Ultrasonography Performed by Military Nurses in Combat Operations

A Perspective for the Future?

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ABSTRACT

Introduction: In current French military operations, it is not uncommon for military nurses (MNs) alone to be required to support soldiers in isolated areas. At a time when advanced practice nurses in the civilian sector develop extended skills, we asked MNs about their willingness to be trained in point-of-care ultrasound (POCUS). **Methods:** We conducted a web-based survey from 1 November 2018 to 1 December 2018, including all MNs deployed in Operation Barkhane. The questionnaire, sent by e-mail, aimed to describe the willingness of MNs to be trained in POCUS. Their opinion on the usefulness of this training, the situations, and ultrasound (US) targets that seemed most useful to them were also studied. **Results:** Thirty of 34 questionnaires were completed. On average, MNs had 7.4 years of practice and had been deployed three times for military operations. Five MNs reported having had informal training in clinical US by the military physicians (MPs) they work with and had performed POCUS in real-life situations; 24 (96%) of the untrained MNs wanted to be trained. Twenty-nine (96%) of the MNs felt that there was added value in knowing how to perform POCUS, especially in operations and in isolated posts without an MP. Focused assessment with sonography for trauma and pleural and renal US were the targets considered most useful to them, in that order. **Conclusion:** MNs are interested in learning POCUS and say it would be beneficial for the patient. Available scientific data tend to validate their ability after a brief training course to perform reliable, targeted US examinations in the field.

Keywords: *ultrasonography; military medicine; military nurse*

Introduction

The aim of the military health system on the battlefield is to preserve the fighting force in an austere, resource-scarce environment to accomplish the military objective. The French defense health service is committed to providing emergency and routine health care as close to the operations as possible.

After Operation Serval (11 January 2013 to 31 July 2014), which stopped the jihadist offensive threatening Bamako and put an end to the industrial organization of terrorism that had developed in northern Mali, Operation Barkhane (Appendix 1) took over and has been supporting the armed forces of the Sahel countries (Mauritania, Mali, Burkina Faso, Niger, and Chad) to prevent the reconstitution of terrorist refuge areas in the region since 1 August 2014. At present, it represents the largest French deployment in a foreign operation, with 5,100 soldiers.

The French tactical combat casualty care (TCCC) course allows any combatant, regardless of their employment level, to provide lifesaving skills to render basic medical aid to a trauma casualty. Three types of courses are given: level 1 for all servicemembers, level 2 for combat medics, and level 3 common for MNs and MPs. The course is mandatory before a foreign deployment. In the absence of the MP, the protocolized level 3 French TCCC course allows the MN alone to stabilize a wounded soldier while waiting for the medical evacuation team. It assures the acquisition of a high level of knowledge in traumatology and the practice of specialized medical procedures, such as placing a chest tube, transfusing blood products, and using vasopressive amines.

All MNs follows the same level 3 TCCC course. They are involved in the entire French chain of care for the war-wounded soldier. They provide advanced care in the field, during tactical helicopter medical evacuation to a deployed vital surgery unit, and then during the strategic plane medical evacuation to a metropolitan French military teaching hospital. Those assigned to operational units provide care in forward medical posts as close as possible to the fighting force, paired with an MP or a combat medic.

The tactical helicopter medical evacuation team that ensures the transport from the field to the vital surgery unit includes an MN and an MP, both assigned to operational units. The vital surgery unit is composed of surgeons, anaesthetists, and MNs assigned to military teaching hospitals in France. Finally, following damage-control surgery performed in a deployed vital surgery unit, the strategic plane medical evacuation team overseeing the repatriation of the injured to a military teaching

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hospital is composed of MNs and MPs assigned both to operational units.

