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“Anesthesia-focused sonography”: first analysis of transferring a training from Germany to Ghana

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Short Communication

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ABSTRACT

Background: Education, safety standards and equipment in anesthesia are less developed in low- and middle-income in contrast to rich countries. Regional anesthesia (RA) is cost-effective and used in more than 50% of anesthesia cases in less developed countries. Ultrasound-guided RA contributes to increase success rates, to reduce critical incidents, and to enhance patient safety. Its prerequisites, however, is appropriate training. We investigated whether the seminar “Anesthesia-focused sonography” produced by the German Society of Anesthesiology and Intensive Care Medicine (DGAI) can be transferred to a less developed African country, Ghana.

Methods: The seminar was translated into English and served as basis for the training. 5 German anesthesiologists who are expert seminar facilitators traveled to the Komo Anokye Teaching Hospital (KATH) at Kumasi, the town with the second largest

university of Ghana, to conduct the workshops (3 days didactics, 2 days practical training with patients). Knowledge of participants was examined before and after the seminar, and the course was evaluated by the attendants. To assess practice change, clinical use of ultrasound-guided was analyzed over 7 months before and 7 months after the seminar.

Results: 26 anesthetists from Ghana registered as participants. There was an increase in knowledge as indicated by 63% correct test answers before versus 81% after the seminar. The course was rated as “totally agree” by 85% of participants. Total numbers of ultrasound-guided RA increased by 50% within 7 months after the seminar with a spectrum of changing procedures.

Conclusion: Our ultrasound workshop in Ghana shows that DGAI-certified know-how can be transferred and met with great acceptance. The increased number of ultrasound-guided procedures in patient

care after the workshop indicated success of the project. In addition, ultrasound-guided blocks have now been included in residency education at the KATH and the World Federation of Societies of Anesthesiologists accredited the department of anesthesiology as a training center for ultrasound-guided RA.

Keywords

Ghana · ultrasound · DGAI-certified workshop · regional anesthesia · central venous catheter

INTRODUCTION

Regional anesthetic procedures [RA] are associated with lower risk of postoperative complications and shorter hospital stay compared to general anesthesia in some specialties [1]. Ultrasound-assisted RA procedures can help to increase the success rates of RA, avoid incidents, and enhance patient safety [2]. The American Society of Regional Anesthesia and Pain Medicine (ASRA) and the European Society of Regional Anesthesia and Pain Therapy (ESRA) therefore stated: "It is the common belief of ASRA and ESRA that ultrasound-guided neural blockade is part of the armamentarium of the regional anesthetist "[3]

There are only a few publications about the situation of anesthesia in low- and middle-income countries (LMIC)) [4]. Five billion people in LMIC have no access to high-quality surgical and anesthesia care [5]. In general, LMIC use RA in approximately 57% of surgeries [4], because ventilation and anesthesia machines are only available in 40% of anesthesia cases [4]. In 2011, Ghana was upgraded from a "low" to a "middle income country" by the World Bank [6] because Ghana's health system is above the average of many poor countries. With the background of a relatively stable democracy, efforts have been made to further improve health service and to expand the health care sector, which reflects in declining mortality rates and more treated patients [7].

Kumasi's Komoko Anokye Teaching Hospital (KATH) is the second largest hospital in Ghana [8] and the only tertiary health facility in the Ashanti Region. In 2016, the clinic had approximately 1,200 beds and is accredited by the West African College of Surgeons for postgraduate education in surgery, obstetrics and gynecology, ear, nose and throat medi-

cine, ophthalmology and radiology [8]. The KATH Department of Anesthesiology was equipped with a former model of an ultrasound device donated by the Ulm University Hospital, Germany, but there was no structured training program for ultrasound-guided procedures.

This project aimed to investigate whether the course "Anesthesia-focused ultrasound" developed in Germany could be transferred to Ghana. The project was funded by the Else-Kroener-Fresenius Foundation, the Department of Anesthesiology at the Ulm University Hospital, and the Senior Expert Service (Non-Profit Organization of the Foundation of German Business for International Cooperation), Germany.

