RESEARCH



Practice and challenges related to regional anesthesia in Amhara regional hospitals, Northwest-Ethiopia: a web-based survey study



Belete Muluadam Admassie¹, Biruk Adie Admass¹ and Debas Yaregal Melesse^{1*}

Abstract

Background Regional anesthesia (RA) can improve patient outcomes and reduce perioperative complications including deaths. Despite its benefits, RA is less utilised in low-resource settings. The purpose of this study was to assess practice and challenges related to RA in Amhara Regional Hospitals, Northwest-Ethiopia.

Methods A web- based survey was distributed among 360 anesthetists working in Amhara Regional Hospitals, Northwest-Ethiopia from November 15 - January 30, 2023. An English, semi-structure, self-administered questionnaire was disseminated by email and telegram following ethical clearance. The survey included questions about the use of RA, socio-demographic characteristics of anesthetist, types of practiced regional blocks, and barriers to perform RA. All volunteer respondents who filled online questionnaire during study period were included. The data were coded and analyzed using statistical package for social Sciences (SPSS) software-version 20. Both inferential and descriptive statistics were used to describe the results.

Results The overall response rate was 63.3% (223 out of 360 completed surveys). A total of 132 respondents (36.7%) did not provide a response, and 5 respondents (1.4%) submitted incomplete) surveys. The most frequently self-reported barriers to performing peripheral nerve blocks were a lack of equipment (regional procedure kit including block needle, ultrasound, nerve stimulator, or epidural set) 185 (82.9%), lack of knowledge 171(76.7%), lack of practical skills 112 (50.2%), and lack of drugs/medication 50 (22.4%).

Conclusions The principal findings indicate that all respondents perform spinal anaesthesia, while the practice of peripheral RA varies. Reported barriers to performing RA are related to knowledge and training, as well as a lack of equipment (there aren't enough regional procedure kits available that include an epidural set, block needle, nerve stimulator, and ultrasound). A more stringent approach with specific requirements, distinguishing between neuraxial and peripheral blocks, enhance training opportunities for peripheral nerve blocks are required in Ethiopia.

Keywords Barriers, Pain, Practice, Regional anesthesia, Safety

*Correspondence: Debas Yaregal Melesse dabyyaregal82@gmail.com ¹Department of Anesthesia, University of Gondar, Gondar, Amhara, Ethiopia



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

Introduction

Regional anesthesia (RA) is the process of injecting an anaesthetic around a peripheral nerve to prevent further transmission of pain and prevent or lessen it. There are a number of benefits over general anesthesia, including the avoidance of airway manipulation, avert the use of medications used in general anaesthesia, fewer systemic drug adverse effects, quicker recovery, and noticeably less discomfort following surgery [1]. There is no strict set of guidelines for the use of peripheral blocks but these may be preferable in patients who are at high risk of respiratory depression related to general anaesthesia and in patients where systemic medication are preferably avoided.

Peripheral nerve blocks, intravenous RA, and neuraxial anesthesia (spinal and epidural anesthesia) are the three forms of RA [2]. Efficient and adequate postoperative analgesia and surgical anesthesia can be achieved with neuraxial blocks [3, 4]. The type of procedure, the patient's condition, and the anesthesiologist's preferences all influence whether or not to do a regional block (4). Surgical pain management and the treatment of particular chronic pain conditions are among the indications of RA (5). Peripheral nerve blocks are specifically utilized for nonsurgical analgesia and surgical operations involving the upper or lower extremities. The way that anesthesiologists perform RA varies [5]. Technically, the anatomic structures are located and the needle or catheter placement is realised using ultrasound guidance and/ or nerve stimulator guidance [6]. The provision of anaesthesia is being revolutionised with the emerging trends in RA techniques. There have been new developments in procedure-specific and motor-sparing blocks [7]. In a survey done in University of North Florida, United States, procedural risk, a lack of postoperative care education for professionals, time restraints, and patient anxiety were notes as barriers to the performance of RA [8]. The lack of education and training for anesthesia providers is a key barrier to the development of RA in Ethiopia, despite the fact that it has many potential benefits that are shared with other low-income countries [9]. The characteristics, scope, and challenges pertaining to the practice of RA among anaesthetists employed at Amhara Regional Hospitals remain unknown.

