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The Clinical and Technical Evaluation of a Remote Telementored Telesonography System During the Acute Resuscitation and Transfer of the Injured Patient

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Background: Ultrasound (US) has an ever increasing scope in the evaluation of trauma, but relies greatly on operator experience. NASA has refined telesongraphy (TS) protocols for traumatic injury, especially in reference to mentoring inexperienced users. We hypothesized that such TS might benefit remote terrestrial caregivers. We thus explored using real-time US and video communication between a remote (Banff) and central (Calgary) site during acute trauma resuscitations.

Methods: A existing internet link, allowing bidirectional videoconferencing and unidirectional US transmission was used between the Banff and Calgary ERs. Protocols to direct or observe an extended focused assessment with sonography for trauma (EFAST) were adapted from NASA algorithms. A call rota was established. Technical feasibility was ascertained through review of completed checklists. Involved personnel were interviewed with a semistructured interview.

Results: In addition to three normal volunteers, 20 acute clinical examinations were completed. Technical challenges requiring solution included initiating US; audio and video communications; image freezing; and US transmission delays. FAST exams were completed in all cases and EFASTs in 14. The critical anatomic features of a diagnostic examination were identified in 98% of all FAST exams and a 100% of all EFASTs that were attempted. Enhancement of clinical care included confirmation of five cases of hemoperitoneum and two pneumothoraces (PTXs), as well as educational benefits. Remote personnel were appreciative of the remote direction particularly when instructions were given sequentially in simple, nontechnical language.

Conclusions: The remote real-time guidance or observation of an EFAST using TS appears feasible. Most technical problems were quickly overcome. Further evaluation of this approach and technology is warranted in more remote settings with less experienced personnel.

Key Words: Telemedicine, Teleultrasound, Traumatic injury, Resuscitation, Critical care.

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The use of ultrasound (US) to make diagnoses and to facilitate the safe conduct of medical procedures has become routine in most if not all disciplines of medicine. Both the generation and interpretation of US images are user dependant; however, without the presence of a trained operator, many geographically or socially isolated patients are disadvantaged in being without US services. This lack of access has driven many initiatives to provide US services to remotely located patients who subsequently have their images interpreted by a geographically separate subject matter expert, an activity recognized as telesonography (TS) or tele-US.[1,2] To date, this service has largely been directed toward chronic or subacute medical conditions, as the logistics in providing an immediate acute TS examination are great.[3,4] This is unfortunate, as the acutely injured patient who is at a great risk of dying or being permanently impaired, is one who has to much potentially gain from this service. Injury constitutes the leading causes of death among people 15 to 44 years of age in developed countries, and remains a leading cause of death in the low and middle income countries where infectious disease are predominant.[5] Posttraumatic mortality risks are greatly magnified by remoteness from tertiary care; rural trauma mortality may be 50% greater than in urban settings.[6,7]

The problems of limited medical resources and remote location are no more extreme than aboard the International Space Station. As there is a capable clinical US machine onboard though, the National Aeronautics and Space Administration (NASA) has led the practice of remote telesonogra-

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phy by developing and testing protocols to facilitate the potential diagnosis of emergency conditions using remote US experts directing local less-trained operators.[8–11] Terrestrially, while telemedicine has been used for trauma, reported experience has largely concerned minor injuries or for follow-up care.[12–15] Further, although tele-US has been used to support care in remote areas,[16,17] it has not been specifically reported for the acute resuscitation of major traumatic injury. We thus describe the development of a pilot project to communicate real-time resuscitative EFAST examinations between a rural referral center and a tertiary care receiving center.