MATERIAL AND METHODS

The course "Anesthesia-focused ultrasound", module 1 to 3, which has been certified for years at the Ulm University Department of Anesthesiology, was translated into English and served as basis for the training. Five German anesthesiologists (age 44 to 67) who are expert seminar facilitators traveled to the Komo Anokye Teaching Hospital (KATH) at Kumasi.

The training was named "1st International Workshop on Ultrasound-Guided Regional Blocks" and was offered from 23.05. to 27.05.2016. It has meanwhile been certified by the Ghana College of Physicians & Surgeons. The course was announced in Ghana, Nigeria and Cameroon with flyers and on the Internet (Fig. 1).

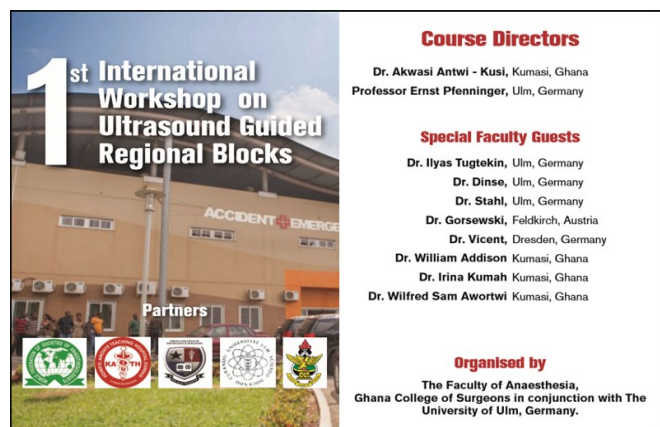


Fig. 1 Program-Flyer

There were 4 ultrasound devices: the older one, which had been in use at KATH for 8 years, and 3 newest generation devices (SonoSite M-Turbo®, FUJIFILM SonoSite GmbH, Frankfurt, Germany). The first three days of the program consisted of lectures and practical exercises on phantoms, subjects and patients. Day 4 and 5 were used to apply the learned skills at the hospital (table 1).

The educational success of the seminar was evaluated by a questionnaire, which had been developed by the German faculty. It consisted of 17 multiple-choice (MC) questions (Appendix 1). The attendants an-

swered the questions before and at the end of the course. To analyze its educational value, the participants rated the seminar using an established evaluation form [9] at the program's end.

Results are presented in absolute and relative numbers. The Chi-square test and Fischer's exact P test (Origin Pro 2017, Graphing & Analysis, Origin Lab Corporation®, Northampton, USA) were used for statistical calculations. Multiple tests were corrected by Bonferroni's rule. A p-value of less than 0.05 was considered significant.

Table. 1 Course program, Kumasi, May 2016

Day 1. May 23 nd	Day 2. May 24 th	Day 3. May 25 th	Day 4.	Day 5. May 27 th
Basics and Vascular access	Upper Extremity, Brachial Plexus	Lower Extremity, Plexus lumbalis and sacralis	Clinical Practice	Clinical Practice
Introduction	Nerve blocks above the clavicle	Plexus lumbalis	Hands-on session Upper limb blocks	Hands-on session – Ultrasound guided Vascular Access
Ultrasound machine	Practice: nerve blocks above the clavicle	Practice: Lumbar Plexus		
How do nerves look like, how to find nerves, trans-	Nerve blocks below the clavicle	Sciatic nerve blocks	Hands-on session Lower limb blocks	Hands-on session (All blocks)
Doppler: Basics and meaning for regional an-	Practice: nerve blocks below the clavicle	Practice: Sciatic nerve blocks		
Ultrasound-guided	Local Anaesthetics			

RESULTS

26 registered participants (age 26 to 50, mean 34,2; 19 male, 7 female) attended the seminar; most of them were from Ghana, two from Nigeria and one from Cameroon. All were certified or anesthesiologists in training; "nurse anesthetists" were not allowed. Practical exercises on subjects and patients took place at more than 60% of time. In the last 2 days, participants had to transfer their knowledge and so far, gained skills doing ultrasound-guided regional blocks at hospital patients under supervision of the course faculty. Only two participants had ultrasound experience before.

