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Editorial

The acronym of resuscitation ultrasound: RCC – Resume chest compressions!

Acronyms and point-of-care ultrasound "protocols"

Resuscitation ultrasound is a subgroup of point-of-care ultrasound (PoCUS) procedures to improve resuscitation efforts. It can lead to interventions and mainly differs from expert transthoracic echocardiography or laboratory ultrasound of routine diagnostics: Resuscitation ultrasound should be simple, trainable by a broad number of doctors handling acute medical problems. Thus, rather than imaging experts, resuscitation experts are required.

Clinical scientists start research in this field often with an acronym naming a "protocol". Such protocols introduce novel PoCUS approaches and contain a limited number of sonograms to be obtained in a specific order with the aim to understand the actual physiological state of a patient [1]. Resuscitation related protocols are e.g. TRUE for airway management, FAST/E-FAST in trauma, LUS for lung ultrasound, FEEL, SHoC or RUSH in shock. Early protocols (e.g. FATE) describe static views and were not developed for ALS, originally. Unfortunately acronyms for such protocols are increasing in numbers and rigorous scientific validation is scarce, except few with feasibility data or small sample size. Tests within specific clinical scenarios, robust data on improvement in training or clinical outcomes are still lacking (e.g. for CAUSE, RUSH, FATE, BLEEP, CLUE or EGLS).

However dynamic PoCUS protocols more include procedural aspects and start with a clinical question, describe a step by step approach of obtaining sonograms within different clinical processes, suggest the integration within a clinical procedure (e.g. ALS) and end with a clinical answer. Dynamic protocols are e.g. airway ultrasound exam [2], sweep of subxiphoid four chamber view with inferior vena cava (IVC), short axis, which would be mandatory in CPR [3–5]. Lung ultrasound limited to pneumothorax diagnostics, which would be of utmost interest, has been included into the European Resuscitation Council (ERC) guidelines, but has not been tested in CPR [6]. Nevertheless, ERC 2015 guidelines contain several resuscitation ultrasound methods (Table 1) [7].

Danger of "New Toy Syndrome"

It had to be cautioned: "First do no harm" [11]. However, ultrasound has been shown to prolong interruptions of chest compressions [8–10]. The dilemma is the duty to identify treatable conditions, but also to ensure uninterrupted chest compressions. Along with recognizing the benefit of uninterrupted chest compressions, the need for cautious, ALS-conformed integration of interventions such as endotracheal intubation into the overall resuscitation process has been pointed out [7]. There is no reason to presume that with ultrasound, this should be any different. Apart from the inherent time consumption of novel ultrasound procedures and the struggle for good images under time pressure, there is considerable danger of distraction of single providers, and the whole team to stare at images, playing with a new toy. Furthermore, cognitive load increases: When needing to integrate information from EKG, blood pressure/pulse check and resuscitation ultrasound – questioning, if this is a reliable finding or diagnosis while observing suboptimal images, and the question of what to do with this novel information. This obviously calls for a procedural approach of any resuscitation ultrasound protocol.

US-CAB or ALS-US-CAB or?

The *US-CAB* by Lien and coworkers published in this issue [4], slightly moves into this direction. By design, the proposed ultrasound applications are check of Cardiac and cava view (subxiphoid evaluation of cardiac contour and activity, as well as size of IVC), check Airway (confirmation of endotracheal tube position) and check Breathing – (asymmetry in bilateral ventilation). They found diagnostic accuracy for A and B, and rapid identification of esophageal as well as endobronchial tube misplacements as expected [2], found cardiac abnormalities to be treated and were able to draw a timeline for the prognostic value of resuscitation ultrasound regarding return of spontaneous circulation. This significantly adds to previous outcome data [12].

Regarding procedural aspects, those results are promising, because time data are available for single ultrasound applications and – most importantly – cardiac views took no more than the arbitrarily set of a cut-off of ten seconds. The authors conclude that their protocol was feasible and ALS-conformed. But again, single parts of the protocol seem to be interchangeable, and specific alignment of C-A-B versus A-B-C would not make any difference. The IFEM working group for SHoC has undertaken a two step-approach, resulting in a hierarchy of findings based on review of the local epidemiology of reversible causes in cardiac arrest and peri-arrest situations, and consequently, a hierarchy of ultrasound applications, that is, another protocol. It even suggests a specific task alignment. But this has yet to be validated [13].