METHODS

The Calgary Health Region (CHR) provides virtually all acute hospital care to the residents of the City of Calgary and a large surrounding area (population 1.2 million) in the Province of Alberta, Canada. Adult tertiary and quaternary level trauma care in the CHR is regionalized to a single site, the Foothills Medical Centre (FMC). The Banff Mineral Springs Hospital (BMSH) is a community hospital, located in Banff, Alberta, that provides integrated prehospital and specialty in-hospital services to Banff National Park and adjacent regions of eastern British Columbia. As BMSH services numerous recreational mountain resorts and treacherous mountain portions of the Trans-Canada Highway, this facility is regularly faced with severe multisystem trauma that requires transfer to definitive care at FMC. The BMSH refers the second greatest caseload of major trauma cases (Injury Severity Score >12) of all the referring hospitals in Southern Alberta, despite having one tenth the acute care beds of the largest referral center. All seriously ill or injured patients from the CHRs catchment area are currently referred through a single coordination center, the Southern Alberta Regional Coordination Centre (SARCC) which maintains a telephone hotline and arranges urgent conference calls between all appropriate physicians to facilitate the safe transport of the critically ill and injured. When a seriously injured patient is to be referred from BMSH to FMC, an teleconference involving the spoken word only will analyze the mode and details of the patient transport which may involve either air or ground transport as deemed appropriate.

To evaluate the effectiveness and practicality of using real-time tele-US during the acute resuscitation of trauma, bidirectional videoconferencing technology was installed in both the trauma resuscitation room of the BMSH and the telemedicine room of FMC. The digital output of a clinical ultrasound machine (Sonix OP, Ultrasonix Corporation, Richmond, BC) located in the resuscitation suite at BMSH
F1 (Fig. 1) was directed to a viewing station at FMC that per-
F2 mitted both videoconferencing (Fig. 2) and viewing of the
F3 Banff ultrasound output (Fig. 3). This system used a high-definition audio conference phone with two high definition pan/tilt/zoom cameras (Lifesize Corporation, Austin, TX). A "Room" unit as used in Calgary and a "TEAM" unit in Banff.

Fig. 1. *Resuscitation room in the Banff Mineral Springs Hospital illustrating ultrasound equipment and videoconferencing screen.*

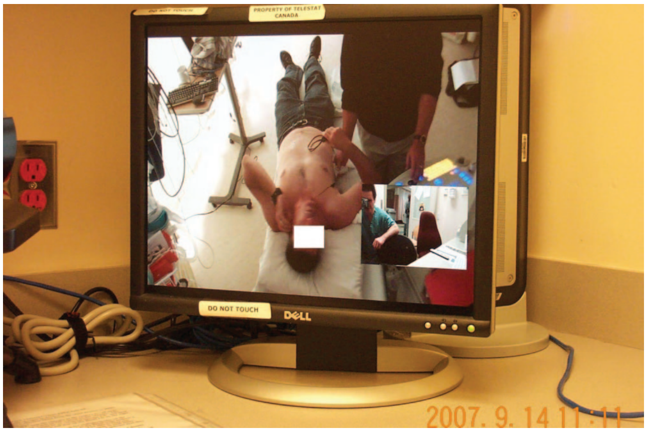

Fig. 2. *Videoconferencing room in the emergency department at the Foothills Medical Centre illustrating videoconferencing equipment and macroscopic view of a simulated patient in Banff.*

Fig. 3. *Videoconferencing room in the emergency department at the Foothills Medical Centre illustrating videoconferencing equipment and ultrasound video monitor.*

The BHSH resuscitation procedure was viewed on a flat panel TFT active matrix video monitor (1905 FP, Dell Computers) and the tele-US images were viewed on 20-inch flat LCD video-monitor (iMAC A1076 Apple Computers, Cupertino, CA). The teleconferencing system was configured to add delay to the IP packets (270 ms one way) and throttled to a bandwidth of 2 Mbps to mimic a satellite DVB-RCS system using commercially available software (Tornado, Packet-Storm Communications, Eatontown, NJ).