In the theoretical knowledge test before starting the course, the so-called "pre-test", 69% of correct answers showed a very high level of knowledge (Table 2). This could be further increased to 84% in the "post-test", i.e. the test after the seminar. Two participants did not participate in the "post-test". After an organizational mishap, the "pre-test" was only carried out after the first session in which the basics of sonography were presented. Because question 1 to 4 refer to these basics, they were not counted in the final evaluation. Excluding question 1 to 4, a correct response rate of 63% was counted, which increased

to 81% after the seminar. This difference is significant. The evaluation of the course by the registered participants is shown in Table 3.

Table 2: Knowledge test before (Pre-test) and after (Post-test) the course

	Participants	S Points	%	Chi-Square
Pre-test Question 1 – 17	26	304 / 442	68,8	
Post-test Question 1 – 17	24	344 / 408	84,3	p = 0,054
Pre-test Question 5 – 17	26	213 / 338	63,0	
Post-test Question 5 - 17	24	252 / 312	80,7	p = 0,045

Because of a mishap, the pre-test was carried out after the first morning session,

so that questions 1 to 4 were already presented. Answers to questions 5 to 17 are therefore the actual before / after comparisons. They are evaluated separately.

Tab. 3 Evaluation of the course by the participants after finishing the seminar.

	TOTALLY AGREE	AGREE	NEUTRAL	DIS-AGREE	TOTALLY DISAGREE
• The workshop met my expectations by addressing some important issues in my work	25 (96.1%)	1 (3.9%)	-	-	-
• Presentations/lectures were interactive and stimulated lively discussion	22 (84.6%)	4 (15.4%)	-	-	-
• The various presentations were relevant to my work/practice	23 (88.5%)	3 (11.5%)	-	-	-
• The workshop was well organized	25 (96.1%)	1 (3.9%)	-	-	-
• The meal served was good and timely	21 (80.7%)	5 (19.3%)	-	-	-
• There was enough hands- on practice	16 (61.5%)	9 (34.6%)	1 (3.9%)	-	-
• The facilitators demonstrated in depth knowledge of the topic	25 (96.1%)	1 (3.9%)	-	-	-
• The organization of the workshop permitted networking and discussion on the sidelines	17 (65.4%)	5 (19.2%)	4 (15.4%)	-	-
• I will recommend this workshop for anyone who is interested in nerve blocks	25 (96.1%)	1 (3.9%)	-	-	-
AVERAGE	85,0%	12,4%	2,1%		

n = number of seminar participants; % = percentage values based on 26 respondents

To assess practice changes, ultrasound-guided RA and central venous catheterization performed at KATH were compared over 7 months before and 7 months after the seminar. Overall, blocks increased by 50% after the workshop. While vertical infraclavicular blocks decreased by 11%, the number of supraclavicular blocs increased by 47% and interscalene blocks by 27%. Blocks that were not previously used, such as N. axillary blocks, blockages of the femoral nerve and the sciatic nerve were first performed (Table 4). The number of ultrasound-assisted central venous catheters increased by 35%.

Table 4: Ultrasound-assisted RA blocks and central venous lines over 7 months before and 7 months after the seminar

	VIB	SCB	ISB	AXB	NFB	NSB	TAP		Total	CVL
before seminar										
Nov 2015 –	98	19	15	0	0	0	0		132	65
after seminar										
June -	87	28	19	32*	19*	8*	5		198	88
December 2016	89 %	147%	127%						150%	135%

VIB = Vertical infraclavicular brachial plexus block, SCB = Supraclavicular brachial plexus block, ISB = Interscalene brachial plexus block, AXB = Axillary plexus block, FNB = Femoral nerve block, SNB = Sciatic nerve block, TAP= Abdominal wall block (TAP = transversus abdominis plane), Total = Sum of all blocks, CVL = Central venous line; % = Percentage of the number in the time after the seminar in relation to the time before the seminar

DISCUSSION

In 2007, the participants of the second World Health Organization (WHO) meeting on "Global Initiative for Emergency and Essential Surgical Care" concluded that the provision of essential surgical and anesthesiologic services in less developed countries requires an increased level of safety in surgery and anesthesiology [10]. Sonography-based procedures increase safety in RA blocks and central venous catheter application [1,2]. Our course is a modular, standardized, anesthesia-centered training that defines the training requirements for sonography-assisted blocks [11-13]. Because ultrasound-guided RA is a challenging and complex art, training and teaching are indispensable [14].

