Teaching Neuraxial Anesthesia Techniques for Obstetric Care in a Ghanaian Referral Hospital: Achievements and Obstacles

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Neuraxial anesthesia techniques for cesarean delivery have become commonplace in high-income countries.1–3 Preference for the use of neuraxial anesthesia has resulted, in part, from recognition that general anesthesia may increase maternal risk.4,5 Unfortunately, many low- and middle-income countries continue to use general anesthesia for cesarean delivery, contributing to maternal deaths in both healthy and medically complicated patients.4–7 Mishaps include pulmonary aspiration of gastric contents and/or hypoxemia related to difficult intubation, unrecognized esophageal intubation, hypoventilation, or premature extubation. These problems may account for 3% to 9% of hospital-based maternal deaths.4–7

Anesthesia providers in low-income countries are few and rarely care for obstetric patients outside the operating room.10 The first encounter between the parturient and anesthesia provider is usually in the operating room immediately before induction of anesthesia. The absence of anesthesia coverage on the labor ward may contribute to inadequate maternal and neonatal resuscitation, analgesia provision, airway management, intensive care, and preoperative assessment before surgery.4,10,11 Many low-income country labor wards do not provide analgesia or companion support to women in labor.10,12–14 Small doses of IV/IM opioids may be infrequently used for analgesia early in labor, although the effectiveness is variable at best.4,13 Surveys suggest that women in low-income countries desire labor pain relief;15 however, many are unaware of the options or their availability.

Kybele, Inc. (www.kybeleworldwide.org) is a North Carolina-based 501(c)(3) humanitarian organization that partners with institutions or governments in low-income countries to improve maternal and neonatal care standards.16 An invitation in 2004 by a Ghanaian anesthesiologist led to Kybele’s exploratory visit to understand the local medical culture and needs.17 Observations and focus group discussions at numerous facilities revealed a staff preference for the use of general anesthesia for cesarean delivery due to unfamiliarity with neuraxial techniques, lack of training in treating side effects and complications, and an inconsistent supply of spinal needles and drugs.10 Kybele’s initial interventions consisted of didactic lectures given to nurse anesthetists and anesthesiologists by multidisciplinary experts at local conferences. In January 2007, Kybele signed a 5-year memorandum of understanding with the Ghana Health Service to strengthen hospital capacity in delivering maternal and newborn care.18 Kybele was granted approval by the Ghana Health Service to conduct training and to collect data within the program.

Kybele selected Ridge Regional Hospital, a busy referral center in Accra, as the training site. The hospital is among the largest hospitals in Ghana with a 900-patient capacity. The maternity unit had grown from 1900 deliveries per year in 2004 to 11,000 deliveries in 2012; approximately 60% of which were deemed high risk. At the program onset, Ridge Regional Hospital had 3 anesthesia physicians and 4 nurse anesthetists to cover 3 to 4 operating rooms for the hospital. Anesthesia services were not provided outside the operating rooms. The labor ward consisted of 6 labor and 2 delivery beds located a considerable distance from the operating rooms.
The Kybele teams comprised 6 to 17 medical volunteers per visit. They traveled to Ghana 2 to 3 times per year from 2007 to 2011 to provide 1 to 2 weeks of intensive on-site, locally relevant training and follow-up. The volunteers were obstetricians, anesthesiologists, nurse anesthetists, neonatologists, nurses, and midwives from Canada, England, and the United States, all experienced in the care of high-risk parturients and newborns. The following is an account of the activities undertaken, challenges, and outcomes achieved in working with the anesthesia department at Ridge Regional Hospital to introduce the use of neuraxial anesthesia techniques in obstetric patients.

**PROGRAM IMPLEMENTATION**

**Spinal Anesthesia for Cesarean Delivery**

Observations revealed deficiencies in the local standards of anesthesia practice. Standard monitors such as electrocardiogram, pulse oximeter, capnograph, peripheral nerve stimulators, and noninvasive arterial blood pressure devices were frequently unavailable or not used. Surprisingly, the availability of anesthesia drugs was generally adequate; however, an incomplete understanding of pharmacologic effects occasionally resulted in adverse patient outcomes. For example, sedation was administered to a compromised patient with respiratory distress, leading to cardiac arrest, and swallowing had been used as criteria for tracheal extubation, resulting in airway obstruction. Frequent electrical power outages and an inconsistent supply of clean water contributed significantly to disruption of service. These observations reinforced the advantages spinal anesthesia could provide within the resource-restricted environment, including less cleaning of reusable items (e.g., airway devices), avoidance of airway manipulation, less postoperative pain, less nausea and vomiting, earlier breastfeeding (thus decreasing the risk for neonatal hypoglycemia), reduced nurse workload, and possibly, lower costs.

