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State-of-the-art education in emergency ultrasound

Introduction

The use of emergency ultrasound has increased dramatically in the last two decades as more and more evidence is published proving its utility and benefit in improving patient care, efficiency, and patient satisfaction [1–17]. With the increasing evidence of its advantages, the following question arises: how do we most efficiently educate providers in this modality. In the United States, emergency ultrasound has been a required part of residency education for over a decade now. However, this is not true in other parts of the world, and even in the U.S. many providers finished their training before this requirement was put into place. Thus, we have a new technology with proven benefits, but providers with no experience in using it. This problem can be solved many ways. In this article the most up-to-date methods for learning emergency ultrasound will be highlighted.

One issue with learning point-of-care ultrasound is that it is a complex, blended skill. By this, we mean there is a physical component, the physical skill of obtaining adequate images that requires some dexterity training. There is also the pattern recognition and interpretation skill once the image is obtained. Lastly, there is the cognitive skill of applying the gained diagnostic information to the clinical situation. Therefore, any attempt at teaching emergency ultrasound should incorporate all three. It is acceptable to teach one at a time as long as it is part of an organized approach and understood that all three are necessary for true proficiency in the skill. The learning of all three skills can take place in one of many ways. There are the traditional ways, newer technologically based methods, and blended forms.

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Traditional emergency ultrasound education

Direct mentorship

This is a great model that has been in place for as long as medical education has existed. In this ideal scenario the apprentice would see patients with the master. Under their direct supervision they would learn the skills of image acquisition, image interpretation, and clinical translation all contemporaneously on real patients with real pathology. This is the model that is attempted in U.S. residencies and fellowships. There is usually an ultrasound director that each resident and fellow spends dedicated time with. For this model to work, though, several assumptions are made:

- There must be adequate time with the master/mentor. This is very difficult with the number of learners compared to the number of master educators available.
- There must be adequate patients and pathology. In a given clinical setting there are usually certain patients and pathology that exist and are adequate for training in specific modalities. However, the pathology that comes through the door when the master and learner are working together cannot be controlled. Certain rare conditions may never been see live, in person during the educational experience.

Because of the limitations imposed by time with the master and with the variety and amount of pathology that is seen during this time it is necessary to supplement with other forms of education. Furthermore, some do not have any access to a master, and therefore the entirety of their education will be gained through these other avenues.

Published hardcopy textbooks

There are a number of very good published textbooks on emergency ultrasound. These can serve as great supplements to the master/mentor approach previously described. By reading ahead of time, the amount of direct teaching can be reduced, and more directed education can take place. Furthermore, images within the text can be a great pathology supplement, especially for pathology that is rare and the learner may not have a chance to see in person. There are, however, a number of limitations to published textbooks:

- They cannot teach the physical skill of obtaining adequate images. They can give helpful tips, but this skill must be obtained by actual scanning.
- They are not up to date. Emergency ultrasound is a very dynamic field with new research being published constantly. Even if the material is up to date when submitted, the publication process is such that it will usually be several years old by the time it is in the hands of the learner.
- Textbooks limit the visual education to still images instead of video clips. This is simply inadequate to learn ultrasound interpretation. Ultrasound interpretation is about recognizing structures not in isolation, but in relation to other structures in the body in real time. Many pathologic find-

ings rely on motion, such as cardiac pathology, fluctuance of an abscess, and the motion of a pleural line when evaluating for pneumothorax.

Educational courses

Focused single or multiday courses are a very popular way of learning new ultrasound procedures. Providers block off a time of dedicated education where they come and learn through lecture and hands on practice. The goal of these courses is to concentrate learning into a very short period and acquire skills that otherwise would take quite some time to acquire. For these courses to be successful, they must be focused and have adequate time for hands on practice. There are many limitations to this:

- Cost—It is very expensive to organize the facilities, educators, machines, models, and other logistics.
- Time—Even though this is a very focused time, it still takes away from working physicians' actual practice.
- Efficacy—It is unclear how effective isolated courses are. It seems that they work best as a kind of jump-start for a physician who is already very interested; however, it is clear that a few days is not enough to master emergency ultrasound.
- Pathology—It is very difficult to arrange pathology for hands-on scanning. Therefore the practice sessions can focus on image acquisition skills, but without the pathology it is difficult to learn to apply the skill to clinical situations.