In 2015, there were 70 anesthesiologists and 22 physicians in anesthesia training in Ghana (personal correspondence, author A.A-K.) Most anesthesia cases were performed by 565 nurse anesthetists. This implies that 0.26 anesthesiologists were available for

100,000 inhabitants. In contrast, 27.8 anesthesiologists are responsible for a population of 100,000 Germans [15]. Our ultrasound workshop was attended by 23 Ghanaian anesthetists, which approx. 25% of all anesthesiologists in Ghana.

The great educational value of our workshop is reflected in the 85% "totally agree" rating in the participant evaluation form. The lowest agreement with 61% was the question for the possibility of "practical exercises". Niazi et al. [16] describe three dimensions of a learning period in ultrasound-assisted RA: acquiring basic knowledge, teaching generic skills, and testing the method in simulation models, corpses, and animal models. All these learning dimensions were offered in our workshop. Nevertheless, although practical exercises took place at more than half of the time, this was still perceived as not completely sufficient by some attendants.

The evaluation of knowledge gain with MC questions is generally accepted as a "user-friendly" as-

assessment strategy and has long been part of medical education [30]. Surprisingly, 68% correct answers were given already at the beginning of the course. On one hand, this might have happened because questions were "too easy", but on the other hand, this could be an indicator of great theoretical preparation of motivated students. In advanced training certified by German medical associations, 70-80% of correctly answered MC questions are regarded as a prerequisite for a successful seminar. This means that all course participants successfully completed our ultrasound course with an average correct response rate of 84%.

10,319 anesthesia cases were performed at KATH in the year 2015, 54% of which were general anesthesia (GA) and 42% neuraxial procedures. Local infiltration anesthesia was used in 3% and RA blocks in 1%, only [18]. In the 7 months following our seminar, the number of ultrasound-assisted peripheral nerve blocks increased by 50% compared to the same period before the seminar. RA increasingly replaced GA, especially for hand surgery, while spinal anesthesia continued to be preferred for lower extremity surgery. However, because orthopedic surgery accounts for 16% of all interventions at KATH, the first 27 femoral or sciatic nerve blocks in the 7 months after our course may indicate a practice change.

Ultrasound-assisted RA was performed in the post-seminar period by 4 specialists and 3 physicians in training, in contrast to only 2 specialists before the seminar. 13 doctors now inserted central venous catheters with sonography, which is technically easier than without. The success rate of RA has been indicated with 97% by the hospital, which is within the range described in the literature [19] ("success" has been defined as performing surgery without additional analgesia measures). Far beyond, there were also advantages in terms of costs - especially in hand surgery - during the post-seminar era. 250 hand-surgical patients were enrolled in 70% ultrasound-assisted RA. The cost in RA is estimated about 120 Ghanaian Cedi (about 25 Euro) in contrast to about 300 Cedi (about 64 Euro) for GA. With an estimated number 500 hand surgery procedures per year with a share of 340 RA, this would save 62,000 cedi (about 13.150

euros) in one year.

Limitations

Until our workshop, there were only two ultrasonic devices suitable for peripheral nerve blocks in Ghana, one in the capital Accra and one in Kumasi. KATH has now 3 devices. However, most of our participants will not be able to use such a device in the near future. Its acquisition is too expensive for state and local hospitals. In addition, for example, at the University of Development's Tamale Teaching Hospital, the northernmost university in Ghana, there was not a single anesthesiologist in 2016 (visiting author E.G.P.), and anesthesia was carried out by nurse anesthetists as in other smaller rural clinics, only. Although RA was more often used than GA [38], it was limited to spinal and infiltration procedures. Nevertheless, even in LMIC, ultrasound equipment is increasingly used in gynecological and obstetric scenarios [20], which somehow offers cause for hope that ultrasound will also be used in RA.