Ridge Regional Hospital anesthesia providers received didactic and practical training in the use of spinal anesthesia for cesarean delivery over 3 consecutive 1- to 2-week visits between 2006 and 2007. Patient eligibility, sterile preparation, needle selection, lumbar spinal interspace identification, local anesthetic dosage, sensory block assessment, hemodynamic monitoring, treatment of side effects, and complications were reviewed. Pencil point (25-gauge) needles were available for use, and 10 mg hyperbaric 0.5% bupivacaine was the preferred spinal dose. Opioid (fentanyl 25 μg) was rarely added because of lack of availability. A review of operating room logbooks (2004–2006) revealed prior limited use of spinal anesthesia for cesarean delivery (Fig. 1). Over the course of the program, the following areas were addressed and re-emphasized: preanesthetic evaluation and assessment of patients, customer care behavior, the spinal anesthesia technique, treatment of hypotension, and management of suboptimal neuraxial block.

After training in 2007, the use of spinal anesthesia increased significantly from 6% to 89% over 3 years (2008–2010) (Fig. 1). Reviews conducted in 2011 and 2012 confirmed a continued change in practice. In August to September 2011, 528 (95%) of 559 cesarean deliveries were performed using spinal anesthesia. Similarly, in August to September 2012, 553 (97%) of 570 cesarean deliveries were conducted with spinal anesthesia. There were 11,007 deliveries at Ridge Regional Hospital in 2012; of these, 13.6% and 2.7% had pregnancy-induced hypertension and hemorrhage, respectively. There were 3851 cesarean deliveries (35%). Data analysis revealed that cases of severe hemorrhage were predominantly conducted with general anesthesia, but the vast majority of hypertension-related cesarean deliveries used spinal anesthesia.

Spinal anesthesia continued to be used for cesarean delivery, even though the number of cesarean deliveries increased significantly after the program commenced (Table 1). Despite the large increase in patient admissions and the number of cesarean deliveries, the overall cesarean delivery rate remained relatively constant between 29% and 36% (Table 1). Kybele trainers and other external partners initially provided monitors, airway equipment, and disposable equipment; subsequently, local colleagues engaged hospital administrators to provide ongoing equipment needs. The collaboration spawned other clinical activities and accomplishments: a preanesthesia clinic, recruitment of additional anesthesia staff, initiation of a nurse anesthesia training program, and the creation of a dedicated obstetric operating and postanesthesia care unit. Maternal mortality decreased by 23% overall, from 496 to 380 maternal deaths/100,000 live births, over the 5-year period despite an increase in patient volume and high-risk disease acuity. In 2008, the World Health Organization estimated the maternal mortality ratio in Ghana was 409 maternal deaths per 100,000 live births with an uncertainty interval ranging from 248 to 633.17

**Single-Shot Spinal Labor Analgesia**

After the introduction of spinal anesthesia for cesarean delivery, a literature review and focus group discussions with Ridge Regional Hospital anesthesia leaders led to the development of a locally relevant single-shot spinal labor analgesia protocol (Supplemental Digital Content 1, http://links.lww.com/AA/B14). Epidural anesthesia was deemed inappropriate because of safety concerns and equipment limitations. In addition, a resuscitation box, equipment trolley, and a patient data record were developed (Supplemental Digital Content 2, http://links.lww.com/AA/B15; and Supplemental Digital Content 3, http://links.lww.com/AA/B16). The patient data record and a logbook recorded all patients who received spinal labor analgesia.

A demonstration/training program was undertaken to determine feasibility, staff, and patient acceptance of single-shot spinal labor analgesia in June 2007. This was conducted over 1 week during which 10 healthy, low-risk patients were recruited for training purposes. Risks and benefits were explained to patients before the procedure, and spinal analgesia was conducted with the customary sterile technique including skin preparation, hat, mask, and sterile gloves. Pencil-point (25-gauge) needles were used; plain bupivacaine 2.5 mg was the preferred spinal dose. An opioid, fentanyl 25 μg, was added if available. Reinforcement of training also occurred with subsequent Kybele visits. Two local nurse anesthetists had become proficient with spinal anesthesia for cesarean delivery and agreed to work in the...
labor ward. They recruited patients after the departure of the Kybele team. The department altered the daily schedule to allow the nurse anesthetists to be on duty in the labor ward during the morning shift (8 am–2 pm). Procedure complications and adherence to the protocol were assessed at subsequent Kybele visits by interviewing nurse anesthetists and midwives and reviewing the patient record sheets and procedure logbook.

