Chadian hospitals (21). In contrast multiparameter monitors are found in many of operating rooms of teaching hospitals (12). Capnography is exceptional because these devices require much maintenance and tend to function badly in hot and saturated environments.

African specialists do not hesitate to qualify their continent as a cemetery for medical devices, because so much second hand material is inadequate and does not resist local working conditions (4). Ironically, transport and customs costs often exceed the intrinsic value of given – and

sometimes unrequested – material, and are charged to the receiver. This imported material also mobilizes important human resources before breaking down, resources which could definitely be used in a better way. To manage disparate and out-of-date material, without control over its acquisition, is one more difficulty the local heads of departments must deal with. Sponsors all too often act according to how *they* perceive the needs of the assisted countries. This approach led to grotesque situations like snow-ploughs rusting away in the middle of Africa. Anesthesia is not immune to this syndrome. In 2005 a European government even proposed a helicopter to the emergency room of an African University Hospital where the operating rooms still lacked the most basic monitoring. The material cost (fuel and maintenance) resulting from one single hour of flight for such a machine would easily pay the annual wages of a nurse anesthetist in Africa (CM, author, personal communication)...

Endotracheal intubation equipment (laryngoscope, *cannulae*) exists but it is often shared between several operating rooms, sometimes even two sites of anesthesia (12). In some countries most centers even lack any type of oxygen supply (21, 16). The small equipment (facial masks, endotracheal tubes) is generally available for adult patients but pediatric material is much harder to find (2). Laryngeal masks and the material of cricothyroidotomy are almost never to be found.

Perfusion material exists as do the usual intravenous crystalloid solutions ; in contrast, extension tubings, three-way stop-cocks and large syringes are rare conveniences. The supply of disposables remains a daily hassle. For example needles for lumbar puncture suitable for spinal anesthesia are not available all year around ; there are no Tuohy needles nor epidural catheters. Electric injection pumps remain a rarity.

As far as hospital hygiene is concerned the emergence of AIDS and its corollary, the resurgence of pulmonary tuberculosis, question the prac-

tice of re-sterilizing ‘single use’ devices like surgical gloves, endotracheal tubes, naso-gastric tubes, suction tubes, and manual ventilation equipment. Furthermore the use of anti-bacterial filters is exceptional on anesthesia circuits. The basics of hygiene are poorly understood and hence implemented by OR personnel (26). Adapting practices to international standards would incur prohibitive costs, but this situation nevertheless represents a real and very immediate problem.

### 5. Available drugs

Easily available drugs are listed in Table 3, although their availability fluctuates according to countries and source of provisioning. To this list one must add basic crystalloid perfusion solutions which are often produced in local factories : NaCl 0.9% and Dextrose 5% in Water.

The traditional antidotes used in anesthesia are generally non available.

Broadly speaking the essential drugs to deliver anesthesia can be found, but their provisioning is irregular. Medical disposables classically used in anesthesia and intensive care are much more difficult to obtain.

Drugs can be ordered through private pharmacy wholesalers who regroup orders on the international market and import bulk quantities according to the expressed needs and to their own interests. They buy generics as well as specialties in Europe, Morocco or Mauritius where French industries have established commercial branches or production plants. Other sources exist in so-called emergent countries like India, China, Brazil and even Togo. In practice only the Indian products are encountered with some frequency in sub-Saharan Africa. The quality of such products (in terms of galenic preparation and variability of concentration) goes from best to worst. Analyses carried out in Cotonou and in Belgium showed that certain specialties produced in India exceeded the most stringent

Table 3

Drugs most frequently available in sub-Saharan French-speaking Africa

Anesthetics	Thiopental, Ketamine, and seldom Propofol
Opiates	Pethidine, Fentanyl, and inconstantly Morphine
Myorelaxants	Gallamine, Pancuronium bromide, Succinylcholine (rare)
Benzodiazepines	Diazepam, and seldom Midazolam
Halogenated vapors	Isoflurane ; Halothane being in the process of withdrawal
Local anesthetics	Lidocaine 1 to 2% (5% still exists) ; Bupivacaine 0,5%
Hemodynamic drugs	Adrenalin, Atropine, Ephedrine, Clonidine, Nicardipine

Sources : references 2, 14, 21, 22, 27.