A clinical rotation was developed involving interested trauma surgeons and emergency physicians at FMC to prospectively test the system. When an appropriate patient suspected of having potentially sustained traumatic multisystem injuries was assessed at BMSH, the on-call Foothills Medical Centre Physician (FMCP) was activated as was the principle investigator (A.W.K.) to provide a potential dual FMC response. Inclusion criteria for a tele-evaluation were (i) 18 years of age or older; (ii) presenting to BMSH with a traumatic injury; and (iii) judged by the BMSH Emergency Department physician to have an injury sufficiently serious as to warrant hospital admission. Exclusion criteria were (1) severely injured patients for whom transfer to the Level I trauma center was already waiting and (2) unstable patients who required urgent procedures or interventions. The study was approved by the Conjoint Health Research Ethics Board at the University of Calgary.

Ultrasound Examination Protocol

After a request for consultation was initiated, the on-call FMC clinician reported immediately to the telemedicine room, and initiated a bidirectional video conference call with the BMSH resuscitative suit. After confirming bidirectional voice and audio communication with the Banff Mineral Springs Clinician (BMSC), the patient's clinical history and demographics were recorded by the FMCP. A tele-US examination was thereafter conducted according to the preanalyzed
F4 checklist (Fig. 4). The essential sonographic landmarks were based on consensus guidelines for the FAST examination[18] and original description of the EFAST.[19] Although all patients at BMSH were attended to by a licensed physician, the remote tele-US examinations were performed by a variety of physicians, residents in training, and students. Depending on the comfort level of the remote clinician, the examination consisted of (a) a telementored session with the FMCP directing the BMSC in a step by step fashion or (b) a telesonographic session wherein the BMSC illustrated each step in the checklist to the satisfaction of the FMCP.

Each FMCP remotely supervising a TS examination completed the evaluative checklist and was encouraged to dictate a full report of the interaction. Involved BMSCs were interviewed by a research coordinator and both quantitative and qualitative evaluations of the opinions regarding the TS examination were recorded.

Patient Name: ______________________ Patient Number: ______________

Date & Time of Transmission: ____________________ / ________________

Clinical/Technology Evaluation

1) **Pericardial space**
- Y□N□NA□ Appropriate gain settings to display fluid?
- Y□N□NA□ IND□ Pericardial Effusion

2) **Right upper quadrant**
- Y□N□NA□ Interface between liver and kidney is well identified?
- Y□N□NA□ IND□ Abdominal free fluid detected?
- Y□N□NA□ Diaphragm identified?
- Y□N□NA□ IND□ Pleural effusion identified: If IND, why? ________________

3) **Cardiac Activity:**
- Y□N□NA□ Heart beating?
- Y□N□NA□ Heart beating vigorously?
- Y□N□NA□ IND□ Absent or indeterminate? If IND, why? ________________

4) **Left upper quadrant**
- Y□N□NA□ Interface between spleen & kidney well seen?
- Y□N□NA□ IND□ Free fluid detected?
- Y□N□NA□ Diaphragm identified?
- Y□N□NA□ IND□ Pleural effusion identified: If IND, why? ________________

5) **Pelvis**
- Y□N□NA□ Urine in bladder and bladder wall detected?
- Y□N□NA□ Presence of Foley catheter confirmed?
- Y□N□NA□ IND□ Free fluid around the bladder detected? : If IND, why?__________

6) **Left Lung field**
- Y□N□NA□ pleural sliding seen in 2nd intercostal space mid-clavicular line?
- Y□N□NA□ pleural sliding seen in 4-5th intercostals space anterior-axillary line?
- Y□N□NA□ moving comet-tail artifacts seen in 2nd intercostal space mid-clavicular line?
- Y□N□NA□ moving comet-tails seen in 4-5th intercostals space anterior-axillary line?

7) **Right lung field**
- Y□N□NA□ pleural sliding seen in 2nd intercostal space mid-clavicular line?
- Y□N□NA□ pleural sliding seen in 4-5th intercostals space anterior-axillary line?
- Y□N□NA□ moving comet-tail artifacts seen in 2nd intercostal space mid-clavicular line?
- Y□N□NA□ moving comet-tails seen in 4-5th intercostals space anterior-axillary line?