In the current arrangement of Operation Barkhane, the doctrine of the French defense health service is to ensure medical support of the fighting unit by a level 3 TCCC course holder when the tactical medical evacuation time to the vital surgery unit is more than 30 minutes. The decision to deploy either an MP–MN pair or an MN alone with a combat medic to support the fighting unit is made by the medical director in agreement with the military unit staff, according to the anticipated duration and intensity of the combat operation. Given the shortage of MPs in the French defense health service, it is not uncommon to see the MN–combat medic pair alone providing the medical support of isolated high-risk combat operations.

For MPs, an additional in-depth training course in tactical US of 3 days is proposed by the French defense health service because its utility in resource-scarce situations can help in making diagnostic, treatment, and evacuation decisions. The recent preliminary results of extended focused assessment with sonography for trauma (e-FAST) performed by medical trainees in combat-like exercise conditions shows its feasibility and its usefulness to guide therapeutic decisions and medical evacuation priorities.[1]

Even though MNs and MPs follow the same level 3 French TCCC course, complementary training on tactical US is not accessible to MNs deployed to foreign operations. At a time when US has become an extension of clinical examination and a validated aid in making medical decisions on the battlefield, we questioned our MNs on their willingness to be trained in clinical US.

Methods

From 1 November 2018 to 1 December 2018, we conducted a descriptive multicenter study through a survey addressed to all French MNs deployed in Operation Barkhane (East and West Zones). The survey was first validated by the medical director of Operation Barkhane, located at the joint theater command post in N'Djamena, Chad (Appendix 2). It was then distributed electronically via the operational intranet. Each MP responsible for a forward medical post (Role 1), vital surgery unit (Role 2), and aeromedical evacuation team received the questionnaire and forwarded it to the MNs under his command. Responses were collected either electronically by return e-mail or in paper form after printing the questionnaire. After 15 days, a reminder e-mail was sent to the medical facilities that had not responded.

After a short explanation of the study objective, the first part of the questionnaire collected demographic data aiming to describe the MN: nursing assignments, years of practice, number of missions, and type of position held during the current mission.

- The second part of the survey was designed to find out
- Their previous clinical US training and their willingness to be trained.
- Their previous clinical US practice.
- Their opinion on the added value of an MN trained in US.
- The US targets they considered most useful to acquire.
- The presence of an US scanner in their MN–MP pair.

The questionnaires were anonymized by a third party, who collected them.

Descriptive statistical analyses were performed by describing numerical variables with means, while categorical variables were described with proportions. All statistical analyses were performed using Microsoft Excel version 16.36. This observational study was exempted from ethics board approval by the French defense health service institutional review board.

Results

Of 34 MNs surveyed, 30 completed the questionnaires. On average, they had 7.4 years of practice and had already carried out three overseas missions of 4 months each. Seventy-three per cent had been assigned to operational units only, 10% to military teaching hospitals only, and 17% to both (Table 1).

TABLE 1 *Demographic Data of the Medical Nurses Surveyed*

Demographic Data	n (%)
Years of practice (average)	7.4 (–)
Assignment in operational units only	25 (74.5%)
Assignment in military teaching hospitals only	4 (12%)
Assignment in both (hospitals, then operational units, or vice versa)	5 (14.5%)
Number of missions accomplished as a medical nurse (average)	3 (–)
Type of position held during the mandate	
Role 1 (forward medical post)	19 (55%)
Role 2 (vital surgery unit)	5 (15%)
Tactical helicopter medical evacuation team	3 (9%)
Strategic plane medical evacuation team	3 (9%)
Special Operations Forces	4 (12%)