European criteria (Van Brandt, personal communication) while some products coming from an African country had unreliable concentrations of active substances (Pharmaciens Sans Frontières, personal communication). The international press also reported about drugs being produced without any respect for Good Manufacturing Practices, some of which were pure and simple forgeries, i.e. products which present exactly like the true drug but do not contain any active ingredient whatsoever. Benin started being confronted with this phenomenon around 2002. The CNHU of Cotonou has already had the experience of fentanyl of considerably reduced potency, propofol which appeared as a look-alike of the drug marketed by Fresenius® but never managed to induce an anesthetic, Diazepam and Pethidine which caused epidemics of allergic skin reactions (LT, author, personal communication). In nearby Nigeria Dr Dora Akunyili found evidence of fake adrenalin, fake muscle relaxants and infected intravenous drips (6, 7). A survey conducted with the support of the World Health Organisation found more than half of the drugs on sale in Nigeria were either fake or sub-standard (7).

Besides private wholesalers, the hospitals can order drugs from their National Center for Drug Supplies, State organizations existing in many African countries which function with co-operation subsidies from technically developed countries, like the Netherlands or Switzerland. These centers buy and deliver products which are quality controlled by national laboratories or laboratories working for several countries such as Cotonou and Niamey. Despite such precautions batches of specialty drugs with reduced effectiveness have been delivered by these Centers. Hospitals can order on credit from these organizations, and refund progressively as they use and sell the drugs. Such a system offers regularity and assurance of supply, but it is based on reciprocal confidence and regularity of payment. Conflicts emerge when the hospitals do not honour their debts. Whole hospitals, including academic centers, have thus been excluded from such supply lines for several months, or even years, and had to pass through local wholesale companies or turned directly to the international market to end up with more expensive and less regular supplies of questionable quality.

Some drug companies aggressively market expensive last-generation antibiotics and analgesics which end up ruining families (or patients leaving the hospital without treatment) when simpler and less expensive alternatives exist, especially on the generic market.

A last aspect deserves some comment. Many products used in third world countries are old and have long lost any commercial value for their manufacturing companies. However, they have the advantage of being cheap and well-known to clinicians. Commercial logics, and a certain consumerist pressure focused on serious but very rare accidents (such as the risks of malignant hyperthermia or hepatitis with Halothane) lead to the withdrawal of many molecules without taking into account that safety or financial conditions for the use of the new molecules are not met in third world countries. Withdrawing Halothane has been a catastrophe for pediatric anesthesia for that half of Humanity whose anesthesia providers have neither the means, nor the material, nor the training needed to use Sevoflurane (18).

In practice for anesthesia practitioners the described situation leads to an irregular and unforeseeable drug supply, with sometimes dangerous surprises for the patient. The CNHU of Cotonou has experienced months without opiates, others without myorelaxants or halogenated vapors, and experienced strange epidemics of 'anaphylactic reactions'. Chronic lack of succinylcholine has been demonstrated to play an important role in the resurgence of inhalation syndromes during caesarean sections (14, 27). Ensuring a reliable and regular supply in basic anesthetic drugs remains a real puzzle shared by all anesthesia services in Africa, which often prevents them from reaching a correct level of practice ensuring a minimum of safety for even the simplest cases.

## 6. *Anesthesia techniques*

General anesthesia is the most practiced technique in Africa because of available means and skills. It involves manual or spontaneous ventilation by face mask or endotracheal intubation, artificial ventilation being unavailable in the majority of the district hospitals. General anesthesia is practiced with or without intubation according to the importance and the duration of the interventions in regional or department hospitals and in academic centers; mechanical artificial ventilation is possible only in the latter structures, supervised by anesthesiologists, provided the adequate equipment is in working condition.

One could roughly estimate that 80 % of cases are performed under general anesthesia (2, 21). As an example, Table 4 gives the proportion of anesthesia techniques for the Centre National

Table 4  
Anesthesia at the CHU of Cotonou : General Statistics

Year 2005	Central OR		Maternity		ENT-OPHT OR	
Anesthetic technique	N	%	N	%	N	%
GA	1427	92.1	1064	75.5	264	100
LRA	122	7.8	344	24.4	0*	0*
<i>Total</i>	1749	100	1408	100	264	100

0\* : in ophthalmology, blocks are performed by ophthalmologists.

