User's perceptions of remote trauma telesonography

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Summary

We established a pilot tele-ultrasound system between a rural referring hospital and a tertiary care trauma centre to facilitate telementoring during acute trauma resuscitations. Over a 12-month period, 23 tele-ultrasound examinations were completed. The clinical protocol examined both the Focused Assessment with Sonography for Trauma (FAST) and the Extended FAST (EFAST) for pneumothoraxes. Twenty of the examinations were conducted during acute trauma resuscitations and three during live patient simulations. FAST examinations were completed in all 23 cases and EFAST examinations in 17 cases. There were 18 clinical users, of whom 14 completed a survey (76% response rate). Overall, 93% of respondents were either satisfied or very satisfied with the telemedicine interaction and agreed or strongly agreed that the technology could potentially benefit injured patients in the far north of Canada. In addition, 93% of the respondents felt that the project had improved collegiality between the two institutions involved. The majority of respondents (71%) agreed or strongly agreed that the project had improved their ultrasound skills. We believe that as further experience is obtained, tele-ultrasound will prove to be an important aid to the care of remotely injured and ill patients.

Introduction

The use of ultrasound has become commonplace in many aspects of medical care, and an established component of many physical examinations.[1] As the images can be transmitted, they can be interpreted by a remotely-located expert, i.e. the process of telesonography.[2,3] To date, telesonography has been directed mainly towards chronic or sub-acute medical conditions due to the complex logistics required to provide an immediate tele-ultrasound examination.[4,5]

During the initial assessment of acutely injured patients, ultrasound can confirm or refute clinical diagnoses and assist in the safer performance of invasive procedures. We recently initiated a telemedicine link between a remote resuscitating hospital and the emergency department of our trauma referral centre. The receiving physicians were able to view the ultrasound images generated in the trauma bay and to mentor the remote clinician by videoconference. In order to evaluate the acceptability of this approach, we surveyed the clinical users regarding their perceptions of the tele-ultrasound system.

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Tele-ultrasound system

The Banff Mineral Springs Hospital (BMSH) is a community hospital that provides integrated pre-hospital and specialty in-hospital services to the Banff National Park and adjacent regions of eastern British Columbia. Adult tertiary and quaternary level trauma care in the Calgary Health Region is provided on a single site, the Foothills Medical Centre (FMC) in the city of Calgary, which is the referral centre for the BMSH. Because the BMSH services numerous recreational mountain resorts and treacherous mountain portions of the Trans-Canada Highway, it regularly manages severe multi-system trauma cases that require transfer to the FMC for definitive care. In good conditions, travel times are 75 min by ground and 35 min by air.

The digital output of a clinical ultrasound machine (Sonix OP, Ultrasonix Corporation, Richmond, BC) located in the

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Figure 1 Resuscitation room at the Banff Mineral Springs Hospital

resuscitation suite at the BMSH was transmitted to a viewing station at the FMC. This permitted both ordinary videoconferencing and viewing of the Banff ultrasound images. The system used commercial videoconferencing units from the same manufacturer (Lifesize Corporation, Austin, TX). A Room unit was used in Calgary and a Team unit in Banff (Figures 1 and 2). The BMSH resuscitation procedure was viewed on a 61-cm monitor and the tele-ultrasound images were viewed on a 51-cm monitor.

The system was established as part of a project to study the potential of telesonography conducted by communications satellite. Thus, some latency was built into the system to simulate the delay via a satellite link. The videoconferencing system was thus configured to add delay to the IP packets (270 ms one way) and constrained to a bandwidth of 2 Mbit/s using commercially available software (Tornado, PacketStorm Communications, Eatontown, NJ). The technical aspects have been reported elsewhere.[6]

Figure 2 Novice ultrasound user in Banff being mentored by the emergency medicine ultrasound director in Calgary via the videoconferencing system. A local expert user is observing

Methods

The study was approved by the appropriate ethics committee. Over a 12-month period, 23 tele-ultrasound examinations were completed. The clinical protocol examined both the Focused Assessment with Sonography for Trauma (FAST) and the Extended FAST (EFAST) for pneumothoraxes. Twenty of the examinations were conducted during acute trauma resuscitations and three during live patient simulations. FAST examinations were completed in all 23 cases and EFAST examinations in 17 cases.

The clinical personnel included trauma surgeons and emergency physicians at the FMC, as well as physicians, medical students, residents and nurses at the BMSH who performed the tele-ultrasound examinations. Attempts were made to contact all personnel and request them to complete a 7-item survey about their perceptions of the tele-ultrasound interaction and the potential uses of the system in other settings.

Results

During the study period, there were 18 users. Of the staff who used the system, 14 completed the survey, i.e. there was a 76% response rate. There were three respondents from the FMC: two trauma surgeons and one emergency physician. There were 11 respondents from the BMSH: 1 nurse, 2 residents and 8 physicians. The majority had previously performed a standard FAST examination, but only one had previously performed an extended FAST examination (Table 1).