The purpose of this study was to assess practice and challenges related to RA in Amhara Regional Hospitals, Northwest-Ethiopia.

Methods

Study design, area, and period

A web-based survey was conducted from November 15 - January 30, 2023 Northwest, Ethiopia. Following ethical clearance from the University of Gondar, School of Medicine, with approval number 10/10/340/2023, an email containing a link to a Google Drive questionnaire with four sections was sent to all 360 Amhara Regional Anaesthetists members (non-physicians only). The questionnaire/interview/survey was developed for this study (supplementary file). The questions covered the sociodemographic characteristics of anaesthetists, the types of RA (2 neuraxial blocks (spinal, epidural) used, 19 peripheral nerve blocks and fascial plane blocks, and 1 intravenous RA), and the barriers to performing RA. The study comprised the voluntary respondents who responded to the online survey within the designated timeframe. The anaesthetists who declined to fill out the questionnaire were not included in the research.

The dependent variable was the anesthetists' use of RA (practiced / not) in Amhara Regional Hospitals. Independent variables included socio-demographic (academic background/educational qualification (Diploma in anesthesia, Bachelor Science in anesthesia, Master of Science student of anesthesia, and Master of Science holder in anesthesia), participant age, gender, and year of experience), anesthetist-related (lack of knowledge, fear of complications, lack of practical skill), and health facility-related (category of clinical settings, availability of equipment (regional procedure kit), availability of drugs/ medications). In Africa, the majority of hospitals only provide spinal and occasionally local anesthetic infiltration, (is a part of a peripheral nerve block which the process of injecting the local anesthetic around the nerve), as RA. Anaesthetists were considered to be practicing RA if they could perform at least one of the techniques. In this study, if a respondent performed more than five different types of regional blocks (including central and peripheral nerve blocks), their practice of RA was categorised as practiced [10]. In Ethiopia, there are three different types of anaesthetists: those with a medical doctorate who specialise in anaesthesiology; those with a bachelor's degree who enrol directly in universities to pursue anaesthesia training after completing grade 12; those with a master's degree in advanced clinical anaesthesia who attend universities; and those with a diploma in post-basic anaesthesia who have upgraded from nursing backgrounds.

Data collection tool, procedures, ethical approval, and quality management

The online survey questionnaire was delivered via email and telegram (this is the telegram group set up for anaesthetists who practice in Amhara Hospitals, Ethiopia) following ethical permission from the University of Gondar, School of Medicine, with approval number 10/10/340/2023. Every volunteer who participated in the study provided data via email. An online survey questionnaire in Google form was provided in English. It was semi-structured and asked participants to complete it themselves. The survey included questions about the use of RA, socio-demographic characteristics of anesthetist, types of practiced regional blocks, and barriers to perform RA.

The cover page of the online survey had instructions on how to complete it. The deadline was reminded by email and a Telegram page, and the primary investigator oversaw daily data gathering. Ten anesthetists were pretested the data collection tool to ensure a specific level of data quality, and were excluded from the main study. The principal investigator verified the accuracy and completeness of the data.

Data processing and analysis procedures

Once the data collection process was finished, Epi-data was used to code, enter, and check the data for errors. Subsequently, the data were exported into SPSS and analysis using SPSS version 20. Using the Shapiro-Wilk normality test, the data's normality was examined. Frequency and percentage were used to present categorical data, and mean±Standard deviation was used to present normally distributed data. For the bivariate analysis, chi-squared statistical tests were employed. Nevertheless, no single variable met the requirements of the bivariate binary logistic analysis, meaning that it was not suitable for inclusion in the multivariate binary logistic regression analysis.

Table 1	Socio-demographic	characteristics	of anesthetists
(N = 223)			

Variables	Frequency (n) percent- age (%) (N=223)
Sex	
Male	187 (83.9%)
Female	36 (16.1%)
Age (years)	
>30	194 (87%)
≤30	29 (13%)
Highest level of qualification	
Diploma	3 (1.3%)
Bachelor science	114 (51.1%)
Master of science student	18 (8.1%)
Master of science holder	88 (39.5%)
Category of hospital	
District	50 (22.4%)
Referral	98 (43.9%)
Teaching	75 (33.6%)
Years of anaesthetist experience	
≤1	16 (7.2%)
1–5	143 (64.1%)
5–10	58 (26%)
>10	6 (7.2%)

n=the frequency of each category, N=total number of the respondents

Results

A total of 360 anesthetists received the survey. A complete set of questionnaire responses were obtained from 223 respondents (response rate of 63.3%) and incorporated into the data analysis. Of the 223 anesthesia providers, 187 (83.9%) were males, and their average age (Mean+- SD) was 27.9 ± 2.4 year old. More than half of respondents 114 (51.1%) were bachelor degree holders in anesthesia and 143 (64.1%) had one to five years of job experience (Table 1).