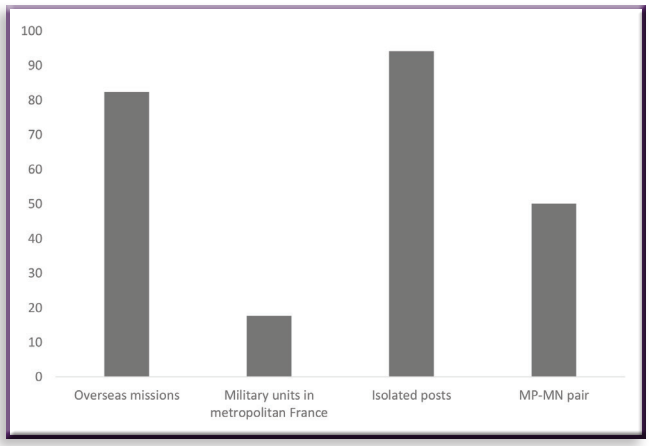
Four MNs assigned to military teaching hospitals reported having had informal training in clinical US by the MPs they work with and had performed focused assessment with sonography for trauma (FAST) examinations in real-life situations, respectively 50, 20, 10, and 2 times. The two most-experienced MNs reported having performed biliary and renal examinations one time each.

One MN assigned to an operational unit reported having had informal training by the MPs of the unit he worked with and had performed three FAST examinations in real-life situations. Three MNs assigned to an operational unit (one in a forward medical post and two in Special Operations Forces) reported having performed, respectively, a FAST and a biliary and a lower extremity deep vein US examination, under the surveillance of the MP they work with, but considered themselves untrained in POCUS.

Ninety-six percent of the untrained MNs were willing to join a specific course. Twenty-nine (96%) of the MNs surveyed felt that there was an added value in knowing how to perform a clinical US, especially in isolated posts without an MP (94%), in overseas missions (82%) rather than in operational units in metropolitan France (17%), and in the MN–MP pair (50%) (Figure 1).

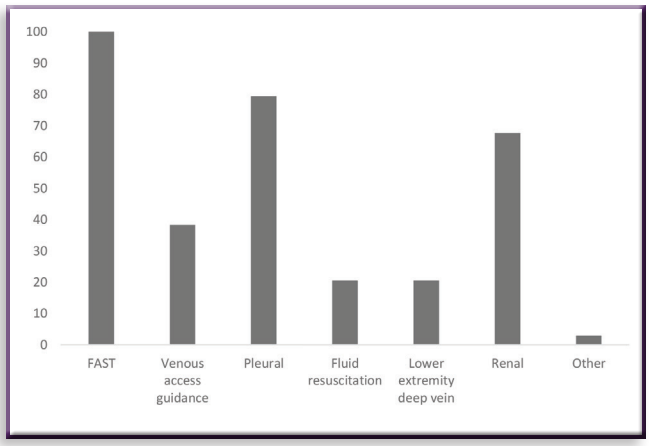
In order of importance, targets considered most useful to the MNs were the FAST (100%) and the pleural (79%) and renal (67%) examinations, followed by venous access guidance

FIGURE 1 *Added value situations for POCUS performed by military nurses.*



POCUS, point-of-care ultrasound.

FIGURE 2 *Useful ultrasound targets according to the military nurses surveyed.*



FAST, focused assessment with sonography for trauma.

(38%), fluid resuscitation evaluation (20%), and lower extremity deep vein examination (20%). One MN thought that hepatic examination could be useful (Figure 2). Ninety percent of MN–MP pairs were already equipped with US scanners in Operation Barkhane.

Discussion

Most of the MNs surveyed in our study had a meaningful experience during foreign deployment and are assigned in operational units. However, of the five MNs trained in POCUS, four practiced in military teaching hospitals and only one was assigned to an operational unit. We can assume that MNs practicing in hospitals and therefore in a vital surgery unit when they are in foreign operations are more likely to be trained in POCUS, given their integration into the team composed of a surgeon and an anesthetist, who can be considered expert in POCUS, based on their daily practice. Unfortunately, the MNs most likely to find themselves isolated without an MP are those in operational units and with lack of training in POCUS.

Our survey shows that they recognize the usefulness of US in deteriorated situations and would like to be trained to improve the management of their patients. They think it would be useful for them to be able to carry out certain targeted examinations following dedicated training. The level 3 French TCCC course allows them to perform forward advanced resuscitation procedures and to manage the medical evacuation of an injured soldier without the presence of an MP. In view of the autonomy conferred to MNs by this course, we should give them all the point-of-care imaging tools available to perform high-quality resuscitation up front. Given the accessibility of US scanners in foreign operations, implementing a standardized specific US course as a priority to our operational units' MNs is a path we seriously need to consider.

