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Review article

Training in regional anesthesia



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ABSTRACT

Introduction: The implementation of a method of ultrasonography with the purpose of visualization of anatomic structures created a whole new chapter in the history of regional anesthesia. In addition, the European Society of Regional Anesthesia (ESRA) has provided the opportunity to obtain European Diploma in Regional Anesthesia (EDRA) recognized worldwide.

Aim: The aim of this work is to describe factors influencing training in regional anesthesia, obtaining EDRA certifying both practical skills and theoretical knowledge, implementation of internationally recognized recommendations in daily practice and methods of evaluating effectiveness of teaching by using cumulative summation analysis (CUSUM).

Material and methods: The work is based on the available literature and the experience of the authors.

Results and discussion: Ultrasonography changed the face of regional anesthesia. Meanwhile, thanks to both European and American Society of Regional Anesthesia (ESRA/ASRA), a growing interest of EDRA shows the importance of a crucial development in regional anesthesia. Also, an important role is played by the possibility of assessment of acquired skills, which can be obtained with the use of CUSUM.

Conclusions: The overall objective of ESRA/ASRA is to widen the circle of anesthesiologists, assistance in acquiring diversified medical experiments, formation of new personnel and exploring the secrets of regional anesthesia among medical practitioners. Undoubtedly, EDRA is invaluable in career development all over the world. Additionally, it is becoming a tool of encouragement for anesthesiologists, for safe and advanced practice in the operating room, making them experts in the field.

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1. Introduction

'I accept with respect and gratitude for my Masters given me the title of medical doctor and fully aware of the responsibilities associated, hereby I promise to (...) serve life and human health (...), to the best of my knowledge prevent suffering and prevent diseases (...), constantly expand my medical expertise and make available to the medical world everything that I can invent and refine...' Each and every doctor remembers these words of the medical oath uttered on the completion of the medical school, solemnly vowing to follow the principles contained in the code of medical ethics. As early as the 5th century BC, Hippocrates – a Greek medic – imposed on future physicians a moral and ethical obligation to lifelong and permanent vocational training. For failure of the aforementioned rules, besides remorse, one can be faced with proceedings for professional liability. Regional anesthesia is undoubtedly a perfect example, where theoretical knowledge, practical skills and experience are essential. The prevailing opinion about the unpredictability and the unsuitability of the perineural blockades is not due to imperfections of this very method but due to the absence of one of the aforementioned elements. It shows how significant it is to implement training in this field already at an early stage of learning, which does not necessarily mean that it is an area dedicated to young residents only. On the contrary, young physicians need mentors, senior fellow professionals to be able to draw on their expertise and experience, while maintaining the safety rules corresponding to the current standards of medical knowledge. In addition, the process of self-education is also extremely essential, which is above and beyond facilitated by the universally available Internet access. It is a huge source of theoretical information transformed into practice via computer animations, video clips and teaching workshops using live human and animal models, phantoms and simulators. Currently, these are the main tools used to acquire the necessary skills. Unfortunately, even the best model is no substitute for direct supervision and assistance that can be provided only by a physician specialist who may complement imperfections of each teaching method. In light of the current data, the number of medical specialists practicing regional anesthesia in Poland is still significantly limited, which puts further education in this field under a big question mark. Therefore, an emphasis should be put on young doctors in order to provide the next generations with comfort which senior medical specialists are deprived from.

Modern anesthesiology requires a doctor's in-depth theoretical preparation and practical skills, of which regional anesthesia is an adequate example. For the regional blockade to be effective, apart from the knowledge of the principles and the method of executing the procedure, the doctor must have a completed manual training before approaching a patient with a 'needle' in order to perform anesthesia for surgery.