Practice and Barriers to performance of RA

The majority of respondents, 221 (99.1%), learned about RA from the RA course, and 96 (43%) expressed satisfaction with the level of RA training they received. Two hundred and five respondents (91.9%) selected RA due to its safety, and 174 respondents (78%) used surface anatomy to locate nerves. The most frequently self-reported barriers to performing peripheral nerve blocks were a lack of equipment (regional procedure kit including block needle, ultrasound, nerve stimulator, or epidural set) 185 (82.9%), lack of knowledge 171(76.7%), lack of practical skills 112 (50.2%), and lack of drugs/medication 50 (22.4%) (Table 2).

Frequency of practiced types of RA

The RA used by anesthesia providers were spinal anesthesia 223 (100%), Transverses Abdominal Plane Block (TAP) 178 (79.8%), ilioinguinal and iliohypogastric nerve blocks 151 (67.7%), axillary nerve block 140 (62.8%), supraclavicular block 125 (56.1%), and the least used block was Bier's block accounted 0.4% (Table 3).

Practice of techniques of RA

Anesthetists who performed 1–5 RA blocks accounted for 39.9%, followed by those who performed 6–10 (17.3%), 11–15 (25%), > 16 (17.8%). The number of blocks that the respondents were comfortable to perform on average was 8.9 (SD 6).

Of the anesthetists working at Amhara Regional Hospitals, 91 (40.8%) performed at most five distinct types of RA, while 132 (59.2%) performed above five different types.

Discussion

This study investigated the practice and challenges related to RA in Amhara Regional Hospitals, Northwest-Ethiopia.

Proficiency in RA was defined as performing five or more blocks, including neuraxial techniques such as spinal anaesthesia. Our study found that 132 (59.2%) of anaesthesia providers were considered proficient in RA based on their self-reported performance of more than 5 types of neuraxial and peripheral nerve blocks. Expertise

Table 2 Participants response on practice of regional anesthesia (N = 223)

How did you locate nerves while doing peripheral	Frequency		
nerve blocks	(%)		
Nerve stimulator	98 (43.9%)		
Surface anatomy	174 (78%)		
Using ultra sound	15 (6.7%)		
Why did you use this regional block?			
As a sole anesthesia	158 (70.8%)		
To supplement for GA	62 (27.8%)		
For post-operative analgesia	78 (34.9%)		
It is Safe	205 (91.9%)		
Less costly	132 (59.2%)		
For which surgical diagnostic/procedure did use regional bl	ocks		
Gynecological procedures	112 (50.2%)		
Labor pain	16 (7.2%)		
Cesarean section	223 (100%)		
Orthopedic procedures	202 (90.5%)		
General surgeries	215 (96.4%)		
What are the major challenges in practicing regional anesthesia service			
in your set up?			
Lack of equipment (regional procedure kit)	185 (82.9%)		
Lack of practical skills to perform the procedure	112 (50.2%)		
Lack of drugs/medications	50 (22.4%)		
Lack of Knowledge of the procedure itself	171(76.7%)		
Fear of complications	10 (4.5%)		
Lack of time to perform	9 (4%)		
Lack of appropriate space	6 (2.7%)		
Scope of practice	5 (2.2%)		
Other staff	6 (2.7%)		
Learning of regional anesthesia: Sources			
Courses	221 (99.1%)		
Workshops	50 (22.4%)		
Self -learning	120 (53.8%)		
Formal training	5 (2.2%)		
Satisfaction with the extent of training in nerve blockage technique			
Very dissatisfied	34 (15.2%)		
Dissatisfied	66 (29.6%)		
Neutral	20 (9%)		
Satisfied	96 (43%)		
Very satisfied	7 (3.1%)		
Did you know protocols /guidelines for regional anesthesia complica- tion management			
Yes	79 (35.4%)		
No	144 (64.6%)		