Newer technologic methods

Ebooks

This is a variation of the published hardcopy textbook, but it has some advantages.

- Ultrasound is a very visual medium, meaning video clips are essential. Ebooks allow for embedded videos, coupled with audio explanations and even links to other resources that allow for a richer educational experience. It is also much easier to have this form of book with you at all times since it can exist in the cloud and can be accessed through a tablet or smartphone device.
- Ebooks can be updated in real time. They still suffer some of the same challenges of printed textbooks in terms of becoming outdated, but they can be updated much more easily. An update can be pushed to the electronic version without the need to buy a completely new copy.
- Expense—Because of the very small marginal cost, they can be much more affordable for resource limited regions. There is no expense associated with printing and shipping physical books.

Podcasts/Blogs/Apps/#FOAMED

There is a movement within medical education in general called FOAMED (Free Open Access Medical Education). It refers to the current abundance of available resources in terms of podcasts, blogs, apps, and other social media education. It is something that was not available even a decade ago, but now there are more resources than can possibly be consumed. These can be consumed any time, any where, and the portability of even having them on a smartphone makes some apps extremely useful even at the bedside as "just-in-time learning". However, there are limitations and drawbacks:

- Peer review—Most podcasts, blogs, and online resources are not peer-reviewed in the traditional sense. Many argue that the comment sections and nature of social media make it very robustly peer-reviewed. However, this peer review takes place after publication, not before. So consumers should be conscious of this.
- Lack of organization—Most sites attempt to educate with bite-sized education that is not organized in a strict, longitudinal manner. Learners may therefore be learning about advanced cardiac imaging before they have ever watched a lesson on basic ultrasound physics.
- These resources cannot teach the skill of image acquisition. Similar to textbooks, they can give tips and show videos of good technique, but actual practice is necessary to learn this skill.

Simulation

There are a number of ultrasound simulators on the market that attempt to teach all three aspects of emergency ultrasound. They are a very good option, especially for combining the image acquisition with interpretation and sometimes clinical application. However, there are limitations to this as well:

- Image acquisition—Usually they do an "OK" job, but not optimal job at teaching the hand movements required. They are better than nothing when it comes to this skill, but they are still not as good as actual scanning.
- Patient variability—They usually do not do a good enough job teaching anatomical and pathologic variability. They usually show standard views and "standard" pathology.
- Cost—Most are very expensive and cost prohibitive for most individual learners, and certainly for those in resource limited areas.

Online programs/fellowships

This is kept separate from the podcasts/blogs/FOAMED section as these are not free. There are online options for educational programs designed and structured to be an organized approach and to meet all three of the educational pillars of emergency ultrasound. The main downside to these programs is the cost, which can be prohibitive for some learners.

State-of-the-art blended education

The ideal education in emergency ultrasound would leverage the strengths of each of these types of education and overlap them to account for their individual weaknesses. Honestly, this blended education is frequently what new millennial learners already create for themselves.

An example of an organized approach is both a traditional fellowship and an online fellowship such as The Ultrasound Leadership Academy or 123 Sonography. With a traditional fellowship there is direct mentoring of the fellow and the fellowship director. There is also a curricu-

Abstract · Zusammenfassung

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Abstract

Background. There are many ways to learn emergency ultrasound, and now advances in technology can potentially allow emergency ultrasound to be learned more efficiently. The traditional method of learning emergency ultrasound was through direct mentorship, published hardcopy textbooks, and short educational courses. This is a completely valid approach, but it is one that does not work for many, and it can possibly be improved.