Forty-six women (mean age 28 years) received spinal labor analgesia; of these, 6 patients requested a second dose when the initial analgesia waned. Fifty percent of the patients were nulliparous. The median verbal pain scale (0–10 scale) score was 9 (range 5–10) before and 0 (range 0–4) after analgesia. The mean cervical dilation was 5 cm (range 3–8 cm) immediately before initiation of analgesia. Ephedrine (10 mg) was available to treat hypotension, but was not needed because systolic blood pressure remained within 10% of baseline in all patients. Protocol deviations were noted in 26 patients who received higher than the recommended dose of 2.5 mg bupivacaine (range 3–6 mg). Opioid availability was limited such that only 4 patients received bupivacaine/opioid combination, 3 fentanyl (maximum 25 μg) and 1 meperidine (10 mg). Overall, motor block was minimal by the time of complete cervical dilation, and patients maintained the ability to ambulate to an adjacent room for delivery once leg strength was tested at bedside. One patient had a paresthesia during spinal administration without further complication. All patients were seen the following day, and no postpartum complications were identified. Unfortunately, efforts to sustain service delivery were hampered by prolonged anesthesia staff shortages that required the nurse anesthetists to work in the operating room.

Twelve months after the preliminary labor analgesia program, 65 patients (17% nulliparous) were randomly surveyed the day after vaginal delivery to assess their experience before, during, and after delivery (Supplemental Digital Content 4, http://links.lww.com/AA/B17). Sixty-one percent of patients reported pain and anxiety before, 29% during and 13% after delivery. Only 51% of patients were asked about the severity of the labor pain by hospital staff. Patients reported being offered the following modalities for labor pain control: nothing (44%), reassurance (22%), IV injection (22%), spinal medication (7%), and could not remember (5%). When asked which aspects of care could improve the labor and delivery experience, 46% reported the provision of pain relief, followed by 29% desiring companion support.

**DISCUSSION**

There has been a steady and sustained increase in the use of spinal anesthesia for operative delivery at Ridge Regional Hospital. The anesthesia providers continue to use the spinal technique despite a rapid increase in the number of cesarean deliveries performed and staff shortages. This is commendable since other countries with sufficient numbers of trained anesthesia providers and readily available spinal anesthesia supplies still report more frequent use of general anesthesia for cesarean delivery. Fear of neuraxial anesthesia by patients, reluctance of surgeons to operate on “awake” patients, and unfamiliarity of anesthesiologists using neuraxial techniques for obstetric patients were recognized factors.
At Ridge Regional Hospital, spinal anesthesia use for cesarean delivery has been sustained due to support by the obstetric and nursing staff, as well as administrators who ensure an adequate supply of 25-gauge pencil-point spinal needles and local anesthetics. This support was achieved through concerted and sustained advocacy efforts at individual and departmental levels. Spinal anesthesia consumes fewer resources than general anesthesia for operative deliveries. Furthermore, a patient immediately knowing the sex of her baby has also become a positive practice.

A limitation of the program was the lack of anesthesia-related mortality data collected before the commencement of the Kybele collaboration. Deaths due to anesthesia are often unknown or underreported. In sub-Saharan Africa, perioperative maternal death rates are reported to be as high as 1% to 3.8%. Anesthesia complications were implicated in a number of the deaths. Airway complications that accompany general anesthesia are minimized when spinal anesthesia techniques are used for cesarean delivery. A 2012 Ridge Regional Hospital internal audit identified 54 maternal deaths. Of these, 3 anesthesia-related deaths were identified; 2 deaths were due to airway complications during general anesthesia; and 1 death was related to high spinal anesthesia. Forty-one percent of the maternal deaths occurred in the operating room and postanesthesia care unit.

General or spinal anesthesia must be conducted or closely supervised by experienced providers who adequately monitor and treat complications as is summarized in the triennial report on confidential enquiries of maternal deaths from South Africa. Although the number of deaths related to spinal anesthesia were higher than general anesthesia (79% vs 17%) in this report, it is correctly stated that, “no conclusion can be drawn on the safety of spinal anesthesia (79% vs 17%) in this report, it is correctly stated that, “no conclusion can be drawn on the safety of spinal compared with general anesthesia as denominator data are not available.” Anesthesia accounted for 2.5% of deaths in >580,000 cesarean deliveries. The majority of anesthesia-related deaths occurred in smaller hospitals where supervision was often inadequate. The trend towards neuraxial anesthesia was obvious and appropriate because the avoidance of airway manipulation under general anesthesia has been instrumental in reducing anesthesia-related maternal deaths. Correct standards of care, however, need to be emphasized during training to avoid deaths due to complications of spinal anesthesia.