Good knowledge of anatomy and topography, in combination with the ability of imaging by means of the ultrasound scanner, gives anesthesiologists a tool for the performance of regional blockade of practically any nerve or plexus. There are many ways to acquire the skills: regional anesthesia training courses, teaching materials in the form of films, computer

programs, web sites or scientific literature. The simulations of the techniques of performed blockades are becoming a crucial element of the training in regional anesthesia. This plays a critical role in the opportunity to learn the basis of sonoanatomy on live models. The European Society of Regional Anesthesia (ESRA) brings together physicians of various specialties, who want to deepen their knowledge and skills through international courses, internships and the opportunity of receiving a diploma such as European Diploma in Regional Anesthesia (EDRA) after meeting several criteria and passing a practical and theoretical examination. The cumulative summation analysis (CUSUM) is an objective self-assessment tool that offers a level of contextualized scrutiny checks to measure an individual's acquired skills.

2. Aim

The aim of this work is to describe factors influencing training in regional anesthesia, obtaining EDRA certifying both practical skills and theoretical knowledge, implementation of internationally recognized recommendations in daily practice and methods of evaluating the effectiveness of teaching by using CUSUM.

3. Material and methods

The work is based on the available literature and the experience of the authors.

4. Results and discussion

4.1. Factors influencing training

The wide dissemination of the imaging method, such as ultrasonography, had already changed the face of regional anesthesia; by attracting numerous young anesthesiologists and allowing senior specialists to relive this so very engaging field of medicine. Equipping the operating room with the ultrasound scanner is closely linked to the hospital's economic status, which unfortunately is the main limiting factor for this method among anesthesiologists. Numerous doctors participated in perfectly prepared workshops in ultrasonography and neurostimulation in anesthesia, both in Poland and overseas, after which they were fully charged with positive energy and willingness to implement theory into practice. However, often they collided with the harsh reality of the shortage of time, the right tools or simply lack of commitment of the senior specialists. In many cases, these are significant obstacles, at times even insurmountable, which make training in this field of secondary importance, often leading into oblivion. A new tendency among young residents of anesthesiology and intensive care, in some European countries, becomes a 40-h working time greatly limiting the possibility of training. It significantly interferes with the opinion of Peter Marhofer, one of the icons of modern regional anesthesia, a physician with extensive experience in conducting perineural blockades. According to him, the ability to effectively perform such

blockades requires not only highly specialized equipment, but above all, high-quality intensive practical training.

4.2. European Diploma of Regional Anesthesia

For many years now teaching in this area has been promoted by the European Society of Regional Anesthesiology and Pain Medicine. In 2005, ESRA introduced an interesting form of knowledge improvement – ESRA Diploma (now EDRA).^{1,2} The idea was created in order to establish European standards in regional anesthesia. It has been dedicated to a wide range of anesthesiologists interested in acquiring additional knowledge and skills. Regional anesthesia techniques are an integral part of anesthesiology, often performed on high-risk patients including children and elderly people. The purpose of the exam is to develop a holistic approach to the patient. An important thing is not only the practical implementation of the blockade, but also a wide knowledge of anatomy, physiology and pharmacology.

In 2007, barely three applicants took the examination, however since then the interest among European anesthetists has steadily increased. In 2013 nearly three hundred doctors received EDRA which is progressively gaining popularity, not only in Europe, but in Asia and the United States as well.

The ESRA Diploma Board is responsible for determining examination rules, accreditation of courses and the choice of examiners. The exam is divided into two separate parts: theoretical (stage I) and practical (stage II). To be able to participate in the first component, at least 2 years of medical practice and active membership within ESRA are required. One should also enter into workshops recognized by ESRA which are held during the annual congress; such as cadaver based workshops in Innsbruck and Ljubljana or Winter-Week Course in Grindelwald, Switzerland. In some cases local workshops providing educational points are also accepted.

A list of recommended literature, theory topics and required practical skills are made available for each candidate before the exam. All the topics are related to regional anesthesia, pain therapy, anatomy, physiology, and pharmacology. The first test takes place one day before the ESRA annual meeting. The test containing 100 multiple-choice questions lasts for 2 hours. It is composed of 70% of the applicable regional anesthesia and treatment of acute pain, 10% of chronic pain, 10% of physiology and pathophysiology and 10% of neurostimulation methods, ultrasound and basic statistics.