Educational methods and resources. Technology has allowed those without access to some of the above to learn, and even those who do have access will benefit from newer methods, which include electronic education such as podcasts, blogs, apps, and other Free Open Access Medical Education (FOAMED). Generally these resources are regularly updated in real time without the publication delays inherent in older media, and they are peer reviewed by thousands of individuals who can comment and discuss in real time. They can be combined with simulation and online mentoring for a much richer blended educational experience that is offered by technology.

Conclusion. There is a fair amount of evidence showing how this combination of methods and newer technology can be leveraged to improve the educational experience. The right combination of methods will depend on the learner. The good news is that there are many options and there has never been a better time to learn emergency ultrasound regardless of the geographical location, access, or specific situation of the learner.

Keywords

Ultrasonography · Online education · FOAMED · Technology · Simulation

Fortbildung in Notfallsonographie – Stand der Wissenschaft

Zusammenfassung

Hintergrund. Es gibt zahlreiche Wege, die Notfallsonographie zu erlernen. Heutzutage gibt es sogar Möglichkeiten, durch sinnvollen Einsatz technologischer Errungenschaften die Notfallsonographie potenziell effizienter zu erlernen. Bei der traditionellen Lernmethode für die Notfallsonographie handelte es sich um ein direktes Mentoring in Kombination mit Publikationen im Sinne gedruckter Lehrbücher und kurzen Fortbildungskursen. Das ist ein völlig valider Ansatz, aber er ist für viele nicht passend und lässt sich vielleicht für fast jeden verbessern.

Unterrichtsmethoden und Hilfsmittel. Aktuelle Technologien ermöglichen es all jenen zu lernen, die keinen Zugang zu manchen der genannten Ansätze haben, und selbst jene, die Zugang dazu haben, werden von den neueren Verfahren profitieren.

Zu diesen Verfahren gehören die elektronische Fortbildung in Form von Podcasts, Blogs, Apps und anderen Angeboten der kostenfreien, offen zugänglichen medizinischen Fortbildung, Free Open Access Medical Education (FOAMED). Diese Quellen werden i. Allg. regelmäßig in Echtzeit aktualisiert – ohne die zeitlichen Verzögerungen der Publikationen älterer Medien – und einer Expertenbegutachtung durch Tausende von Einzelpersonen unterzogen, die in Echtzeit kommentieren und diskutieren können.

Simulationen und Online-Mentoring können damit kombiniert werden und somit durch wirkungsvollen Einsatz der technologischen Möglichkeiten eine deutlich facettenreichere Lernerfahrung bieten.

Zusammenfassung. Es bestehen zahlreiche Nachweise dafür, dass diese Kombination aus bestehenden Verfahren und neueren Technologien für bessere Lernerfahrungen eingesetzt werden kann. Die richtige Mischung und Verfahrensauswahl hängt von dem einzelnen Lernenden ab. Die gute Nachricht dabei ist, dass es viele Optionen gibt und es nie eine günstigere Gelegenheit gab, die Notfallsonographie zu erlernen, unabhängig von geographischer Lage, Zugang oder spezieller Situation des Lernenden.

Schlüsselwörter

Notfallsonographie · Online-Fortbildung · FOAMED · Technologien · Simulation

lum that seeks to add other resources such as textbook required reading and online videos and resources. Focused, multiday courses are also frequently a part of such fellowship where the fellow both learns and teaches. Finally, most universities also have some simulators to help with specific task training and supplement areas where they are lacking specific pathology.

The Ultrasound Leadership Academy is an online program that incorporates video module education, ebook required reading, image review, FOAMED resources, journal articles, and online face-to-face mentoring. It also incorporates focused multiday in-person courses to work on image acquisition with a mentor, a personal ultrasound machine, and personal simulation for at-home pathology practice.