Table 5  
Anesthesia at the HOMEL Mother-and-Child (university-affiliated) Hospital of Cotonou, Republic of Benin :  
General Statistics

Year 2005	Obstetrics		Gynecology		Pediatrics		Total	
GA	1484	49.9	1019	92.7*	66	100*	2569	61.9*
LRA	1497	51.1	101	9.2*	20	30.3*	1618	39.0*
<i>Total patients</i>	2981	100	1099	100*	66	100*	4146	100*

\* Sums may exceed 100% of cases because some patients benefit from an intraoperative spinal or epidural analgesia along with a general anesthetic.

Hospitalier Universitaire in Cotonou, Benin. In 2005, a total of 3221 patients underwent an anesthetic : 2755 (85.5%) had a general anesthetic and 466 a loco-regional technique, mainly spinal anesthesia ; to this number one should add an unknown number of peribulbar blocks performed by ophthalmologists.

Loco-regional anesthetics are certainly not performed as often as could be, even in teaching centers. The HOMEL center, specialized in mother-and-child care performs 51 % of obstetrical interventions and 65% of its cesarean sections under loco-regional, mainly spinal, anesthesia (Table 5). Knowing the specific risks of general anesthesia during or just after delivery, the figure of 25% loco-regional anesthesia found in the other teaching center is unsatisfactory (Table 4).

A study of anesthesia practice in 14 Beninese peripheral hospitals (one per department, chosen at random) during the year 2001 found that 63% of interventions were performed under general anesthetic, two-third of which using a face mask and one-third using endotracheal intubation (2). The same study also disclosed that 72% of involved procedures were emergencies.

Spinal anesthesia is used in most hospitals as all ISARs are trained to master the technique. However it still needs to be made available on a permanent basis by ensuring an uninterrupted supply of needles ; in the same way wide gaps of safety

persist due to a lack of comprehension of the implied physiological mechanisms, whatever the level of the hospital (9).

The availability of material still limits the use of the epidural anesthesia. Notorious exceptions exist : Chinese hospitals and some private clinics in Gabon, in Burkina-Faso and in the Republic of Ivory Coast enjoy their own privileged supply lines.

Peripheral nerve blocks remain rarely practiced, primarily for lack of training of the anesthesiologists themselves ; but the problem of adequate supply of local anesthetics and needles constitute real obstacles also, like for other techniques. The couple euros a needle can cost often prevents using a locoregional technique.

However, loco-regional techniques enjoyed a renewed interest over the last few years, since anesthesiologists got gradually more present in the operating rooms. Anesthesiology Training Programmes in Abidjan, Cotonou, Dakar and Yaounde play a central role for diffusing these techniques (23). Table 6 demonstrates the impact on anesthesia practice in a Togolese university hospital after hiring three new anesthesiologists graduating from the Cotonou program over a period of three years. The total number of operated patients increased, the proportion of general anesthetics decreased dramatically, and a variety of new techniques were introduced. The magnitude of the observed changes prove that front line actors' knowledge and skills

Table 6

Evolution of Anesthesia Techniques at the Centre Hospitalier Universitaire Tokoin, Lome, (republic of Togo) : General Statistics

	Year 2002		First semester 2006	
GA	1318	90.0	1004	52.8
Spinal	117	8.0	803	42.2
Caudal			4	0.2
Lower Limb Blocks			46	2.4
Axillary Block			40	2.1
Para-Umbilical			5	0.3
Any non-spinal LRA	29	2.0		
<i>Total</i>	1464	100	1902	100

Note : no patient has benefited from a combination of techniques.

Source : Ouro Bang'na (author), personal data.

have been upgraded : techniques have adequately been passed over to anesthesia nurses.