Finally, a major problem in LMIC is the maintenance of high-tech foreign equipment. A Ghana-based employee of the ultrasound equipment company lives in the capital Accra, which is a 5 hours distance drive. If necessary, the devices should either be brought to Accra or, if possible, serviced on site at Kumasi. Generally, a written maintenance contract is unknown in Ghana, technicians are requested if required. In case of major repairs, however, the devices would have to be sent by airplane to the manufacturer abroad.

CONCLUSION

The implementation of a German DGAI and DEGUM certified sonography seminar is possible in an LMIC and has been successfully performed at Kumasi / Ghana. If there is a high level of acceptance, there may be an increase in RA practice as well as a change in the spectrum of RA procedures offered in a developing country. The seminar can serve as a multiplier for Ghana and for other West African countries. However, the high cost of a sonography device and the low number of anesthesiologists will restrict

widespread use of ultrasound-assisted RA in less developed countries in the near future.

AUTHOR'S CONTRIBUTIONS

Study design/planning: E.G.P., I.T., W.S., Study conduct: E.G.P., I.T., W.S., A.D., O.V., A.A-K., W.S., Data analysis: E.G.P., A. A-K., Writing paper: E.G.P., S.H., Revising paper: all authors

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REFERENCES

- [1] Saied N.N, et al. Effect of anaesthesia type on postoperative mortality and morbidities: a matched analysis of the NSQIP database. *Br J Anaesth*, 2017. 118: p.118:105-11
- [2] Neal J.M. Ultrasound-guided regional anesthesia and patient safety: update of an evidence-based analysis. *Reg Anesth Pain Med*, 2016. 41: p195-204
PMid:26695877 [View Article](#) [PubMed/NCBI](#)
- [3] Ivani G, Ferrante F.M. The American Society of Regional Anesthesia and Pain Medicine and the European Society of Regional Anaesthesia and Pain Therapy. Joint Committee recommendations for education and training in ultrasound-guided regional anesthesia: Why do we need these guidelines? *Reg Anesth Pain Med*, 2009; 34: p.8-9 PMid:19258980 [View Article](#) [PubMed/NCBI](#)
- [4] Vo D, Cherian M.N, Bianchi S, Noël L, Lundeg G, Taqdeer A, Jargo BT, Okello-Nyeko M, Kahandaliyanage A, Setumbwe-Mugisa O, Ochroch EA, Anesthesia capacity in 22 low and middle income countries. *J Anesth Clin Res*, 2012. 3(4): p.207
- [5] Meara J.G, Leather A.J.M, Hagander L, et al., Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development. *Lancet*, 2015. 386: p.569-624 60160-X [View Article](#)
- [6] Ghana Looks to Retool Its Economy as it Reaches Middle-Income Status. [View Article](#)
- [7] International Organization for Migration (2018) World migration report. <https://www.iom.int/countries/ghana/>
- [8] Komfo Anokye Teaching Hospital. [View Article](#)
- [9] Feldman K.A. Grades and college students' evaluations of their courses and teachers. *Res High Educ*, 1976. 4: p.69-111 [View Article](#)
- [10] United Nations, Statistical Division. City population by sex, city and city type: Ghana. August 2016. [View Article](#)
- [11] Bleise S, Einhaus F et al., DGAI-certified course series Anaesthesia Focused Sonography – Module 1: Basics of sonography. *Anaesthesiol Intensivmed Notfallmed Schmerzther*, 2011. 46: p.750-4
PMid:22147612
- [12] Trautner H, Markus CK, Steinhübel B et al., The DGAI training module 2 in Anaesthetic focussed sonography: Vascular sonography. *Anaesthesiol Intensivmed Notfallmed Schmerzther*, 2011. 46: p.756-9
PMid:22161908
- [13] Kefalianakis F, Döffert J, Hillmann R et al. The DGAI training module 3 in Anaesthetic focussed sonography: Neurosonography. *Anaesthesiol Intensivmed Notfallmed Schmerzther*, 2011. 46: p.760-4
PMid:22147613
- [14] Kessler J, Wegener JT, Hollmann MW, Stevens MF., Teaching concepts in ultrasound-guided regional anesthesia. *Curr Op Anesthesiol*, 2016. 29: p.608-13
PMid:27466975 [View Article](#) [PubMed/NCBI](#)
- [15] WHO Meeting on Global Initiative for Emergency and Essential Surgical Care. [View Article](#)
- [16] Niazi AU, Haldipur N, Prasad AG, Chan VW., Ultrasound-guided regional anesthesia performance in the early learning period: effect of simulation training. *Reg Anesth Pain Med*, 2012. 37: p.51-4
PMid:22179300 [View Article](#) [PubMed/NCBI](#)
- [17] Marsh EJ, Roediger HL, Bjorkm RA, Bjork E., The memorial consequences of multiple-choice testing. *Psychon Bull Rev*, 2007. 14: p.194–199
PMid:17694900 [View Article](#) [PubMed/NCBI](#)
- [18] Brouillette MA, Aidoo AJ, Hondras MA, Boateng NA, Antwi-Kusi A, Addison W, Hermanson AR. Anesthesia Capacity in Ghana: A Teaching Hospital's Resources, and the National Workforce and Education. *Anesth Analg*, 2017. 125(6): p. 2063-71
PMid:28922228 [View Article](#) [PubMed/NCBI](#)
- [19] Borah B, Engineer SR, Patel KB., A comparison of ultrasound versus paresthesia technique for supraclavicular brachial plexus block. *International Journal of Advances in Medicine*, 2017. 4(1): p.198-202 [View Article](#)
- [20] Dünser M, Baelani I, Ganbold L., The speciality of anesthesia outside western medicine. *Anaesthesist*, 2006. 55: p.118-32 PMid:16425039 [View Article](#) [PubMed/NCBI](#)
- [21] Gysel W, Villabruna K., Ultrasound Teaching in Developing Countries. *Praxis*, 2016. 105(17): p.1015-8
PMid:27560815 [View Article](#) [PubMed/NCBI](#)