Fig. 4. *Checklist for remote telesonographic examination.*

RESULTS

Quantitative Results

Twenty-three tele-US examinations were completed; 20 during acute trauma resuscitations and 3 during live patient demonstrations. Seventeen separate BMSH clinicians conducted the US examinations. Despite a robust FMC call schedule, FMCP role was fulfilled by an FMC ER physician on five occasions, and the remainder were performed by 2 trauma surgeons with 1 supervising one examination and the other 17. Technically, the FMCP were able to remotely discern 98% (86/88) of the cardinal FAST sonographic landmarks, and 100% (33/33) of the cardinal EFAST landmarks (Tables 1 and 2), in which they were sought. In one case in T1–2,AQ which the patient was hemodynamically unstable, the FAST was limited to confirming the presence of obvious of fluid in Morrison's pouch and the remainder of the FAST sites were

Table 1 Rate of Adequate Visualization of Cardinal FAST Locations

Location	Well Visualized (%)	Not Well Visualized (%)
Pericardial	95 (20/21)	5
Morrison's pouch	100 (23/23)	0
Left-upper quadrant	95 (21/22)	5
Bladder	100 (22/22)	0

Banff-Calgary Acute Trauma Telesonography Project—FAST Exam.

Exams: clinical 20, simulated 3.

Table 2 Rate of Adequate Visualization of Cardinal EFAST Locations

Location	Well Visualized (%)	Not Well Visualized (%)
Right 2nd intercostal space	100 (17/17)	0
Right 4th intercostal space	100 (17/17)	0
Left 2nd intercostal space	100 (16/16)	0
Left 4th intercostal space	100 (16/16)	0

Banff-Calgary Acute Trauma Telesonography Project—EFAST Exam.

Exams: clinical 15, simulated 2.

not examined due to time constrictions. The complete FAST examination was completed in all other cases. There were five positive diagnoses of intraperitoneal fluid and three indeterminate clinical examinations. All positive diagnoses were confirmed with either CT or laparotomy. In all indeterminate cases, follow-up CT scanning was recommended which confirmed significant injuries requiring hospitalization in two, with one patient signing out against medical advice. In two cases, time pressures precluded spending long enough to adequately mentor a less experienced user through the generation of useful images from the pericardial sac and splenorenal interface, respectively. These were considered incomplete examinations in terms of generating useable images (Table 1). There were no known false-negative or false-positive diagnoses. EFAST examinations were completed and diagnostic in all cases performed, although in five cases either the remote examiner was not experienced with EFAST, time precluded examination, or a live volunteer precluded full thoracic exposure, and thus a thoracic examination was not completed. Two PTXs were detected on the basis of absent lung sliding and absent comet-tail artifacts.[19]

Illustrative Results

Specific cases are both illustrative and novel, constituting the first reported examples of these techniques to our knowledge. A 19-year old man presented to BMSH after a high speed skiing collision. He was hemodynamically stable but complained upper abdominal pain. The BMSC had never used the telesonography system before, had only minimal comfort with the FAST, and none with the EFAST. Being telementored by the FMCP, a complete FAST was completed, yielding a positive diagnosis in free intraperitoneal
F5 fluid (Fig. 5), prompting immediate referral to tertiary care, rather than to a secondary center for further imaging. Another case involved a 24-year old man injured after a snowboarding fall. He presented to BMSH hemodynamically stable but with right-sided thoracoabdominal pain. Although the BMSC was a first time user, there were technical problems involving setting the appropriate gain; the EFAST examination confirmed the presence of a subtle pneumothorax. This reinforced the rationale to place a tube thoracostomy before transfer to definitive care. Finally, a 30-year old woman was crushed by a falling tree and was brought to BMSH, hemodynamically unstable. Use of the videoconferencing system allowed immediate consultation between the resuscitating physicians at BMSH and the receiving team of trauma surgeons, critical care physicians, and neurosurgeons. The tele-US system demonstrated both a pneumothorax requiring chest tube placement, as well as an obviously positive FAST examination that mandated a direct admission to the operating room of the FMC, bypassing the emergency department as she was hemodynamically unstable.

