EMJ SONO Case Series

Author Instructions
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About EMJ SONO Cases Series

The EMJ SONO Case Series is a regular journal feature utilizing cases to demonstrate how core and select extended point-of-care ultrasound (POCUS) applications are performed, interpreted, and integrated into clinical care for patients in the Emergency Department (ED).[1]

EMJ Case Series Objectives

This is an educational series intended to provide readers with a protocol for indications and instruction on how to perform specific POCUS applications, a visual guide to interpret POCUS images, and current data establishing the accuracy of each specific POCUS application. Most importantly, this series distills the expertise of POCUS trained clinicians, offering expert tips and pitfalls to avoid in both image acquisition and interpretation. We seek to meet the needs of EMJ's audience and, therefore, cover core POCUS applications while also introducing POCUS in less commonly utilized applications.

Manuscript Requirements

- All POCUS images submitted to EMJ SONO Cases Series must have the written consent of the patient. Consent forms can be found, in various languages, at: https://authors.bmj.com/policies/patient-consent-and-confidentiality/
- Title page, including:
    - Title (Note, this series is an educational series, not a case series. The title is not in the form of a case series; it is an opportunity to introduce upon what POCUS application will be reviewed.)
        - For diagnostic POCUS manuscripts, the title should read: SONO Case Series: Point-of-Care Ultrasound for xxx
        - For Point-of-Care Ultrasound-Guided Regional Anesthesia manuscripts, the title should read: SONO Case Series: Point-of-Care Ultrasound-Guided Regional Anesthesia – the xxx for a Patient with xxx
        - Character count: No more than 100 characters
        - Descriptive title including: POCUS Modality
        - No abbreviations or acronyms (except vs. instead of Versus)
        - Capitalize and single space the first word after a colon or a dash
    - Running title

        - Running title should be no more than 100 characters
    - Author names (Identify author by first and last name with middle initial if relevant, highest degree, author affiliation, address, phone, and email address. Indicate corresponding author.)
        - Number of authors: 3 maximum; submit separate documentation if more than 3 authors
    - Category (SONO Case Series)
    - Funding Source
    - Financial Disclosure
    - Conflict of Interest
    - Clinical Trial Registration
    - Keywords
        - Keywords should be found use MeSH terms from PubMed (link)
            - Always included: Diagnostic Ultrasound, Point-of-Care Ultrasound
            - No more than 5 Keywords
    - Word count
        - Maximum word count 2000 (generally 1500-1700)
- Cover Letter, including:
    - Corresponding author, name and address
    - Presenting manuscript as a part of the EMJ SONO Case Series
    - Statement to verify that case was written exclusively for EMJ SONO Case Series and that no portion of the submission has been previously published or is currently under consideration at another journal
- Main manuscript
- Images
- Supplemental videos (if applicable)
- An abstract is *not* required

Manuscript Preparation

In general:

- Manuscripts should be written in English
- Manuscripts should be written in the present tense
- Please avoid the use of slang language
- Abbreviations should be defined the first time utilized; if an abbreviation is only used once or twice, spell it out each time.
- Please avoid non-standard or institution specific abbreviations
- Reference values should be provided; measurements should be provided in standard international units
- Generic drug names should be used; avoid brand drug names
- Maximum word count 2000 (generally 1500-1700)
- If possible, use UK spellings (set your word language to English or UK)

Manuscript Framework

To make this series predictable to readers, each EMJ SONO Case should follow the same format using the below bolded headings.