### 7. Current problems and difficulties of anesthesia in Africa

The above sections underscore the following problems :

- The lack of equipment regardless of the level of the hospital
- The scarcity of manpower, especially at the medical level, but under-staffing will soon touch the ISARs also, because many are near retirement. Insufficient training and qualification remains a problem. The number of teaching and training structures is insufficient.
- Insufficient continuous education.
- Irregular supplies of drugs and disposables.
- Poor hospital hygiene and poor anesthesia performance adding to poor preoperative health status of the patients to worsen the overall prognosis of operated patients.
- High cost of the health care compared to the purchasing power of the populations. Let us remind the absence of social security in these countries.
- Lack of minimal quality control and lack of authority by the hospital managers or by the national health departments.
- Poor management and bad governance of some hospitals and/or public health structures yielding wrong priorities and incorrect budget allocations.

### 8. Prospects for improvement

Some actions in progress bring hope for improvement :

- Progressive increase in specialized medical staffing in anesthesia thanks to the still function-

ing anesthesiology training programs. The creation of more programs should be supported but existing and future programs should cooperate within a common academic system in order to optimize their scarce resources, especially their teachers.

- In several countries the Ministry for the Health provides grants to help young doctors to enter the discipline. This action is supported by the Belgian Technical Cooperation and the Belgian CUD (Inter-University Cooperation to Development) which also finances grants for anesthesia.
- New schools to teach and train nurse-anesthetists or health technicians specialized in delivering anesthesia have been founded in Benin, Guinea and Chad, and have delivered their first diplomas in 2005. They cannot cope with demand, but could start a 'snowball' effect if future young anesthesiologists commit themselves to teaching. This initiative has been recently supported by the *Commissariat Général de la Coopération Internationale de la Communauté Française de Belgique*.

Other actions are to be developed or conceived in the near future :

- Drastic measures to reduce the emigration of anesthesia professionals, which must be concerted between the governments of African countries and those of more developed countries. African faculties and schools of anesthesia should develop policies aiming at increasing alumni loyalty and to ensure a stable future to their graduates in their country of origin, by providing high-quality training adapted to local realities. In Europe, more constraining measures should be taken to discourage directors of hospital or heads of departments who employ anesthesia professionals under illegal conditions.

- Continuous education programs are needed to maintain and increase the competence of anesthesiologists and nurse-anesthetists. In order to provide effective and safe care under precarious conditions clinicians need more knowledge and more ability to improvise new solutions than those working in a protected environment. This paradox must be well understood when teaching our specialty in third world countries.
- Develop the use of loco-regional anesthesia and to motivate the personnel for its use, with the aim of improving patient safety.
- African countries must close the legal loopholes allowing drug companies to import substandard medications with impunity. They should take legal measures to restrict the current situation of totally unregulated pharmaceutical market which clearly affects good patient care.
- Improve the regularity of supply lines for essential anesthesia drugs and disposables. The needed structures exist, with central purchase offices in most countries, but they do not play their role adequately. The net result at the bedside is disastrous. A list of the 20 indispensable drugs for anesthesia has been agreed upon by a group of academic anesthesiologists in Benin, with the help of future specialists from 10 different countries, and has been forwarded to political authorities but up to date it remains unpublished (Table 7).

Table 7

## A List of 20 essential drugs for anesthesia in developing countries

No hospital should be authorized to perform interventions requiring anesthesia (local, regional or general) without ensuring a reliable supply of the following drugs at any time