The practical part is carried out one year later and it is available for those candidates who passed the first stage and gained practical skills consisting of the following: 150 central, 75 lower limb, 75 upper limb and 30 various regional blockades. In addition, the applicants should have attended at least two various workshops or courses approved by ESRA. The second stage takes place a few days before the annual congress. It lasts 30 min and is conducted by two examiners. The candidate receives two questions, whereas the first one concerns a selected technique of central or peripheral blockade. Within 15 min an examinee should show landmarks on a live model, demonstrate the use of the ultrasound and peripheral nerve stimulator for the location of neural structures, identify the appropriate local-anesthetic drug and its dosage, trace the

dynamics of the blockade, discuss possible complications and side effects, prevention methods and their treatment. The second question relates to the use of appropriate methods of regional anesthesia for selected surgical procedures, such as surgery of the shoulder, chest or knee. All methods must be adapted to the specific clinical situation during intra- and post-operative period. Each candidate must be familiar with anatomical and physiological basis of selected blockades. One should also describe contraindications and the feasibility of 'emergency blockades,' demonstrates knowledge of possible techniques for the use of continuous regional anesthesia and comment on complications, prevention and treatment.

4.3. Method for training in regional anesthesia

In 2010, the committee of ASRA/ESRA published Recommendations for Education and Training of Ultrasound in Clinical Practice of Regional Anesthesia.³ This document is of great value as it defines the objectives which should be sought in performing blockades successfully. It systematizes not only methods of acquiring knowledge, but also advises on how to optimize training among both young physicians and senior specialists (Table 1).

The following 10 points on improving the performance of blockades have been distinguished:

1. Visualize key anatomical structures: vessels, muscle, fascia and bones.
2. Identify the nerves/plexus in short axis.
3. Confirm the anatomy and recognize abnormalities.
4. Plan the optimal way to insert the needle so as to avoid unintended tissue trauma.
5. Maintain aseptic conditions.
6. Insert the needle under visual control at all times during the whole procedure
7. Consider using alternative techniques confirming the location of the needle – neurostimulation.
8. Once the needle tip is in the correct position, insert a test dose – a small volume of the drug. If solution is not visible, it must be assumed that the needle tip is placed intravascularly or beyond the image surface.
9. In order to avoid intravascular application, the needle tip must be visible for the entire duration of injection.
10. Keep the generally accepted safety rules such as the resuscitation equipment, frequent drug aspiration movement, test dose application, adequate monitoring of the patient including its reaction and responses, and assessment of the effects of a given drug.

4.4. Implementation of ASRA/ESRA recommendations in daily practice

The abovementioned recommendations suggest that medical specialists who want to deal with regional anesthesia should participate in accredited practical course lasting for at least 8 h. What is also required is access to additional educational materials, scanning oneself and colleagues, training on simulators and phantoms and close cooperation with the so-called UGRA coordinator (ultrasound-guided regional

Table 1 – Ultrasonography in regional anesthesia.

	Category			
	Understanding the principles of image formation and operation of ultrasound scanner	Image optimization	Image interpretation	Inserting the needle and placing local anesthetic
Specific assignments	Understand the basic principles of image generation Select the most appropriate transducer Select the appropriate depth and apply image focus function Adopt and apply 'time gain compensation' and 'overall gain' functions Apply the color Doppler function Adopt image archiving Follow the principle of screen standarization with respect to the patient	Press the transducer properly Apply longitudinal movements of the transducer, so-called 'alignment' Apply rotational transducer movements Tilt the transducer over PART: Pressure Alignment Rotation Tilting	Identify: – nerves – muscles and fascia – vessels (distinguish arteries from veins) – bones and pleura Identify anatomical artifacts Identify the vascular structures in the line of needle insertion	Adopt 'in-plane' technique Adopt 'out-of-plane' technique Familiarize with the benefits and limitations of these methods Learn to identify intramuscular needle location Learn to recognize correct and incorrect spread of drug Learn the principles of ergonomics Minimize unnecessary transducer movements Eliminate intra nerve needle location

anesthesia). Such person is appointed by the head of the department and is responsible for carrying out the process of training in the field.

