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A new generation of simulator for teaching the new wall blocks

Ultrasound guided regional anesthesia (UGRA) is an invasive procedure that involves complex motor skills.[1] As ultrasound-guided regional anesthesia (UGRA) represents the gold standard for performing regional blocks, there is a need for learning the technical skills associated with this technique to successfully perform a UGRA procedure. A triad of three distinct but interrelated skills are required: image acquisition, anatomical interpretation and hand-eyes coordination.

Although there are simulator models for learning how to perform UGRA, they are not anatomically based and do not use.

We developed an innovative and high-fidelity system simulator for ultrasound-guided fascial blocks based on real ultrasound images, named Block Sim™ (Accurate; Cesena, Forlì-Cesena, Italy), that is able to provide the opportunity to acquire and practice technical skills in a safe, controlled, and reproducible environment. Block Sim™ allows us to practice on: anterior thoracic wall blocks (PECS I, PECS II, serratus plane block and parasternal block), paraneuraxial nerve blocks (paravertebral block and erector spine plane block [ESP]), and abdominal wall blocks (transversus abdominis plane block [TAP]) (Figure 1, 2), quadratus lumborum block (QLB I and II).

The simulator includes three very realistic ultra-durable inserts including traditional anatomical landmarks, a lightweight, compact and easy to store box equipped with high-fidelity sensors for movement detection, and a virtual ultrasound monitor. Thanks to the ultrasound probe software, this new simulation system allows the physician to view real ultrasound images.

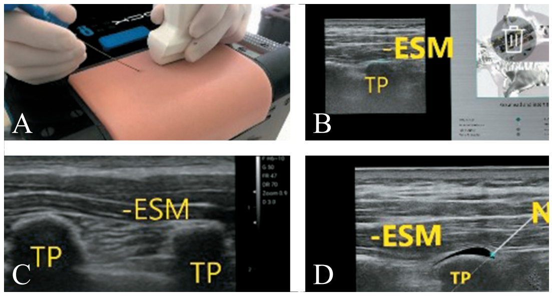

Figure 1.—A) BlockSim™ with insert for practicing UGRA. B) Ultrasound image of BlockSim™ with target. C) Real ultrasound images of paraneuroaxial area. D) ESP Block of BlockSim™ with the needle on the target and opening of fascial plane.
TP: transverse process; N: needle; ESM: erector spine muscle.

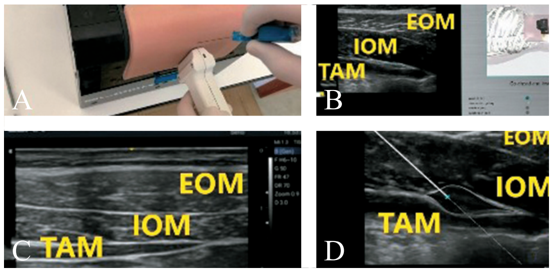

Figure 2.—A) BlockSim™ with insert for practicing UGRA. B) Ultrasound image of BlockSim™ with target. C) Real ultrasound images the abdominal wall is shown. D) Tap block of BlockSim™ with the needle on the target and opening of fascial plane.
N: needle; EOM: external oblique muscle; IOM: internal oblique muscle; TAM: transversus abdomen muscle.

Users can move the ultrasound probe in different directions on the available insert and observe a coherent real-time modification of the scene, allowing to examine the sonoanatomy and to choose the correct entry plane for the needle. Users can perform a simulated injection of the local anesthetic, using an external syringe, when the tip of the needle is inside of the fascia. The user can also learn the sonoanatomy and acquire or improve the coordination capacity between the needle and the probe.

Simulation accelerates skill acquisition, improves skill retention, and reduces the extinction of skills. It has become an integral part of anesthesiology residency training.[2, 3]

Thanks to the software of Block Sim™, the execution of the fascial blocks is very close to reality. It has got inexpensive inserts/pads and can provide tactile feedback, thanks to its realistic insert, coherent simulation of the resistance to penetration of the different tissues traversed by the needle during fascia block procedures. These inserts include traditional anatomical landmarks that provide precise tactile feedback to the user while he is inserting the needle as well as the feel of the typical fascial "pops".