Diagnostic Point-of-Care Ultrasound:

- Title: SONO Case Series: Point-of-Care Ultrasound for xxx
- **Case presentation**:
  - The case presentation should be no longer than 3 short paragraphs (one for case presentation, one for vital signs and physical exam, and one for initial steps in the patient evaluation. This should be roughly 200 to 300 words.
- **What are the indications for performing xxx POCUS?**
- **Which transducer is best suited for performing xxx POCUS?**
- **What views should be obtained when assessing xxx?**
- **How do you interpret xxx POCUS?**
- **What is the interpretation of this patient's ultrasound?**
- **What is the evidence for using xxx POCUS in clinical practice?**
- **What are expert tips when performing xxx POCUS?**
- **What are some pitfalls of performing xxx POCUS?**
  - This section should have 2-3 pitfalls
  - Each pitfall should have a clear, underlined, subheading
- **Case Conclusion**
  - This is a conclusion of the clinical case, not the authors recommendations
  - Should reveal what happened with the patient's specific case

Point-of-Care Ultrasound-Guided Regional Anesthesia:

- Title: SONO Case Series: Point-of-Care Ultrasound-Guided Regional Anesthesia – the xxx for a Patient with xxx
- **Case presentation**:
  - The case presentation should be no longer than 3 short paragraphs (one for case presentation, one for vital signs and physical exam, and one for initial steps in the patient evaluation. This should be roughly 200 to 300 words.
- **What are the indications for performing a xxx Block?**
- **Which ultrasound transducer is best suited for performing a xxx Block?**
- **How do you set up to perform a xxx Block?**
  - Patient consent
  - Sensory examination
  - Patient positioning
  - Ultrasound machine and positioning
  - Equipment
  - Transducer orientation
  - Anesthesia

    - Monitoring
    - In-plane technique
    - Support
- **What views should be obtained when preparing to perform a xxx Block?**
- **Where are you trying to place the tip of your needle?**
- **What is the evidence for performing an ultrasound-guided xxx Block in clinical practice?**
- **What are expert tips when performing a xxx Block?**
- **What are some pitfalls of performing a xxx Block?**
- **Case Conclusion**
    - This is a conclusion of the clinical case, not the authors recommendations
    - Should reveal what happened with the patient's specific case

Patient consent:

- Please find consent form in patient's language at: https://authors.bmj.com/policies/patient-consent-and-confidentiality/

Manuscript Submission

- To submit your manuscript, go to: https://emj.bmj.com/pages/authors/. You will be directed to the EMJ login (https://mc.manuscriptcentral.com/emj).
- When given the option to select the submission 'Category,' select SONO Case Series.
- To expedite review, consider including one or two recommended reviewers when submitting.

Frequently asked questions

- How many images can I include?
    - Include as many images as you need to include to effectively cover your specific POCUS application.
    - Previous submissions have included 3-10 images.

- What are the parameters for submitted images?
    - As outlined at on the BMJ author instructions under 'File Types' at https://authors.bmj.com/writing-and-formatting/formatting-your-paper/, files must have a minimum of 300 dpi.
    - Patient identifiers must be removed; figures that use a black bar to cover patient identifiers are not accepted.

- Can videos be submitted?
    - Yes, videos can be included.
    - Patient identifiers must be removed; figures that use a black bar to cover patient identifiers are not accepted.

- What are the parameters for submitted videos?
  - As outlined at on the BMJ author instructions under 'Multimedia Files' at https://authors.bmj.com/writing-and-formatting/formatting-your-paper/, videos are preferred in .WMF or .AVI formats. Videos can also be submitted as .FLV, .Mov, and .MP4.
  - Videos can be uploaded using the file designation of "Supplementary File – Video."

- When will this manuscript be published?
  - Generally, these cases are being published quickly on-line and then published in writing every other month. Please reach out to sally.graglia@ucsf.edu for specifics.

References:

1. Carley, S., & McDermott, C. (2020). Introducing the SONO case series. *Emergency Medicine Journal*, *37*(9), 581-581.

SONO case series: point-of-care ultrasound for fracture diagnosis

CASE PRESENTATION

A 34-year-old man with no significant medical history presented to the ED with right lower extremity (RLE) pain after a motorcycle crash. The patient reported that he was travelling at approximately 8 km per hour when he hit a piece of trash on the roadway, skidded to one side, and fell to the ground with his motorcycle landing on top of his RLE. He attempted to ambulate on scene but was unable to bear weight due to severe pain in his RLE. He was helmeted during the crash and denied any other problems.