Overall, 93% of respondents were either satisfied or very satisfied with the telemedicine interaction and agreed or strongly agreed that the technology could potentially benefit injured patients in the far north of Canada (Table 2). Furthermore, 93% of the respondents felt that the project had improved collegiality between the two institutions involved. The majority of respondents (71%) agreed or strongly agreed that the project had improved their ultrasound skills. One respondent was neutral and two (14%) did not feel that their personnel skills were improved. Both of the latter respondents had reported great experience with ultrasound prior to commencing the study. The majority (64%) were neutral regarding the question as to whether the system was a better teaching than clinical tool, with 28% strongly or simply disagreeing that the tele-ultrasound was better for teaching.

Table 1 Self-rated experience ($n = 14$)

	None	Limited	Great
Standard FAST examination	1 (7%)	6 (43%)	7 (50%)
Expanded FAST examination	8 (57%)	5 (36%)	1 (7%)

Table 2 User perceptions ($n = 14$)

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
Satisfied with the system	7 (50%)	6 (43%)	–	–	–	1 (7%)
Tele-ultrasound could benefit the north of Canada	11 (79%)	2 (14%)	–	–	–	1 (7%)
Collegiality is improved	10 (71%)	3 (21%)	1 (7%)	–	–	–
Personal skills are improved	7 (50%)	3 (21%)	1 (7%)	2 (14%)	–	1 (7%)
The system is a better teaching than clinical tool	–	–	9 (64%)	3 (21%)	1 (7%)	1 (7%)

Discussion

Remotely injured patients are at greater risk of dying or being permanently impaired, than their urban counterparts. Post-traumatic mortality risks are greatly magnified by remoteness and rural trauma mortality may be 50% greater than in urban settings.[7,8] The reasons for this are not fully defined, but are associated with increased pre-hospital emergency medical services response time, time on scene and distance to the scene.[9,10] We also speculate that diminished familiarity with major trauma, absence of advanced diagnostic and therapeutic modalities such as tomographic imaging and interventional angiography, unavailability of surgical subspecialties and multi-disciplinary critical care units, and the delay engendered by intra-hospital transfer are also factors that probably affect outcomes.

Ultrasound is one of the most widely used diagnostic imaging modalities.[11] However, one of the main limiting factors involving the use of ultrasound is its requirement for a high-level of operator experience to generate and to interpret images, in order to produce meaningful clinical information.[12]

To our knowledge the present study represents the first evaluation of tele-ultrasonography in acute multi-system trauma resuscitations. Overall, the majority of respondents were either satisfied or very satisfied with the telemedicine interaction and agreed or strongly agreed with the suggestion that the technology could benefit injured patients in the far north of Canada. The majority of users felt that being able to gain the advice and direction of more experienced remote clinicians aided their personal ultrasound skills. It is not unexpected that those who had the greatest confidence and experience were the least likely to find this aspect of the tele-ultrasound interaction helpful. Respondents were generally neutral regarding the question about whether the tele-ultrasound system was a better teaching or clinical tool. In retrospect, this question might have been better worded to allow the response that it was both a good teaching AND clinical tool.

During the study, one instance occurred where the most senior Banff physician was extremely busy caring for multiple patients. In this situation the initial ultrasound examination was delegated to a trainee who was supervised remotely, and the Banff physician verified the results subsequently. This allowed the trainee to learn with less pressure of time, allowed the Calgary physician to work with a remote novice, and freed the responsible Banff physician to care for a greater number of patients simultaneously while still teaching. Future studies of user satisfaction might obtain feedback from novice trainees such as medical students and nurses to gain insights into the potential educational advantages.

The generally reported satisfaction also agreed with the users' comments during interactive sessions. There have been innumerable telemedicine projects that have been initiated over the last few years, that were initially successful but later failed due to loss of interest or perceived usefulness among the users.[13,14] We were greatly encouraged by the overall perception of 92% of the respondents that the tele-ultrasound system had improved the overall collegiality between the two hospitals.

There were certain limitations to the present study. Any survey is limited by the nature of data that is opinion rather than quantitative. Furthermore, our sample was modest in size. We surveyed the users after the system had six months to mature. There was a definite technological learning period associated with the equipment before the staff became adept at using it. It is likely that if the users had been surveyed during the initial phase, the results might not have been so positive. Finally, because our survey was designed to be quick and simple to administer, questions about specific details could not be asked. However, it was our perception that remote users were more appreciative when either the patient was seriously ill and further consultation with other specialties was required, or when the patient was stable and a novice user could be remotely educated and tutored without haste.

We believe that as further experience is obtained, tele-ultrasound will prove to be an important aid to the care of remotely injured and ill patients.

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