These recommendations do not impose rigid training regimen, but rather emphasize the need to match training methods with the conditions in hospitals. The Clinical Department of Anesthesiology and Intensive Care at Regional Specialistic Hospital in Olsztyn in Poland regularly holds workshops on the use of ultrasound in regional anesthesia for residents enrolled in the ward. A 3-hours discussion of each topic takes place in two terms, so as only up to six or seven people could participate in each one of them. The course begins with a brief presentation containing the outline of sonoanatomy of a given access, possible performance techniques, anatomical variants, optimization of the obtained image artifacts and pitfalls associated with the blockade. Due to the important role of neurostimulation, the following topics are being presented: the advantages of the combined use of ultrasound and neurostimulation (dual-guidance), issues concerning the correct operation of the stimulator and the expected motor response. Owing to a wide range of subjects being discussed, each meeting is devoted to exclusively one or two blockades the most.

For instance, the topic of brachial plexus blockade is divided into four separately discussed meetings. Practical sessions consist of two parts. There are three standpoints prepared with ultrasound scanners for up to two people to each one of them. The department has no possibility to involve live models, therefore the residents carry out the examination by practicing on each other. In the second part, participants practice with the needle and ultrasound apparatus using turkey breast or tofu. Exercises are intended to facilitate the use of a needle and ultrasonography and to develop coordinated visual-motor movements. The phantom is used with needle stimulation and ultrasound neurostimulator, as described in the literature below, in order to follow the method of 'dual-guidance' emphasizing its role. In meat or tofu there is a metal wire imitating nervous structure.⁴ The electrode

grounding neurostimulator is connected to the wire and the second electrode to the needle. Once the stimulator and ultrasound are switched on, the needle is inserted and once its tip touches the wire a diode of the neurostimulator turns on indicating that the electrical circuit is being closed.

One of the most common mistakes made by novice, according to some authors, is looking at the injection point instead of the ultrasound screen.⁵ To eliminate this error during the practical session, residents use a simple device. For instance, based on certain sport disciplines, a player practices with custom designed glasses without lenses. The lower part of the spectacle frame is sealed and a basketball or hockey player is forced to look at the playing field instead at the ball or puck. In a similar manner a medical resident is wearing such glasses observing the image on the ultrasound screen instead of looking at the needle and phantom, so that one acquires the habit of proceeding in this way with the real patient.

Systemic toxicity effects of locally-anesthetic drugs is a very rare, but dangerous phenomena. Using the simulator with such a scenario, both the trainee and senior anesthesiologist can practice all stages of the proceedings concerning this very complication. Unfortunately, the availability of simulators is limited. It has been proven that training, based on a checklist for treatment of local anesthetic systemic toxicity, increases the effectiveness in the event of its occurrence. The protocol serves as a list which the trainee must complete by remembering the sequence and details of the procedure at each stage. The effectiveness of memorization is checked by answering questions about each step. For instance, what dose of adrenaline to administer when cardiac arrest occurs due to the complication or how to prepare intralipid. It has been shown that compared with untrained doctors, those who passed the course were far better able to cope with this difficult situation. Each resident of the Clinical Department of Anesthesiology and Intensive Care in Olsztyn undergoes such a training while working on the Orthopedic Trauma Ward.⁶

For many years there has been a debate if training in the field of various techniques of regional anesthesia can be performed on the patients. The concept of 'see one, do one' turns out to be expensive both in terms of economics as well as its effects, time-consuming and seems to be an inconsistent teaching model. Instead, the possibility for acquiring the needed skills should provide the ability to perform procedures at various levels (phantoms, cadavers, virtual models), before entering the operating room. It seems clear that, from the ethical and practical point of view, simulation is a key element proceeding approaching a patient with the needle. This has been proven by various scholar works. A large number of authors recommend further research to determine the amount of blockades that a trainee should perform in order to achieve adequate skills. These undoubtedly indicate the simulation training as a major factor in improving the percentage of effective blockades.