On physical examination, he was well-appearing overall, with vital signs notable only for mild hypertension to 156/94 mm Hg, a pulse of 80 beats/min, a respiratory rate of 15 breaths/min, and an oxygen saturation of 99% on room air. Examination of his distal right leg was notable for swelling without obvious deformity nor other evidence of trauma. Passive and active range of motion of his right knee and ankle were limited by pain. His right foot was neurovascularly intact, with normal sensation and motor function and palpable distal pulses. The rest of the physical examination was unremarkable

After a negative extended Focused Assessment with Sonography in Trauma, a point-of-care ultrasound (POCUS) of the right lower leg was performed as part of the initial evaluation, revealing a discontinuity of the cortical surface of the tibia consistent with an acute fracture. This diagnosis was subsequently confirmed on X-ray, which also demonstrated an ipsilateral proximal fibula fracture (figure 1).

WHAT ARE THE INDICATIONS AND CONTRAINDICATIONS FOR PERFORMING MUSCULOSKELETAL (MSK) POCUS FOR FRACTURES?

In 2016, the American College of Emergency Physicians specifically included MSK ultrasound, such as for abscess, cellulitis, fractures, tendon injuries and joint effusions, in their recommended curriculum for emergency ultrasound learning objectives.[1] This case presentation will focus specifically on MSK POCUS for fractures.

MSK POCUS for fractures is indicated whenever a fracture is clinically suspected. POCUS is potentially advantageous over other imaging modalities in the following scenarios:

1. Rapidity of diagnosis: As a bedside modality performed by the treating physician, ultrasound can be more rapidly obtained than X-ray and much more rapidly than cross-sectional imaging such as CT or MRI.[2 3]
2. Avoidance of ionising radiation: Unlike traditional radiographic modalities such as X-ray or CT, ultrasound does not expose the patient to ionising radiation.

Figure 1 Photograph of the patient's right lower extremity at time of arrival in the ED, lateral x-ray of the right ankle, and longitudinal ultrasound of the right tibia showing a cortical disruption.

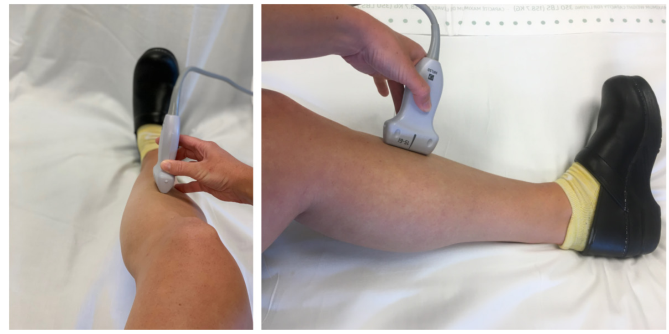

Figure 2 Transducer orientation for tibial ultrasound, longitudinal view.

3. Low-resource settings: With the increasing availability of ultrasound machines, POCUS can provide a uniquely accessible diagnostic tool for acute traumatic bony injuries in settings where access to advanced imaging is limited, such as global health practices, military field medicine, and event or disaster medicine.
4. Paediatrics: In addition to the avoidance of ionising radiation, POCUS offers a better paediatric patient experience. The machines are smaller and less noisy than other imaging techniques, and bedside imaging allows caregivers to remain with the patient during image acquisition, all of which helps to decrease patient anxiety. There is increasing data that ultrasound is a better tolerated imaging modality in children as compared with either X-ray or CT.[4–7]

While there are no absolute contraindications to MSK POCUS for fractures, consideration should be given to the following specific situations:

1. Patient comfort: MSK POCUS for fractures can be uncomfortable for the patient as it requires making contact with the affected area. Adequate analgesia should be administered prior to performing MSK POCUS.
2. Open wounds or open fractures: The clinician must take caution not to seed infectious material into a patient's wound and to protect the ultrasound transducer from becoming contaminated. The use of sterile ultrasound gel and disposable transducer covers can minimise risk of infection.