Cazes et al.[2] assessed the number of US examinations required to perform reliable diagnoses on 10 novice military generalist practitioners without previous experience during their residency. After 2 hours of theoretical training, a minimum of 30 FAST and 20 pleural examinations were sufficient to ensure optimal performance.

The FAST examination is recognized as the most useful target the MNs surveyed wanted to acquire. The basic examination includes the upper right and left abdomen, cardiac, and pelvic views. This first-line imaging assesses for intrathoracic and intra-abdominal traumatic injury, providing information for guiding triage, treatment, and evacuation priorities.

In a civilian setting, Bowra et al.[3] assessed the accuracy of a nurse-performed FAST examination for the detection of free fluid in the peritoneal cavity and pericardial space in patients brought to the emergency department following trauma, after a 1-day training course and a minimum of 25 supervised validated scans. The results are encouraging, with an overall accuracy of 95%, similar to physicians' performance. In a military setting, Monti et al.[4] showed that a 4-hour introductory e-FAST training intervention among US-naïve U.S. military medics allows them to perform as well as previously trained emergency medicine physicians.

The pleural US examination considered as their secondary target by the MNs presents a real added value in the noisy environment of a battlefield, where physical examination is limited and radiography often unavailable, to provide early diagnosis of a tension pneumothorax and/or hemothorax. In various civilian and military studies, the ability of nonphysicians to perform and interpret pleural US examination shows high levels of sensitivity and specificity.[5–7]

As for other US targets, they are of interest in the diagnosis of pathologies or trauma caused by the operational constraints. They can assist the MN located in a remote position in making therapeutic and evacuation decisions in conjunction with teleconsultation or predefined protocols. Renal US assesses for hydronephrosis indicative of ureterolithiasis, often seen with dehydration in a hot climate; fluid resuscitation evaluation allows one to estimate the intravascular volume status and guide the need for fluid administration; and finally, lower extremity deep vein examination permits the diagnosis of thrombosis related to prolonged sitting in convoys. Evidence from the available studies points out the ability and accuracy of nonphysicians to perform these specific US examinations.[8–11]

Because combat medics are paired with MNs, it would have been interesting to know whether their opinion mirrored that of the nurses. In the study by Morgan et al[12], 29 Special Forces medical sergeants performed 109 US examinations in a 1-year deployment, following an average of 16.7 hours of

didactic training and 8 to 52 hours of practical training over 2 years. More than half of the US examinations performed in the field by combat medics were musculoskeletal, assessing for fractures (39/109) and soft-tissue applications (22/109) to discriminate abscesses, cellulitis, and foreign bodies in wounds. None of the MNs surveyed during our study mentioned their interest in acquiring these two applications, probably because of the lack of information on US use in these pathologies. On the other hand, FAST and e-FAST examinations were the second-highest frequency examinations performed (34/109), matching the desire of our MNs to acquire the technique. That encouraging experience led the US MPs to develop a 24-hour curriculum of didactic and hands-on US training for Special Operations medics: the Special Operator Level Clinical Ultrasound (SOLCUS).

Our study has some limitations. First, it would have been preferable to have a larger sample to gather additional feedback and give more power to our survey. Second, our survey was distributed to the MNs by their head physicians and thus could be prone to bias from their encouraging participation or input on answers. Unfortunately, the lack of access to an intranet network for the MNs deployed in far-forward locations made an unmediated exchange impossible.