Other staff; Surgeons are included in this context as other staff members who occasionally participate in specific anaesthesia types choice

in RA goes beyond technical proficiency; non-cognitive aspects must also be considered, according to an observational study of practice of RA conducted in the United Kingdom (UK) [11]. A study conducted in Ethiopia supported the findings of this investigation, which found that 61% of the 105 anesthetists who took part in the survey practice RA mostly in operating rooms [12]. The fact that both studies were conducted in the same nation may

Table 3 Frequency and percentage of practiced types of RA (N = 223)

Types of regional blocks	Frequency (%)
Central neuraxial	
Spinal anesthesia	223 (100)
Epidural (lumbar, thorax)	98 (31.1)
Peripheral and fascial plane	
Ankle block	64 (28.7)
Supraclavicular block	125 (56.1)
Caudal epidural block	111 (49.8)
Sciatic nerve block	89 (39.9)
Popliteal block	66 (29.6)
Femoral nerve block	114 (51.1)
Lumbar plexuses	82 (36.8)
Saphenous nerve block	56 (25.1)
Interscalene block	87 (39)
Elbow block	17 (7.6)
Infraclavicular block	91 (40.8)
Axillary nerve block	151 (67.7)
Intercostal nerve block	18 (8.1)
Transverses abdominal plane block	178 (79.8)
llioinguinal and iliohypogastric nerve block	140 (62.8)
Thoracic paravertebral block	94 (42.2)
Cervical plexuses block	104 (46.6)
Wrist block	45 (20.2)
Rectus sheath block	48 (21.5)
Intravenous	
Biers block	1 (0.4)

account for this commonality considering that the nation is low-middle income country (LMIC).

One study discovered that a qualified anesthesiologist must perform 20 successful RA in each approach and 20 unsupervised RA before becoming competent, despite the fact that data on the number of RA an anesthesiologist must complete to reach the required proficiency in that area is currently unavailable [13].

This study found that spinal anesthesia, transverses abdominal plane block (TAP), ilioinguinal and iliohypogastric nerve blocks, axillary nerve block, and supraclavicular block were the most frequently used RA. This is in line with research done in Nigeria by Rukewe et al. and published in 2010, which showed that spinal, epidural, and peripheral nerve blocks were used 92.9%, 15%, and 2.9% of the time, respectively [14]. In a review by Dohlman et al. (19), neuraxial RA was recommended as the anaesthetic of choice for procedures performed below the umbilicus in low-middle income countries (LMICs) due to its affordability, safety, and effectiveness [15].

Based on data collected from the "Anesthesiologist" free Android app between December 2015 and April 2020, practitioners in LMICs utilised the app more often than those in high-income countries, as shown by clicks. For users from LMICs, surgical blocks, such as ankle, axillary, infraclavicular, interscalene, and supraclavicular blocks, were the main focus.

In high-income countries, more commonly looked at the transverse abdominis, popliteal, femoral, and adductor canal plane blocks.

Of the respondents in our study, 98 (43.9%) identified nerves using nerve stimulators, and 174 (78%) of participants identified nerves using surface anatomy. This is better result than the study done by Rukewe et al. showed that 31.4% of respondents had used nerve stimulator technique, and 47.1% of respondents had never performed a nerve block [14]. This discrepancy may arise from the fact that a larger sample size and all participants in the current study performed spinal blocks. For patients receiving extremities surgery in (LMICs), the use of ultrasound-guided RA holds promise for providing safe and efficient care [16].

Based on our study findings, the most frequently selfreported barriers to performing peripheral nerve blocks were a lack of equipment (regional procedure kit including block needle, ultrasound, nerve stimulator, or epidural set), lack of knowledge, lack of practical skills, and lack of drugs/medication. Numerous studies have thoroughly documented the deficiencies in anesthetic infrastructure, medications, and equipment that severely limit anesthesia capacity in most of LMICs [17-20]. While the lack of personnel and resources makes RA difficult to establish in Rwanda, working with local stakeholders in an academic setting is essential to sustainability [21]. Other earlier studies had also noted these barriers, which included procedural challenge, insufficient postoperative care education for nurses, time constraints, patient concern, and limited exposure to procedures and equipment [8, 14].