WHICH TRANSDUCER IS BEST SUITED FOR PERFORMING MSK POCUS FOR FRACTURES?

The high-frequency linear transducer provides higher resolution images of more superficial structures. POCUS for fractures is intended to evaluate the bony cortex, the outermost layer of the bone structure. As most bones are within 1–5 cm of the skin,

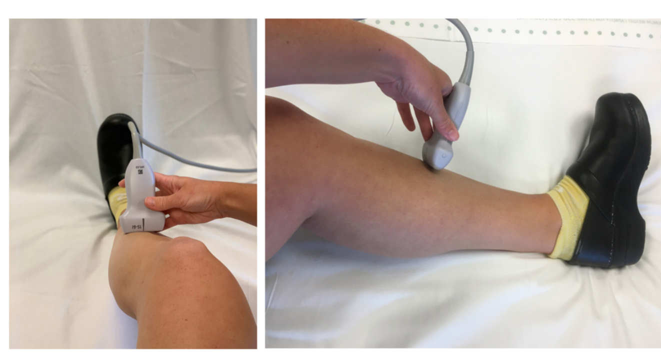

Figure 3 Transducer orientation for tibial ultrasound, transverse view.

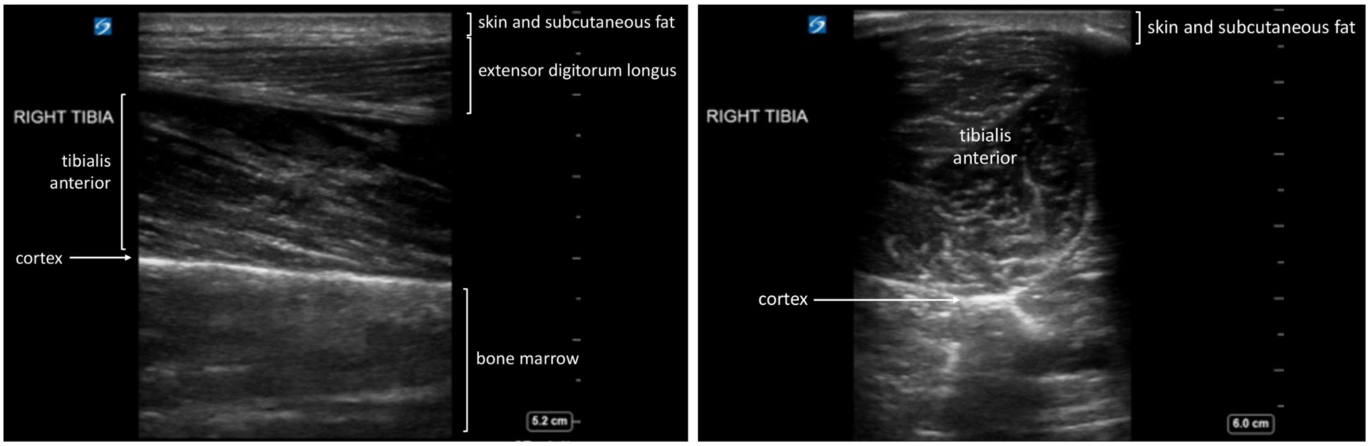

Figure 4 Normal tibial ultrasound, longitudinal (left) and transverse (right) views.

the high-frequency transducer is ideal for imaging most skeletal injuries. For most upper extremity, hand, and lower leg injuries, the high-frequency transducer has adequate depth to visualise all structures superficial to and including the bony cortex.[8]

For patients with larger amounts of tissue between skin and bone or for deeper structures such as the hip or femur, the high-frequency transducer may not offer sufficient depth; in this scenario, the examiner should use the curvilinear transducer, which reaches greater depth at the expense of lower resolution.