Finally, one can create a blended educational experience for themselves. If they pick and choose from each of the different types of education it is possible to now create a robust experience with minimal resources. Below is a list of examples of each of these types of education. Learners should explore them and decide which ones fit their needs and time and resource availability. There are so many resources available that learners can try different ones and then focus on different types of learning based on their current strengths and weaknesses. When creating a blended experience, it is important to be aware of what is available locally. There are courses and resources available around the world.

Evidence regarding newer methods and technology

There is a fair amount of mounting evidence that these newer methods not only are more convenient, but they also enhance the education of the learner. In fact,

there are studies showing that remote education viewed online leads to just as high of knowledge acquisition as in-person courses for procedures such as the EFAST scan and even procedures such as ultrasound-guided vascular access [18, 19]. This remote education can also be combined with in-person education in a "flipped classroom" approach, which has been proven to be a powerful educational method [20, 21].

Newer technology that uses blended education such as Google Glass and wearable technology has been shown to be beneficial and adequate for remote education and emergency ultrasound [22, 23].

Simulation has been proven for some time to be a great way to provide medical education. There is evidence that it has a role specifically in ultrasound education for a decade and a half [5, 6]. Furthermore, there are numerous types of ultrasound training that have been shown to be feasible via simulation (e.g., trauma, gastrointestinal disorders, and obstetrics and gynecology [24–27]).

Examples of available resources

Hard copy textbooks (listed alphabetically):
- Emergency Ultrasound. Ma, Mateer, Blaivas
- Manual of Emergency and Critical Care Ultrasound. Noble, Nelson

Educational courses:
- Too numerous to list. Google ones near you.

Ebooks (listed alphabetically):
- ACEP DVT Ultrasound eBook
- ACEP Trauma Ultrasound eBook
- Essentials of Point of Care Ultrasound
- Introduction to Bedside Ultrasound Volume 1
- Introduction to Bedside Ultrasound Volume 2

Podcasts/blogs/apps/FOAMED (listed alphabetically):
- Biology—http://www.efsumb.org
- Echocalc (British Society of Echocardiographers)
- Emergency Ultrasound smartphone app—iOS
- European Federation of Societies for Ultrasound in Medicine and
- Meritus—http://meritus.kopernika.pl/
- One Minute Ultrasound smartphone app—iOS and Android
- Sonoguide—http://www.sonoguide.com
- Sonomojo—www.sonomojo.org
- Sonospot—www.sonospot.com
- The EDE Blog—www.edeblog.com
- The SonoCave—www.thesonocave.com
- The Ultrasound Podcast—www.ultrasoundpodcast.com
- Ultrasound of the Week—www.ultrasoundoftheweek.com
- 5 min. Sono—5minsono.com

Online programs/online fellowships (listed alphabetically):
- The Ultrasound Leadership Academy—www.ultrasoundleadershipacademy.com
- 123 Sonography—www.123sonography.com

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Compliance with ethical guidelines

Conflict of interest. M.S. Dawson states the following: he is the co-creator of the free Ultrasound Podcast, One Minute Ultrasound smartphone app, and Introduction to Bedside Ultrasound Volume 1 and 2. He is also a founder and co-director of the nonprofit Ultrasound Leadership Academy.

The accompanying manuscript does not include studies on humans or animals.

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Buchbesprechungen

Berghold, F., Brugger, H., Burtscher et al. (Hrsg.)

Alpin- und Höhenmedizin

Wien: Springer 2015, 485 S., 124 Abb., (ISBN 978-3-7091-1832-0), Hardcover, 68.00 EUR

Historisch gesehen hat die breite Palette der Alpinmedizin zwei markante Wurzeln: aus dem alpinen Rettungswesen, das ursprünglich mit dem Abtransport von toten Unfallopfern ins Tal beschäftigt war, entwickelte sich um die Mitte des vorigen Jahrhunderts, vor rund 60 Jahren, die Disziplin der alpinen Notfallmedizin, Hand in Hand mit der Rettung aus der Luft. Der zweite bedeutsame Grundpfeiler heißt Mount Everest, der nach jahrzehntelangem erfolglosen Bemühen schließlich 1953 erstbestiegen wurde, und zwar mit entscheidender Unterstützung der damals erst jungen, kaum etablierten wissenschaftlichen Disziplin der Höhenmedizin.