Regional procedures could yield benefits for LMICs if they are supported, trained, and provided with enough needles and local anesthetics on a regular basis [22]. According to a study by Hanna et al., refraining from using RA may have significant anesthesiology-related reasons include reasons such as a relative shortage of regional anesthesiology faculty, concerns over regional anesthetic techniques decreasing operating room efficiency, or uncertainty about how best to teach regional techniques [23].

Among the barriers to the underuse of RA in LMICs, were a lack of specific supplies, medications, equipment, a designated area, training for anaesthesia staff, skilled nursing support, knowledgeable administrative staff, facility and logistics planning, patient and surgeon education, and quality assurance programmes [24].

This research was aimed to investigate the barriers behind LMICs underutilization of regional blocks. While there are many potential benefits to RA, one major barrier to its development is the lack of education and training for anaesthetic providers in LMICs. Particularly in Sub-Saharan Africa, anaesthesia experts frequently receive inadequate support and are undervalued. Additionally, finding and keeping enough qualified practitioners to fill open positions is a persistent challenge. In LMICs, anaesthesia capability is further challenged by deficiencies in anaesthesia infrastructure, equipmentsupplies, and medications. As ultrasound-guided RA becomes more user-friendly and long-lasting, it might be able to improve access to safe and dependable anaesthesia in LMICs [25].

This study had limitations, such as difficulty reaching anesthetists working in remote locations and absence of a validated tool to measure the competency based on the number of regional blocks accessible, which prevents generalization.

Conclusions and Recommendations

The principal findings indicate that all respondents perform spinal anaesthesia, while the practice of peripheral RA varies. Reported barriers to performing RA are related to knowledge and training, as well as a lack of equipment (there aren't enough regional procedure kits available that include an epidural set, block needle, nerve stimulator, and ultrasound).

Substantial human and financial resources—possibly most importantly, institutional will—will be needed to offer the necessary number of training opportunities in RA and skilled trainers in Ethiopia. A more stringent approach with specific requirements, distinguishing between neuraxial and peripheral blocks, enhance training opportunities for peripheral nerve blocks are also required.

Supplementary Information

The online version contains supplementary material available at https://doi.or g/10.1186/s12871-024-02783-4.

Supplementary Material 1

Acknowledgements

statement: The authors acknowledge the participants who made this study possible.

Author contributions

"B. M. Admassie and D.Y.Melesse contributed to the conception the research and interpreted the results. B. A. Admass participate in reviewing preparation of the manuscript. All authors read and approved the manuscript."

Funding statement

This research was conducted without funding.

Data availability

"The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request for research purposes.".

Declarations

Ethics approval and consent to participate

The Declaration of Helsinki was followed in the conduct of this study and the study was conducted after approval with registration number 10/10/340/2023 was obtained from University of Gondar's ethical review committee. Before participating in the study, each research participant signed a written informed consent form.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

Conflict of Interest-

The authors declare no competing interests.

Received: 7 March 2024 / Accepted: 23 October 2024 Published online: 04 November 2024

References

- Li J, Lam D, King H, Credaroli E, Harmon E, Vadivelu N. <ArticleTitle Language="En">Novel Regional Anesthesia for Outpatient surgery. Curr Pain Headache Rep. 2019;23(10):69.
- 2. Folino TB, Mahboobi SK. Regional anesthetic blocks. 2020.
- Jakobsson J, Johnson MZ. Perioperative regional anaesthesia and postoperative longer-term outcomes. F1000Research 2016, 5.
- Kamel I, Ahmed MF, Sethi A. Regional anesthesia for orthopedic procedures: What orthopedic surgeons need to know. World J Orthop. 2022;13(1):11–35.
- Al Harbi M, Kaki AM, Kamal A, El-Dawlatly A, Daghistani M, El Tahan MR. A survey of the practice of regional anesthesia in Saudi Arabia. Saudi J Anaesth. 2013;7(4):367–70.
- Delbos A, Philippe M, Clément C, Olivier R, Coppens S. Ultrasoundguided ankle block. History revisited. Best Pract Res Clin Anaesthesiol. 2019;33(1):79–93.
- Kurdi MS, Agrawal P, Thakkar P, Arora D, Barde SM, Eswaran K. Recent advancements in regional anaesthesia. Indian J Anaesth. 2023;67(1):63–70.
- Boyd AM, Eastwood VC, Kalynych NM, McDonough JP. Clinician perceived barriers to the use of regional anaesthesia and analgesia. Acute Pain. 2006;8(1):23–7.
- Burton ZA, Ayele Y, McDonald P. Establishing a sustainable anaesthetic education programme at Jimma University Medical Centre, Ethiopia. Anaesth Intensive Care. 2019;47(4):334–42.
- Habtu E, Nigatu M, Ayele Y, Tila M, Demissie WR. Practice of regional anesthesia and its associated factors among anesthesia professionals working in teaching referral hospitals of Ethiopia; A multi-center study. Open Pain J 2021, 14(1).