WHICH VIEWS SHOULD BE ACQUIRED FOR MSK POCUS FOR FRACTURES?

Ideally all POCUS, including MSK POCUS for fractures, assesses the structure of interest in two views: longitudinal and transverse. In the longitudinal view, the transducer axis is aligned with the long axis of the bone; in the transverse view, the transducer is perpendicular to the long axis of the bone (see figures 2 and 3).

To assess for fractures, the clinician should first obtain a longitudinal view of the bone either proximal or distal to the area of maximal pain. Ultrasound images of normal bone show an uninterrupted line of bright white, echogenic cortex (see figure 4). The clinician can then scan proximally or distally across the area of maximal pain, assessing for a disruption in the cortical line, as seen in figure 5.

Though it is more difficult to see cortical disruptions in the transverse view, this view can also demonstrate associated soft-tissue abnormalities, such as haematomas, which are visualised as anechoic or hypoechoic fluid collections and are often associated with fractures.

Figure 5 Longitudinal view of tibial fracture, showing cortical disruption and associated haematoma.

HOW DO YOU INTERPRET MSK POCUS FOR FRACTURES?

A normal superficial bony cortex is seen as a bright white, echogenic line. As ultrasound waves do not travel through bone, all structures deep to the cortex (including bony trabeculae and bone marrow) appear as anechoic or hypoechoic shadows below the echogenic cortical line (see figure 4).

Fractures are seen as disruptions and/or displacements of the echogenic cortical line. Ultrasound of the surrounding soft tissue can also identify associated haematomas, seen as anechoic or hypoechoic fluid collections near the site of cortical disruption (see figure 5).[9]

There is an increasing body of literature demonstrating that the sensitivity and specificity of ultrasound for long bone fractures justifies its inclusion in clincial practice. A meta-analysis performed in 2013 of ED physician-performed POCUS for extremity fractures showed sensitivities ranging from 85% to 100% and specificities from 73% to 100%.[10]

HOW DO YOU INTEGRATE MSK POCUS FOR FRACTURES INTO CLINICAL PRACTICE?

While ultrasound will likely never completely replace X-ray and CT imaging for many orthopaedic injuries, it is increasingly being used for identification of MSK injuries in the ED and has many advantages over traditional imaging modalities. POCUS offers a more portable and faster diagnosis of fractures,[2] can be less anxiety provoking[4–6] and is safer than ionising radiation. MSK POCUS for fractures is also easy to accurately perform, even by physicians without extensive sonography training.[11] Furthermore, there is evidence that MSK POCUS for fractures can be relied on to guide management. For example, a study comparing management decisions for elbow fractures and dislocations based on ED physician-performed POCUS found high sensitivity and specificity for appropriate management decisions when compared with treatment decisions based on CT imaging.[12]

In our case, the diagnosis of a tibial fracture was suspected on the patient's presentation and confirmed by bedside ultrasound within 10 min of the patient's arrival in the ED, prior to any other imaging. This allowed for prompt diagnosis-guided management, including providing appropriate analgesia prior to manipulation for additional imaging and rapidly obtaining orthopaedics consultation.

WHAT ARE SOME OF THE PITFALLS OF MSK POCUS FOR FRACTURES?

The sensitivity and specificity of ultrasound for fracture identification are generally lower than that of conventional X-ray imaging and CT[4 9 13]; thus, POCUS is seldom used as a sole imaging modality. Additional imaging should always be obtained if clinical suspicion for bony injury persists after an unrevealing POCUS study.

POCUS should be used with caution in cases where there is suspicion of open fracture to avoid introduction of bacteria into the wound and subsequent iatrogenic infection.

CASE CONCLUSION

The patient was admitted to the orthopaedic surgery service and underwent tibial open reduction/internal fixation with intramedullary nail placement on hospital day 1. The fibular fracture was managed non-operatively with a short leg splint. He was discharged home on hospital day 2 in good condition.

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