Training resuscitation ultrasound is mandatory

Unfortunately, the study by Lien et al. failed to measure duration of interruptions of chest compressions, although it seemed to be reasonable to assume those were resumed promptly. However, it has to be recognized, that providers were obviously instructed to minimize interruptions. How should this be trained, and how much training is

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Table 1
Core elements of introductory course training including Resuscitation Ultrasound, minimum time requirements in Germany Society of Ultrasound in Medicine (DEGUM), Emergency Ultrasound, Society of Anesthesiology and Intensive Care Medicine (DGAI). Note that this does not imply competence and proficiency at this stage.

	ERC 2015 recommendations	Novel ERC resuscitation ultrasound workshop format	Scientific data for CPR available	Minimum time for introductory training within German systems (hrs)
Interruption Training	X	X (priority)	X	1.5 (0.5 theory, 1 hands-on)
A; Ultrasound for tracheal (and esophageal) tube detection	X	(X)	X	1 (0.5 + 0.5 theory, hands-on)
B; bi- or unilateral ventilation (lung sliding, lung pulse, B-Lines, rule out or in PTX)	X limited to PTX diagnosis	(X)	no scientific data in CPR	2.5 (1.25 + 1.25 theory, hands-on)
C; peri-arrest cardiac ultrasound (subxiphoidal sweep with 4-chamber view to IVC, short axis and back)	X	X	X	4 (2 theory, 2 hands-on) within a one-day (8 h) course
Training of combining and processing A-B-C (Airway Ultrasound exam plus C)	not yet	(X)	Lien et al. [14]	1 + 1
Total				11

enough? In the study, a brief four-hour training effort, lacking to extensively describe the concept and scientific data regarding its educational science in behind, was delivered to novice instructors. After assessment, they were deemed to be competent and proficient to apply ALS-conformed resuscitation ultrasound, and not to forget the inclusion of pericardial punctures [4,14]. From nationwide published teaching concepts for portions of introductory resuscitation ultrasound at least in Germany (Table 1) this has to be questioned.

Thus, protocols should address procedural aspects. The FEEL protocol, conceptualized before 2007, addressed this for better resuscitation ultrasound: it combined imaging, the ALS-conformed procedure itself, and its effective training [3,5,15]. The teaching concept comprised blended learning, a minimum of a one day introductory course with hands-on training and post-course learning. This approach has been educationally validated [5,16]. FEEL has been part of the portfolio of Resuscitation Council, UK courses since September 2013 and at German Society of Ultrasound in Medicine (DEGUM) from 2008.

Providers have to learn when, where and how to use ultrasound in an ALS-conformed manner – to do their "resuscitationists' homework" (Table 1). ERC guidelines demand well trained operators. But how can procedural aspects be trained? We need widely available simulation training for ALS-conformed applications and integration of those procedures as well as specific findings into the overall resuscitation process. This shifts the perspective away from imaging to the procedure itself [17,18]. However, educational research in resuscitation ultrasound is still rare.

In CPR, driving force should be the ALS. To address this better, during the Resuscitation 2017 conference in Freiburg, Germany, a novel "resuscitation ultrasound workshop" format was proposed in cooperation with C. Lott, Mainz from the ERC. The emphasis is on training of interruptions, integration of the procedure into the resuscitation process, and image interpretation. The workshop comprises an ALS scenario with simulation technology of guideline-based resuscitation ultrasound items (i.e. probe positions for trachea, for checking lung sliding/lung pulse/B-Lines, and finally for a sweep of subxiphoidal cardiac 4-chamber view including IVC), but mainly with a drill of minimizing interruptions. This is combined with a simple introductory sonogram acquisition training on live models to demonstrate how to do within five to ten seconds. Thus, this resuscitation ultrasound workshop is mainly a procedural training with the limitation of an introductory course which does not confirm competency.

As the training, so should our scientific efforts shift away from the imaging back to train continuity of the ALS and quality of CPR but not erase image acquisition and interpretation training. There it is, our most important outcome measure.

Conflict of interest

There are no conflicts of interest to declare.

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