The interpretation of sonoanatomy image has an important role in the use of ultrasonography. The acquisition of this skill is often limited by time pressure prevailing in the operating room. Therefore, physicians should familiarize themselves with the basic principles before performing the blockade by means of ultrasound on a live patient. Static images in books, scientific articles and videos are devoid of dynamic scanning in real time. A good example is the radial nerve which is hard to identify on the basis of a static image in the axillary area. Scanning the distal part reveals its characteristic pattern on the back part of the humerus. The most effective method of training is practicing on oneself or volunteers, which unfortunately in the current reality is not always possible.

As mentioned previously, a very useful educational tool is the Internet.⁷ A good example is the website of an educational program for simultaneous view ultrasound scans with an external video image of the transducer position in real time. This allows the trainee to understand the fundamental principles of the blockade before and during its execution.⁸

Together with the ultrasound scanner there are also available appropriate educational programs which can be used through the platform consisting of several images displayed on the screen. One image shows an external anatomical point around the blockade together with both the place and manner of application of the head. The second is a schematic course of a plexus or nerve and the third demonstrates sonoanatomy including a description of the most important structures. In contrast, the fourth screen runs an image in real-time. The use of such a program undoubtedly improves the ability of image interpretation. Differentiation of anatomical structures begins with the identification of anatomical points corresponding to the respective anatomical cross-sections imitated by the ultrasound image. The application of these simple patterns with repeated visual identification and the corresponding simplified anatomical cross-sections with additional single-stage visualization of sonographic images in real time, definitely enhances the learning process and the acquisition of practical skills.

4.5. Method of evaluating the effectiveness of teaching

In 1996 a group of scholars, under a supervision of MD Kopacz, introduced the concept of 'a learning curve in regional

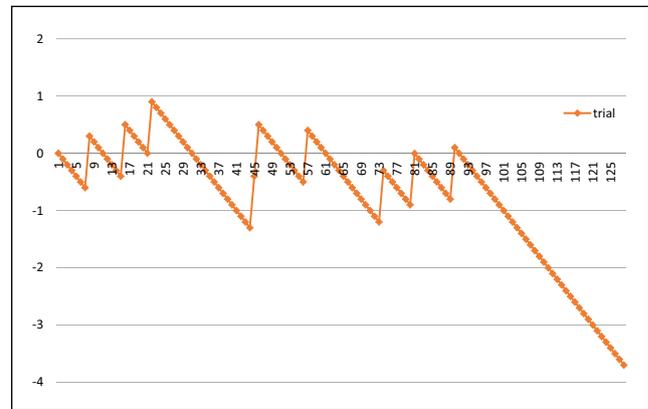


Fig. 1 – CUSUM curve in the implementation of the subarachnoid blockade in the period from February to October 2013.

anesthesia.' It was suggested that the resident doctor should perform at least 60 epidural and 45 subarachnoid blockades in order to reach at least 90% efficacy.⁹ The necessary amount of anesthesia is a variable feature, dependent on many factors such as individual skills, as well as abilities of the trainees themselves.