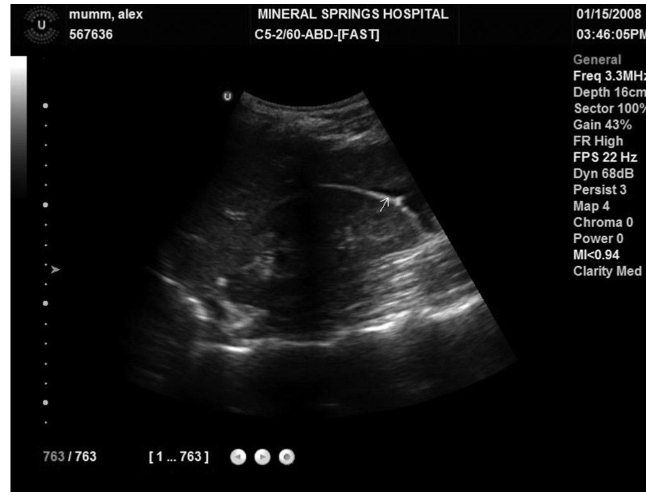

Fig. 5. *Ultrasound image demonstrating free intraperitoneal fluid between the liver and kidney in acutely injured snowboarder.*

Qualitative Results

Despite the initial utilization of direct videoconferencing over an internet connection rather than by satellite transmission, many of the initial tele-US sessions were complicated by delayed sonographic image transition and image freezing, faulty audio, and faulty video transmissions. With experience and technical input, these obstacles were quickly overcome so that there were no technical concerns with the last seven cases, and the time delay of 1 to 2 seconds was perceived by the remote reviewers as real-time motion. Because of the number of involved clinicians, the BMSCs were frequently inexperienced with the telesonography system, and were thus using the equipment for the first time during a clinical encounter. This precluded detailed practice and rehearsal of the ultrasound telementoring protocols and didactic materials that were available from NASA. Nevertheless, all examinations were completed. The BMSCs were appreciative of the remote direction particularly when instructions were given sequentially in simple, nontechnical language. Although the system was initiated for the primary purpose of facilitating telesonography, the two way videoconferencing allowed the receiving surgeons to both involve themselves at an early stage of the case, and to provide guidance and advice to the resuscitating physicians at BMSH. For example, early involvement by teleconference with the on-call neurosurgery resident confirmed the need to administer mannitol for a nonreactive dilated pupil in a severe head injury. Overall, the respondents universally were satisfied with this technology and perceived that it would be of use in remote communities. Residents in training and medical students seemed particularly satisfied with the experience and felt it advanced their skills. Although not formally measured, the general perception was that the project also improved the feeling of collegiality between BMSH and FMC.

DISCUSSION

Ultrasound is one of the most widely used diagnostic imaging modalities throughout the world.[20] Its scope encompasses a large array of medical and surgical conditions. In many remote and operational settings, sonography constitutes the only potential imaging modality. Numerous investigations have highlighted the accuracy of US in the detection of injuries[18,19,21–23] and have explored the utility in a rural hospital without advanced imaging or on-site surgical capability.[24] Studies have shown that non-radiologist operators can reliably perform a number of focused US examinations to facilitate on-site diagnosis.[25] US has several additional advantages: new handheld units are portable; a trauma screening examination can be performed quickly; no contrast materials need to be administered; and it is safe for patients who are pregnant, have a coagulopathy, or have had previous abdominal surgery.[26]