Conclusion

MN use of US is already occurring in an operational environment, although our study shows that 96% of French MNs surveyed deployed in Operation Barkhane are not formally trained in POCUS. They believe that there is an added value in knowing how to perform focused assessment with sonography for trauma and pleural and renal US examinations to improve the management of their patients, especially in foreign deployments and in isolated posts without an MP. MNs working in forward medical posts, who are more likely to be left to their own devices, lack training in POCUS compared with MNs assigned to vital surgery units. Scientific data available tend to validate their ability to perform reliable targeted US examinations in the field after a brief training course. Consideration should be given to adapting and opening the complementary course on tactical US for MNs during their level 3 TCCC course to ensure acquisition of quick and practical US targets. Brief US theoretical training and practical examinations under the supervision of experienced physicians could also be included in military nursing studies. Doing this could be a step toward the training of an upskilled workforce qualified in advanced practice, even though this new concept requires further work to define their operational role within military prehospital care.[13]

Key Messages

- Ninety-six percent of the MNs surveyed are willing to be trained in POCUS, especially in overseas missions and isolated posts without a physician.
- Ultrasound targets they consider most useful to acquire are FAST, pleural, and renal examinations.
- Evidence from civilian and military studies point out the ability and accuracy of nonphysicians to perform ultrasound examinations after a short training course.
- Including POCUS training in the MNs' curriculum should be useful to improve the management of patients in deteriorated situations.

Disclaimer

The views expressed are solely those of the authors and do not reflect the official policy or position of the French Armed Forces.

Ethics Approval

This observational study was waived from ethics board approval.

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Conflicts of Interest

All authors declare no conflicts of interest

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APPENDIX 1

Nurse and Point-of-Care Ultrasound

The aim of this survey is to find out the opinion of military nurses deployed in military operations (all posts and all experience) on the use of point-of-care ultrasound (POCUS) by nurses. The POCUS corresponds to an ultrasound performed at the patient's location (in the field, in a helicopter or CASA flight, in a role 1 treatment room . . .) by a non-radiologist doctor (unit doctor, emergency doctor, resuscitator . . .) aiming to answer a simple binary question (YES/NO) such as the search for free fluid in peritoneal and pericardial space after a trauma (FAST examination).

After a short description of your nursing career, you are asked 5 questions: circle the correct answers. There may be multiple answers. Do not hesitate to write down what you think or your questions, if you have any, at the end of the questionnaire.

Dr. XXXXXXXXXXXX

Initials (First Name-Last name): _____ Year of 1st assignment (civilian or military): _____

Curriculum (circle the answer): Military units only Military teaching hospital only Both

Number of missions as a nurse: _____

Position held during this mandate (role 1/2, aeromedical evacuation team, special unit): _____

1. Are you trained in POCUS? YES NO
   - If NO, would you like to be trained? YES NO
   - If NO, why?
2. Have you ever performed an ultrasound examination alone? YES NO
   - If YES :
     - ☐ In real life or in simulation?
     - ☐ Number ultrasound examinations performed.
     - ☐ Type of target(s) acquired (FAST, biliary, renal examination…?)
3. Do you think that a nurse trained in POCUS can have an added value in the management of a patient? YES NO
   - If YES (tick the proposal(s) you agree with):
     - ☐ In missions (I the field, role 1 or 2)?
     - ☐ In military units in metropolitan France?
     - ☐ In isolated posts without a physician?
     - ☐ In a physician-nurse pair?
4. What type(s) of ultrasound acquisition do you think would be most useful to you:
   - ☐ FAST (search for free fluid in peritoneal and pericardial space)
   - ☐ Venous access guidance
   - ☐ Pleural ultrasound (search of a pneumothorax and/or hemothorax)
   - ☐ Resuscitation evaluation/ Cardiac and inferior vena cava ultrasound (intravascular volume evaluation to guide fluid resuscitation)
   - ☐ Lower extremity deep vein examination (search for thrombosis)
   - ☐ Renal examination (search for kidney stones, urinary globe)?
   - ☐ Other?
5. Is your physician-nurse pair equipped with US scanners? YES NO

Comments / Questions:

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THANK YOU FOR YOUR PARTICIPATION