An important role is played by the possibility of an assessment of acquired skills, which are obtained with the use of CUSUM.¹⁰ A CUSUM graph below presents both positive and failed attempts of a regional nerve blockade in relation to the total number of taken attempts. Reaching 90% effectiveness is considered to be crucial to perform safe and effective regional nerve blockades. Furthermore, 9 out of 10 effective results can be considered as the target value. This means that each unsuccessful attempt increases the curve by about 0.9 and each successful outcome reduces it by about 0.1. Fig. 1 illustrates 129 subarachnoid blockades performed by the resident doctor during the first year of specialization at Clinical Department of Anesthesiology and Intensive Care, Regional Specialistic Hospital in Olsztyn, Poland. The doctor achieved a high percentage of successful attempts. After 7 effective procedures, only 1 failed blockade occurred. Subsequent efforts were successful until the 15th procedure, which in turn was not effective. Among the next ones, merely 2 were unsuccessful up to the 22nd attempt. Following blockades were effective all the way up to the 44th procedure after which next 2 in a row happened to be unsuccessful. Due to the effectiveness of the vast majority of performed blockades there is no reason for concern and a trainee is likely to become proficient in this field. CUSUM is considered to be an excellent tool to track the dynamics of mastering a new technique or a new access in regional anesthesia.

5. Conclusions

The process of education along with the possibility of objective self-assessment plays a vital role in the daily practice. It can be achieved by constant evolution, where the educational recommendations will continually adapt to the needs of anesthesiologists, which in turn will optimize the quality of

care for the patients.¹¹ The overall objective of the ESRA is to widen the circle of anesthesiologists, assistance in acquiring diversified medical experiments, formation of new personnel and exploring the secrets of this engaging field of study among medical practitioners.

Undoubtedly, EDRA diploma is invaluable in career development all over the world. Additionally, it is becoming a tool of encouragement for anesthesiologists, for safe and advanced practice in the operating room, making them experts in the field.

Conflict of interest

None declared.

REFERENCES

1. European Society of Regional Anaesthesia and Pain Therapy. European Diploma in Regional Anaesthesia and Acute Pain Management (EDRA). <http://www.esraeurope.org/education/esra-diploma>. Accessed: 20.12.2015.
2. 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(1):51–54.
3. Sites BD, Chan VW, Neal JM, et al. 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. *Reg Anesth Pain Med.* 2009;34(1):40–46.
4. Tsui BC, Tsiu J. Reusable phantom with feedback signal for ultrasound needle tip control. *Reg Anesth Pain Med.* 2011;36(6):630–631.
5. Sites BD, Spence BC, Gallagher JD, Wiley CW, Bertrand ML, Blike GT. Characterizing novice behavior associated with learning ultrasound-guided peripheral regional anesthesia. *Reg Anesth Pain Med.* 2007;32(2):107–115.
6. Neal JM, Hsiung RL, Mulroy MF, Halpern BB, Dragnich AD, Slee AE. ASRA checklist improves trainee performance during a simulated episode of local anesthetic systemic toxicity. *Reg Anesth Pain Med.* 2012;37(1):8–15.
7. Slater RJ, Warren L. A New Web-based Tool at www.sonography.anaesthesia.org.au to Teach Sonoanatomy. *ASRA Newsletter.* 2011; Feb: 6–7.
8. Wegener JT, van Doorn CT, Eshuis JH, Hollmann MW, Preckel B, Stevens MF. Value of an electronic tutorial for image interpretation in ultrasound – guided regional anesthesia. *Reg Anesth Pain Med.* 2013;38(1):44–49.
9. Kopacz DJ, Neal JM, Pollock JE. The regional anesthesia “learning curve”. What is the minimum number of epidural and spinal blocks to reach consistency? *Reg Anesth.* 1996;21(3):182–190.
10. What is the CUSUM Graphic? <http://www.lsora.com/apps/content/html/>. Accessed: 20.12.2015.
11. Neal JM. Education in regional anesthesia: caseloads, simulation, journals, and politics: 2011 Carl Koller Lecture. *Reg Anesth Pain Med.* 2012;37(6):647–651. <http://dx.doi.org/10.1097/AAP.0b013e318267c043>.