Providing medical care remotely is defined as telemedicine, and the practice is as old as the telephone. The transmission of diagnostic imaging is an important part of telemedicine. During the evaluation of an accident and emergency network in Scotland, 87% of calls were associated with the transmission of radiographic images.[27] Thus, given the myriad of uses that US can be applied to it is logical that telesonography, wherein a patient might benefit from an examination, but where an expert sonographer is not present, should be explored. To date, most empirical studies have focused on fetal ultrasound (i.e., routine prenatal ultrasound), and in most cases the person performing the US has been a trained operator (e.g., ultrasound technician or general practitioner) guided by a specialist (e.g., maternal fetal specialist or perinatologist). For example, Reddy et al. assessed the "teleobstetric ultrasonography services" from an urban tertiary care center in St. John's, Newfoundland to a remote site 200 km away. Forty-nine women were first examined at the remote site by a "trained technologist," supervised by a radiologist at the tertiary center. They then traveled to the tertiary center where they were directly examined by a different radiologist (who was blinded to the results of the previous examination). The technical quality of the transmitted images was reported to be excellent, and all four fetal abnormalities were detected and reported identically on both examinations. Studies from Australia,[2,28] United Kingdom,[29,30] and United States[31,32] similarly concluded that teleguided fetal ultrasound was technically feasible and clinically useful.

Deriving useful clinical information from US requires a two-step process; first generating an image, and second interpreting it. Given the robustness of current information technologies, the current clinically limiting step is image generation. Having a trained but nonclinical ultrasound technologist is also not a real solution for the majority of acute clinical interactions wherein clinicians are called upon to provide resuscitative care. Therefore, a number of technical solutions to the dilemma of how to generate meaningful images without the presence of an experienced ultrasonographer are currently being developed. The potential solutions involve (a) robotic tele-US; (b) three-dimensional acquisition by less trained users with remote interpretation of volume-gathered data; or (c) telementoring of a less experienced remote colleague to generate images that are interpretable to the naked eye.

Fully robotic tele-US systems have been developed and trialed in subacute or chronic care situations. At present though, these systems still required a semitrained assist at the patient-site and are somewhat unwieldy and may have difficulty assessing the lateral surfaces of the abdomen and the spleen and kidneys,[33,34] noting that fluid detection during the standard FAST examination is extremely gravitationally dependant.[35] Another technological approach has examined using a three-dimensional US reconstruction to improve the information content of images to be transmitted and interpreted at a distant as a means of increasing the diagnostic confidence.[36,37] However, to date there are no published results regarding the benefits of either of these techniques in acute trauma resuscitation.

The third practical technique, as used in this study, has been to generate diagnostic quality images from a remote medical interaction using a less than expert care provider using telementored remote US. Early experience with simulated trauma encounters using normal volunteers and chronically ill patients demonstrated that medically useful images are possible with combinations of wireless and satellite image transmission.[38,39] This technique has actually been greatly advanced, however, by investigators from the NASA who are faced with the situation where US is the only imaging modality currently available on the International Space Station (ISS).[9–11,35] Although there are rarely clinically current physicians in space, there are a myriad of potential illnesses and acute conditions that might have to be diagnosed, with ultrasound being the only potential imaging technique that might assist. The concept of remote guidance of untrained ultrasound operators was initially met with some skepticism. However, recent studies performed by the ISS have demonstrated the ability to acquire diagnostic quality real-time US images from nonmedical ultrasound operators.[9–11] The video signal from the ultrasound system on the ISS was transmitted to Mission Control by a nonmedical astronaut on orbit who was guided by a radiologist observing the images as they arrived real-time. To date, almost all regions of the human body have been studied from space using this technique. This concept was further proven during the Winter Olympics where nonmedical athletic trainers in Italy were guided through an ultrasound examination, via the internet, by experts located in the Henry Ford Hospital in Detroit.[8] Several athletes received treatment and returned to win medals after their case was discussed by experts in the Unites States. This versatile technique as it takes advantage of all the attributes of a dedicated if nonexpert human that include dedication to completing the task, real-time learning, and the ability to respond to direction and corrective feedback.

Remotely guided US, with minimally trained operators performing diagnostic quality examinations, is likely also to have applications in emergency and rural medicine. With the ability to transmit real-time video from a remote location via satellite, remotely guided ultrasound could be used to provide preventive medicine or help diagnose illness or injury using nonmedical personnel. When a life-threatening injury is anticipated on the basis of the clinical setting such as a distended abdomen with hypotension, or chest pain with shortness of breath after trauma, ultrasound can confirm that the site of major hemorrhage is intraperitoneal or confirm that a pneumothorax is present in seconds if the examiner knows what to look for or is directed at what to look for.[19,22,40,41] The concept has very broad applicability with significant advantages in terms of advancing health care to the Northern regions of Canada.