	Drug	Administration	Concentration	Presentation
1	Ketamine	IM, IV	50 mg/ml	10 ml vials
2	Thiopental	IV	Powder	1 gr vials
3	Midazolam <i>or</i> Diazepam	IM, IV IM, IV	5 mg/ml 5 mg/ml	5 ml ampoules 2 ml ampoules
4	Fentanyl	IV, spinal, epidural	50 micrograms/ml	10 ml ampoules
5	Morphine	IM, IV, spinal, epidural	10 mg/ml	1 ml ampoules
6	Succinylcholine	IV	50 mg/ml	10 ml ou 2 ml
7	Vecuronium <i>or</i> Pancuronium <i>or</i> Atracurium	IV IV IV	Powder 2 mg/ml 10 mg/ml	10 mg ampoules 2 ml ampoules 5 ml ampoules
8	Atropine	Sub/cut, IM, IV	1 mg/ml	1 ml ampoules
9	Ephedrine	IM, IV	30 mg/ml	1 ml ampoules
10	Adrenaline	s/cut, IV, ITracheal	1 mg/ml	1 ml ampoules
11	Lidocaine	Sub/cut, IM, IV, ITracheal, spinal, epidural	2%, 20 mg/ml	20 ml vials
12	Bupivacaine	Perineural, spinal, epidural	0.5%, 5 mg/ml	20 ml, Isobaric, without preservative
13	Halothane	ITracheal	Pure	Liquid to vaporize, in tainted bottles.
14	Sodium Bicarbonate	IV Perfusion	14 or 42% solution	vials or bottles
15	Calcium gluconate or chloride	IV slow	0,5 or 1 gr in solution	Ampoules
16	Magnesium Sulfate	IV slow	0,3 gr/ml solution	Ampoules or vials
17	Normal Saline	IV, IM, ITrachéal, epidural, spinal.	NaCl 0.9% in water	500 ml bottles or bags
18	5% Dextrose/Water	IV Perfusion	5%	500 ml bottles or bags
19	Ringer-Lactate	IV Perfusion	Known formula	500 ml bottles or bags
20	Oxygen	Respiratory	> 20%	From a concentrator or cylinders.

This list could be completed with other useful drugs whose occasional lack might not endanger patients : Clonidine, Etomidate, Nicardipine, Trinitrine ou equivalent, Potassium chloride.

- Plead with political authorities to purchase adequate equipment for all hospitals, in a hierarchical approach starting with sphygmomanometers, stethoscopes, pulse-oximeters, material for pediatric ventilation and pediatric blood pressure measurement. Cardioscopes and multi-parameter monitors should only come later, once every anesthesia working station will feature the basic equipment.

On a macro-economic level it will be important to find a way to finance the access of the greatest number to health care.

- Will the current Authorities in charge of Public Health be able to provide the foundations of a Health Insurance scheme covering more than vaccines and other types of preventive medicine ? Political stability and physical safety of populations in are *conditiones sine qua non* to support any economical take-off, which in turn might allow for increasing the budget for health. Corruption is a plague which dissipates public money in many African countries, but with notable differences from country to country. As doctors we must commit ourselves so that in the decades to come all citizens from each country can hope to receive good quality health care.
- It will be interesting to follow the development of the fledgling mutual insurance companies which are born in the sub-region.
- Countries having more than ten anesthesiologists can get their National Anesthesia Society recognized by the World Federation of Societies of Anesthesia (WFSA). Where they exist, these National Societies and the Regional Scientific Associations have assumed a motor role in the current evolution by organizing courses, workshops, didactic events and scientific meetings. However, up to date they failed to play any significant political role despite the specific challenges anesthesia must face. Many existing difficulties are totally or partially linked to organizational problems which could be amenable to a better usage of existing resources. Legislative action is needed in most countries, professional regulations are needed, and coordination with pharmacy regulatory bodies is needed to ensure a safe drug supply. Professional societies could tackle important issues if they stood up as constructive spokespersons and negotiated with political authorities. Concerted actions of several national societies within the sub-region could give even more weight to their proposals.

## CONCLUSIONS

Anesthesia in sub-Saharan Africa is confronted with qualified staff shortage, with ageing teachers, with the isolation of nurse-anesthetists (or inadequately trained anesthesia technicians) lacking continuous education, with a shortage of material and technical means, and with an irregular supply of drugs both qualitatively and quantitatively. Deregulating and liberalizing drug markets further worsened the situation for the poorest countries by exposing them to uncontrolled generics and/or fake specialties. Recent political options about immigration taken by some influent European leaders could give the final blow to fragile local health structures.

As far as the material situation is concerned, it will require a prolonged international support, as long as curative medicine, and especially surgery, will remain financially or geographically out of reach for the majority of the African population.

Prospects for improvement come from a few schools struggling to train physicians in the specialty of Anesthesia and Intensive Care, with the hope that our new colleagues will agree to assume teaching endeavors and train future anesthesiologists and nurse-anesthetists. To date, the future of anesthesia in French-speaking Africa literally lies in the hands of no more than a dozen teachers spread over half a dozen countries.

African anesthesiologists face an uphill battle on all fronts, but must start the political struggle for legal structures able to protect the results of their clinical and academic work.

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