- Smith AF, Pope C, Goodwin D, Mort M. What defines expertise in regional anaesthesia? An observational analysis of practice⁺. BJA: Br J Anaesth. 2006;97(3):401–7.
- 12. Merga H, Nega D, Leulayehu A. Practice of regional anesthesia and analgesia in Ethiopian hospital. Int J Med Med Sci. 2015;7(8):130–8.
- Mohammed AH, El Dawlatly A. How to set up a standard regional anesthesia service? Saudi J Anaesth. 2011;5(2):217–8.
- 14. Rukewe A, Fatiregun A. The use of regional anesthesia by anesthesiologists in Nigeria. Anesth Analg. 2010;110(1):243–4.
- Dohlman LE, Kwikiriza A, Ehie O. Benefits and barriers to increasing regional anesthesia in resource-limited settings. Local Reg Anesth 2020:147–58.
- Mohamed SS, Temu R, Komba LF, Kaino MM, Olotu FI, Ndebea AS, Vaughan BN. Patient Satisfaction With, and Outcomes of, Ultrasound-Guided Regional Anesthesia at a Referral Hospital in Tanzania: A Cross-Sectional Study. Anesth Analg. 2024;138(1):180–6.
- Epiu I, Wabule A, Kambugu A, Mayanja-Kizza H, Tindimwebwa JVB, Dubowitz G. Key bottlenecks to the provision of safe obstetric anaesthesia in lowincome countries; a cross-sectional survey of 64 hospitals in Uganda. BMC Pregnancy Childbirth. 2017;17(1):387.
- Gajewski J, Pittalis C, Lavy C, Borgstein E, Bijlmakers L, Mwapasa G, Cheelo M, Le G, Juma A, Kachimba J, et al. Anesthesia Capacity of District-Level Hospitals in Malawi, Tanzania, and Zambia: A Mixed-Methods Study. Anesth Analg. 2020;130(4):845–53.
- Gelb AW, Morriss WW, Johnson W, Merry AF, Abayadeera A, Belii N, Brull SJ, Chibana A, Evans F, Goddia C et al. World Health Organization-World Federation of Societies of Anaesthesiologists (WHO-WFSA) International Standards for a Safe Practice of Anesthesia. *Anesthesia and Analgesia* 2018, 126(6):2047–2055.
- Ho M, Livingston P, Bould MD, Nyandwi JD, Nizeyimana F, Uwineza JB, Urquart R. Barriers and facilitators to implementing a regional anesthesia service in a low-income country: a qualitative study. Pan Afr Med J. 2019;32:152.
- Matthew H, Patricia L, Dylan B, Jean DN, Francoise N, Jean BU, Robin U. Barriers and facilitators to implementing a regional anesthesia service in a low-income country: a qualitative study. *PAMJ* 2019, 32(152).
- 22. Schnittger T. Regional anaesthesia in developing countries. Anaesthesia. 2007;62(Suppl 1):44–7.
- Hanna MN, Jeffries MA, Hamzehzadeh S, Richman JM, Veloso PM, Cox L, Wu CL. Survey of the utilization of regional and general anesthesia in a tertiary teaching hospital. Reg Anesth Pain Med. 2009;34(3):224–8.
- Hodges SC, Mijumbi C, Okello M, McCormick BA, Walker IA, Wilson IH. Anaesthesia services in developing countries: defining the problems. Anaesthesia. 2007;62(1):4–11.
- Dohlman LE, Kwikiriza A, Ehie O. Benefits and Barriers to Increasing Regional Anesthesia in Resource-Limited Settings. Local Reg Anesth. 2020;13:147–58.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.