We demonstrated that spinal labor analgesia can be provided in a low-resource setting with the development of appropriate protocols, staff education, and the availability of a few basic drugs. Spinal labor analgesia was introduced due to staff familiarity and relative simplicity compared to the epidural technique. We avoided epidural anesthesia due to potential complications (postdural puncture headaches after unintentional dural puncture, high spinal anesthesia, neuraxial infection) and the lack of equipment (epidural catheters, low-resistant syringes, infusion devices). Anesthesia providers, midwives, and obstetricians recognized the immediate benefits of spinal labor analgesia by the positive patient responses that ranged from falling asleep to complete excitement over the unexpected experience of pain relief. The presence of fetal heartbeat before and after initiation of analgesia reassured midwives and patients of fetal welfare in relation to the procedure. It is important to note that even though guidelines were developed, protocol deviations occurred. Larger than recommended local anesthetic doses were sometimes administered to extend analgesia duration. Fortunately, there were no untoward effects. Efforts must be made to emphasize and reinforce strict protocol adherence.

Spinal analgesia has risks, complications, and benefits, and these must be anticipated and discussed with the patient. It is reassuring that the incidence of postdural puncture headache is low using small-gauge pencil-point spinal needles. The headache duration is usually self-limiting or can be treated with simple analgesia, rehydration, and bed rest. Resuscitative drugs (vasopressors, anesthesia drugs) and equipment (facemasks, Ambu bag, tracheal tubes) should be readily available. Guidelines and prompt intervention of hemodynamic or respiratory compromise must be taught. Although the duration of spinal analgesia using this protocol is limited, its benefit was understood and patients could receive a second spinal dose, if requested. In labor suites requiring parturients to walk to a separate delivery room, motor weakness from residual spinal analgesia must be considered; convertible labor and delivery beds would help eliminate this potential risk.

Patient acceptance of neuraxial labor analgesia is consistent with other reports. An Indonesian study found that 81% of women were highly satisfied with spinal analgesia comprising bupivacaine 2.5 mg, morphine 250 μg, and clonidine 45 μg. Similarly, in a Finnish study in which 229 parous women received single-shot spinal analgesia with bupivacaine 2.5 mg and fentanyl 25 μg, 85% of patients reported satisfactory analgesia and 81% would request the same technique again.

The provision of labor analgesia in low-income countries requires further study. African women consistently rate childbirth as painful, similar to women in other countries; however, they have few options for pain relief because labor analgesia is rarely provided. Interestingly, 94% of health care workers surveyed in 1 African tertiary center believed women should be offered pain relief, yet less than half had administered any form of analgesia in the 3 months before the survey. The survey further confirmed that the provision of pain relief was the highest rated factor that patients felt would improve their delivery experience. Other African studies have similarly found that women would use labor analgesia if given the opportunity. Our survey corroborates these findings. Midwives at Ridge Regional Hospital appeared supportive of pain-reducing efforts, but the majority of patients were not offered available analgesia. This discrepancy among midwives has many causes, including limited staff availability, other priorities, and complacency.

Another factor limiting the consistent availability of neuraxial labor analgesia is the lack of trained anesthesia providers. In our experience at Ridge Regional Hospital in Ghana, limited manpower was the greatest challenge in establishing anesthesia provider presence on the labor ward. Staff attrition and workload increase due to the increase of cesarean deliveries became problematic. It was hoped that the nurse anesthesia training school, which opened in 2009, would provide available nurse anesthetists; however, insufficient physician anesthesia coverage, lack of a perceived
role for anesthesia providers on the labor ward, and unfamiliarity of anesthesia providers with the labor and delivery environment continue to hamper progress. This situation at Ridge Regional Hospital is not unique because labor ward presence of anesthesia personnel is uncommon in many low-income countries. A practice paradigm shift is required.

The option for pain relief is considered a basic human right and is an index of health care quality and compassion. We must work to understand and address the multifactorial barriers that prevent women from receiving pain relief when they desire it. Providing analgesia during labor may encourage patients to seek earlier hospital admission and promote earlier multidisciplinary patient care. Earlier intervention by anesthesia providers also has the potential to improve patient outcome, especially in cases requiring resuscitation and airway support.

In conclusion, we have demonstrated that training anesthesia providers to conduct spinal anesthesia for cesarean delivery in a low-income country can result in sustained use. Use of simple protocols for spinal labor analgesia can also provide effective pain relief; however, challenges due to manpower, cultural, and logistical constraints can curtail sustainability. Anesthesia providers bring a unique set of skills to the care of high-risk obstetric patients, well recognized in high-resource countries. We must work to overcome barriers that prevent broader roles for involvement of anesthesia providers in maternal and neonatal care in low-resource countries.

DISCLOSURES

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REFERENCES

SPECIAL ARTICLE