The user can practice and develop competency using simulation scenarios based on real clinical images and, at the end of the procedure, an indicative global score will be given to the user based on his performance.

Drawbacks include the initial cost of the manikins and the replacement costs of inserts.

Although these simulators offer significant educational opportunities, first of all for patient safety, and could be used in workshops for training UGRA techniques, in agreement with the recommendations by the European Society of Regional Anesthesia.[4] Data of educational and training outcomes will be needed.

Pierfrancesco FUSCO [1], Gian M. PETRONI [2] *, Astrid U. BEHR [3], Stefania TULLJ [2], Gilberto FIORE [4], Alessandro VERGALLO [5], Franco MARINANGELI [2]

[1]Department of Anesthesia and Intensive Care, San Salvatore Hospital, L'Aquila, Italy; [2]Department of Life, Health and Environmental Sciences, University of L'Aquila, L'Aquila, Italy; [3]Unit of Anesthesia and Resuscitation, Hospital of Camposampiero, Padua, Italy; [4]Department of Anesthesia and Intensive Care, Hospital of Santa Croce di Moncalieri, Moncalieri, Turin, Italy; [5]Department of Anesthesia and Intensive Care, Spedali Civili di Brescia, Brescia, Italy

*Corresponding author: Gian M. Petroni, Department of Life, Health and Environmental Sciences, University of L'Aquila, Via Vetoio, 67100 L'Aquila, Italy. E-mail: gianmpetr@gmail.com

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COVID-19, pneumomediastinum and echocardiography: friends or foes?

Pneumomediastinum has been repeatedly described as a relatively frequent complication of coronavirus disease (COVID-19), but its occurrence seems independent from mechanical ventilation.[1] A recent study showed that COVID-19 patients admitted to intensive care (ICU) have a seven-fold higher incidence of pneumomediastinum as compared to non-COVID-19 patients with acute respiratory distress syndrome (13.6% *vs.* 1.9%). Surprisingly, the presence of pneumomediastinum does not seem to influence prognosis of COVID-19 patients.[2] Hereby we report the indirect usefulness of echocardiography in case of pneumomediastinum.

A 72-year-old woman with severe COVID-19 was admitted to our 14-bed ICU after referral from the Emergency Department of a district Hospital. The patient was intubated one week after her hospital admission. Before the transfer, a computed tomography (CT) scan was performed with a diagnosis of interstitial COVID-like pneumonia and "significant pneumomediastinum"; however, CT images were not readily available on patient's arrival to ICU. Patient conditions were extremely severe (PaO_2/FiO_2 ratio = 66) but she was hemodynamically stable. We performed an echocardiogram on ICU admission but there was not even a single acoustic window, despite patient's small body habitus (55 kg, 1.5 m^2 body surface area). Bilateral pleural sliding and coalescent B-lines were noted. We considered the "unexpected" absence of all acoustic windows (parasternal, apical, subcostal and suprasternal) as a possibility of extensive pneumomediastinum reported on CT scan, and decided to keep positive end-expiratory pressure $\leq$10cmH_2O. The CT scan images were available on the following day, and confirmed a severe pneumomediastinum extending from the mid-abdomen to the neck (Figure 1), justifying the absence of echocardiography windows, though no pneumopericardium was noted.

Interestingly, 48 hours after ICU admission, whilst gas exchanges were grossly unchanged, we were able to obtain some images from the parasternal and subxiphoid window, and three days later we performed a full advanced critical care echocardiogram with all views available and of high-quality. The echocardiogram reported hyperkinetic-hypertrophic left ventricle with diastolic dysfunction grade II, normal right ventricular function and mild pulmonary hypertension, signs of hypovolemia, small pericardial effusion and no significant valve abnormalities.

We briefly discuss two learning points in the relationship between pneumomediastinum and echocardiography. First, considering the high incidence of pneumo-