We found that a tele-US examination could be transmitted and readily interpreted by remote mentoring physicians. Our study had a varied skill level of remote clinicians. When physicians experienced in the FAST ultrasound were in Banff, they could quickly demonstrate the salient points of our checklist to the receiving physicians. When less experienced clinicians or operators were transmitting images, the Calgary physicians were able to telementor the remote users without undo difficulty.

PTXs are the most common serious intrathoracic injury after blunt trauma,[42,43] and a notable cause of preventable death for which relatively simple interventions may be life-saving.[43–46] Our previous initiatives found that the greatest potential improvements with acute trauma teleradiology concerned thoracic trauma and radiologic abnormalities.[47] In this current study, there were no remote users who had more than limited experience with the EFAST, with most having never performed one before. Despite this, the cardinal anatomic feature of emergency thoracic sonography, lung sliding, was identified in all normal cases. We thus found telesonography to be an effective tool that enabled all remote users to quickly learn the most basic steps of emergency thoracic sonography.

Obvious limitations of this study are that it was solely intended as a pilot study and extensive numbers of patients have not been imaged to date. Because of the large number and irregular scheduling of both FMC and BMSH clinicians, as well as the unpredictable nature of trauma occurrences it was impossible to train and familiarize all involved in the communication technology before actual use. This meant that BMSCs were frequently using the system for the first time during an actual TS examination. There was also often pressure of time, with many other conflicting demands upon the caregivers time. The fact that all examinations were complete, though, seems to imply a dedication and willingness to use this technology. Considering all the factors, this pilot therefore more realistically addresses issues of effectiveness, rather than efficacy and sustainability. Because it was difficult to provide immediate responses from the FMCP group to supervise US examinations around the clock, future initiatives will be intended to involve experienced Trauma Fellows in training as well as educating further numbers of FMCPs to consider this activity as an enhancement of the expected regional trauma outreach service, that is currently limited to a telephone conversation. We recognize that just as bedside focused sonography is ideally incorporated into the overall clinical examination,[21,48] that telesonography should be incorporated into the overall telemedical interaction. Although we observed dramatic examples of the adjunctive videoconferencing equipment assisting in the overall assessment and treatment plan formulation of the critically ill, this was not the focus of the study or formally studied. We do intend to address these issues with future study though.

Finally, tele-US has been previously noted to have high start-up costs, and to involve a high cost per patient, prompting recommendations to attempt to use the service for multiple indications if possible.[49] We greatly agree with these sentiments and hope to extend both the scope of our project and the involvement of other specialties as appropriate for the clinical need of the remote patient. Even when mature though, telesonography typically involves real-time moving ultrasound images represents a technical challenge involving high band-widths and high costs.[1] The goal of our project was to study the techniques that will be required to allow remote telesonography to be generalized to other even more remote settings. In this regard, Canadians may be fortunate that the Canadian Space Agency has dedicated bandwidth related to the use of the Anik F2 telecommunications satellite reserved solely for use in the Canadian Artic.

CONCLUSION

Using remote acute resuscitative US to augment real-time videoconferencing during acute trauma care was found to be technically and clinically feasible. Remote experts were able to identify the salient anatomic features of both the FAST and EFAST examinations in nearly all instances. The technology also enhanced ultrasound education of less experienced users and occasionally facilitated important clinical management decisions. Further study should continue with this technology to examine questions regarding generalizability, the role of minimally trained users faced with critical clinical decisions, sustainability, and cost-effectiveness.

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AUTHOR QUERIES

AUTHOR PLEASE ANSWER ALL QUERIES 1

AQ1— Kindly check whether the short title is OK as given.

AQ2— Kindly check whether Tables 1 and 2 are OK as edited.

AQ3— Kindly update Ref. 41 (if possible).