Innerhalb der modernen Alpinmedizin gibt es heute zwei Themenbereiche, die aufgrund ihrer Besonderheiten ausschließlich der Alpinmedizin „gehören": Die Lawinenmedizin und die Medizin der großen und extremen Höhen. Die übrige Themenfülle, mit der sich das vorliegende Buch befasst, ist eine breite Palette von spannenden alpinmedizinischen Inhalten.

Vor diesem Hintergrund präsentiert dieses Buch einen faszinierenden Überblick über die aktuelle Alpin- und Höhenmedizin.

Im Gegensatz zum üblichen, oft geradezu manischen Bemühen um fachliche Konformität eines Kompendiums wurden die Autoren dieses Buches immer wieder dazu ermutigt, in ihrem ganz persönlichen Stil zu schreiben, was sie für richtig halten – und nicht, was „man" für die Wahrheit hält.

Das ist lebendig, das ist so spannend wie die Wirklichkeit. Um der breiten Thematik gerecht zu werden haben fast 40 Autoren, darunter viele bekannte Exponenten der deutschsprachigen Alpin- und Höhenmedizin, aber auch Kollegen aus Frankreich, Italien und Spanien an diesem Standardwerk mitgearbeitet. Dieses Buch durchzieht thematisch ein „roter Faden" durch die drei Abschnitte 1. Alpine Sportmedizin, 2. Alpine Unfallmedizin und 3. Höhenmedizin: Der Bogen beginnt mit den sehr unterschiedlichen alpinistischen Belastungsmustern, der Leistungssteigerung und energetischen Taktik, was auch spezifische Ernährungsfragen aufwirft. Neben höhenbedingten- gibt es auch gesundheitliche Einschränkungen internistischer oder orthopädischer Natur. Besondere Empfehlungen gelten für Kinder und Schwangere, aber auch für die junge Disziplin des Sportkletterns.

Der zweite Abschnitt Alpine Unfallmedizin beginnt mit dem Risikomanagement und der Prävention von Bergunfällen, bevor die Besonderheiten und Herausforderungen, die Möglichkeiten und Grenzen der Erstversorgung Verunglückter im oft extrem schwierigen alpinen Gelände behandelt werden. Blitzschäden, Kälteschäden und Lawinenunfälle zählen zu den typischen alpinen Unfällen, aber auch internistische Notfälle im Gebirge und die logistischen Sonderfälle Canyoning- und Höhlenunfall gehören dazu. Besondere ärztliche Einsatztaktiken, die Technik der lebensrettenden Sofortbergung und die medizinische Ausrüstung sind ebenso Höhepunkte dieses Buches wie die Anforderungskriterien des modernen Berg- und Flugrettungsarztes.

Der dritte Abschnitt Höhenmedizin befasst sich mit den Phänomenen in verschiedenen Höhenlagen, wo die Luft lebensbedrohlich dünn ist, und mit der Anpassungsfähigkeit des Menschen, mit den Ursachen, der Klinik und Therapie der Höhenkrankheit. Der dritte Abschnitt beschreibt die vielschichtigen Aspekte der medizinischen Ausrüstung und ärztlichen Betreuung beim Höhentrekking und Höhenbergsteigen. Nicht zuletzt öffnet der Gesundheitstourismus in alpinen Höhen ganz neue Einsichten und Möglichkeiten.

Fazit

Das Herausgeber- und Autorenteam besteht aus dem who-is-who der Europäischen Alpin- und Höhenmedizin; dementsprechend ist der Inhalt des Buches hervorragend gelungen. Farbige Abbildungen hätten mir noch besser gefallen, die aber den Preis des Buches sicher erhöht hätten.

V. Wenzel (Innsbruck)