Appendix 1: Ultrasound-Guided Workshop: Test

1. Which answer is **TRUE**?

- a. The transformation of electric voltage into ultrasound waves (and vice versa) can be described by the piezo-electric effect
- b. The velocity of sound is the same in all media
- c. The lower the difference of the acoustic impedance the stronger the reflection at the interface
- d. Blood has a high attenuation coefficient which makes the penetration of ultrasound waves impossible
- e. A high frequency ultrasound probe enables high penetration in human tissues

2. Which answer is **WRONG**?

- a. Nerves are always hyperechoic in ultrasound imaging
- b. Dorsal enhancement is typically seen behind large vessels
- c. Dorsal shadowing is typically seen behind bones
- d. The higher the frequency of the ultrasound probe the better the resolution

3. Which answer is **TRUE**?

- a. The _____ nerve is not important for a complete axillary block
- b. The „conjoint tendon „is an important internal landmark in the axillary region
- c. The median nerve penetrates the „conjoint tendon “
- d. The ulnar nerve is always the deepest nerve in the axillary region
- e. The vessels in the axillary region can be identified best with maximum pressure on the ultrasound probe

4. Reasons for using ultrasound for regional anaesthesia? Which of the following is **WRONG**?

- a. We have internal landmarks
- b. We can see the needle tip
- c. We can see the distribution of local anaesthetic
- d. We can visualize vessels and the pleura and therefore improve safety?
- e. It is self-explaining. An ultrasound workshop is not necessary

5. For the interscalene block (ISB): Which of the following

is **WRONG**?

- a. We aim to block the nerve roots C5 to C6
- b. We can use it in combination with general anaesthesia for shoulder surgery
- c. It is always sufficient for hand surgery
- d. Temporary phrenic nerve palsy might be a side effect
- e. A trace-back technique from supraclavicular is a good choice to find the interscalene space

6. Concerning supraclavicular and infraclavicular block: Which of the following is **WRONG**?

- a. Both blocks can be used for hand and elbow surgery
- b. Pneumothorax can be a complication of both blocks
- c. Catheters are possible for both blocks
- d. Supraclavicular block is at the level of the roots and infraclavicular block at the level of the terminal nerves
- e. Phrenic nerve palsy is possible for the supraclavicular block

7. Which statement is **CORRECT** regarding lumbar plexus blocks?

- a. The obturator nerve can be blocked only beneath the biceps femoral muscle
- b. The lateral cutaneous femoral nerve can be imaged between sartorius muscle and lateral tensor fasciae muscle
- c. The saphenous nerve supplies the skin of the lateral lower limb
- d. The saphenous nerve is located beneath the pectineus muscle
- e. All branches of obturator nerve are located between adductor brevis muscle and adductor magnus muscle

8. Which statement is **WRONG** about in-plane needle techniques?

- a. Needle visibility is independent from needle angle
- b. The whole needle can be visualized
- c. Visibility of “ultrasound optimized” needles is evidently enhanced
- d. The needle should be advanced in alignment with the ultrasound beam

9. Which statement is **WRONG** about nerve imaging?

- a. Nerves always appear hypoechogenic

- b. Vessels can be mistaken as nerves
- c. Tendons can be mistaken as nerves
- d. Nerves can be imaged in short axis and long axis
- e. Nerve visibility often depends on ultrasound beam angle
10. Regarding blocks of the sciatic nerve, which of the following is **TRUE**?
- a. The sciatic nerve only contains motoric fibers
- b. The sciatic nerve is comprised of the peroneal, the saphenous and the tibial nerve
- c. The sciatic nerve exits the pelvis through the obturator foramen
- d. To achieve adequate surgical anaesthesia, combination of sciatic and femoral nerve blocks is often necessary
- e. Sciatic nerve block leads to relevant depression of cardiac function
11. Regarding ultrasound-guided central venous access, which of the following is **TRUE**?
- a. Current evidence suggests no advantage regarding reduction of complications by ultrasound
- b. Use of ultrasound guidance reduces number of puncture attempts, hematomas and arterial puncture
- c. The internal jugular vein is usually located deep to the carotid artery
- d. Muscles of the neck must never be penetrated with a puncture cannula
12. Maximum safe dose of xylocaine® (lidocaine) without adrenaline is (**TRUE** answer)
- a. 600 mg
- b. 500 mg
- c. 300 mg
- d. 150 mg
- e. 100 mg
13. Which frequency ranges are used for ultrasound imaging of nerves? The **TRUE** answer is
- a. 2-15 KHz
- b. 2-15 GHz
- c. 2-15 MHz
- d. 2-15 THz
- e. None of the above
14. Which tissue most strongly attenuates the ultrasound beam (**TRUE** answer)?
- a. Fat
- b. Bone
- c. Muscle
- d. Blood
- e. Fasciae
15. The interscalene block aims to inject the brachial plexus between (**TRUE** answer):
- a. The sternocleidomastoid muscle and the first rib
- b. The omohyoid muscle and the sternocleidomastoid muscle
- c. The anterior and middle scalene muscles
- d. The pectoralis minor and the axillary artery
16. When placing an ultrasound-guided supraclavicular nerve block, the pulsating artery found at the inferior portion of the target area is the (**TRUE** answer):
- a. Subclavian artery
- b. External carotid artery
- c. Internal carotid artery
- Vertebral artery
17. After performing a popliteal fossa-sciatic nerve block for an ankle procedure, the patient is experiencing pain on the dorsum of the foot. A likely scenario of failure is (**TRUE** answer):
- a. The femoral nerve has been mistakenly blocked
- b. The saphenous nerve was not adequately anesthetized
- c. There is typically sparing of anaesthesia in this location
- The block occurred distal to the bifurcation of the sciatic, only including the tibial nerve