Institutional Learning Curve of Surgeon-Performed Trauma Ultrasound

R. Stephen Smith, MD, RDMS; Steven J. Kern, MD; William R. Fry, MD, RVT, RDMS; Stephen D. Helmer, PhD

Background: Sonography has become the primary mode for the initial evaluation of abdominal injury in many trauma centers. However, the rate at which nonradiologists become proficient in this technique remains controversial.

Objective: To assess the learning curve for this technique in a single institution.

Design: Retrospective review of sonographic examinations for trauma performed by senior surgical residents during a 24-month period at an American College of Surgeons–verified level I trauma center.

Setting: University-affiliated private hospital.

Patients and Methods: Before the initiation of a program of surgeon-performed trauma ultrasound, senior surgical residents (postgraduate years 4 and 5) received 11.5 hours of hands-on and didactic instruction in the focused ultrasound examination for trauma. This examination then became a standard component of the evaluation of injured patients. Subsequent groups of senior residents received 8 hours of instruction at the onset of new academic years, 6 and 18 months, respectively, after the initial course. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were then calculated for each 6-month period after the introduction of trauma sonography.

Results: During the 24-month study period, 902 sonographic examinations were performed. No statistically significant differences were noted in sensitivity, specificity, accuracy, positive predictive value, or negative predictive value for any 6-month period of study when compared with the other 6-month periods or with the values calculated for the entire study period.

Conclusions: Senior surgical residents are capable of performing the focused ultrasound examination for trauma with a high level of skill after a concise introductory course. A learning curve was not apparent in our series. Criteria for being permitted to perform trauma sonography that include the requirement of a large number of examinations or extensive proctoring should be reassessed.

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In the last decade, emergent sonography has assumed a prominent role in the evaluation of the abdomen and thorax in injured patients. Numerous studies already present in the literature have documented the utility of a focused ultrasound examination to detect free fluid in the pleural, pericardial, and peritoneal spaces and thereby expedite and improve the care of injured patients.1-25 Other studies have determined that sonographic examinations for trauma may be performed with skill and accuracy by physicians and surgeons from a variety of specialty backgrounds.1-10,12-21,23-25 Despite these findings, “turf battles” among surgeons, radiologists, and emergency medicine physicians have developed, and controversy exists concerning the quantity and quality of training required before practitioners should be allowed to perform this technique without the oversight of proctors.26

The purpose of this study was to assess the rate at which surgical residents at a single American College of Surgeons–verified level I trauma center developed adequate skills to perform a limited sonographic examination. This study was conducted as a component of a de novo program of surgeon-performed trauma ultrasound. Additionally, we attempted to determine the nature of the learning curve.

This article is also available on our Web site: www.ama-assn.org/surgery.
MATERIALS AND METHODS

All sonographic examinations performed in the initial assessment phase of trauma patients who came to an American College of Surgeons level I trauma center between January 1, 1995, and January 1, 1997, were reviewed. All sonographic examinations were performed at the bedside as a part of the secondary survey and were conducted in the emergency department within 20 minutes of the arrival of the patient. The studies were performed and interpreted by senior (postgraduate year [PGY]-4 and PGY-5) surgical residents who had received at least 8 hours of instruction in basic trauma sonography, including 4 hours of formal lecture and 4 hours of hands-on experience with live ultrasound models. Before the trauma ultrasound program was implemented in the clinical setting, a mandatory 11.5-hour ultrasound course for surgical residents and attending trauma surgeons was conducted in December 1994. During this course, after a written pretest, lectures provided an overview of a broad spectrum of ultrasound topics: basic ultrasound physics, orientation to the ultrasound machine, normal sonographic anatomy of the abdomen and thorax, abnormal sonographic findings in trauma, the rationale for trauma sonography, sonographic evaluation of vascular trauma, and sonography in the trauma intensive care unit. Lectures were supplemented by a 4-hour hands-on session with live models, including at least 1 model with free abdominal fluid (ie, peritoneal dialysis fluid). Students were then required to perform at least 10 practice examinations and were required to demonstrate adequate competency assessed by both practical and written examinations before they were permitted to perform the ultrasound examination in the clinical setting. Additional introductory courses were held for subsequent classes of PGY-4 residents in June 1995 and June 1996. The subsequent courses were abbreviated to 8 hours because of student and instructor feedback from the original course. Instructors for each trauma ultrasound course were experienced surgical sonographers who possessed the American Registry of Diagnostic Medical Sonographers credential for abdominal ultrasound.

Sonographic examinations were performed for the purpose of detecting abnormal collections of free fluid in the peritoneal cavity and the pericardial space. To assess the abdomen, sonographic imaging of the Morison pouch, the left subdiaphragmatic space and the splenorenal recess, and the pouch of Douglas were performed with right flank, left flank, and suprapubic transducer positions, respectively. The pericardial space was assessed via a subxiphoid transducer placement. Sonographic studies were usually accomplished before the insertion of a nasogastric tube or urinary catheter. No attempts were made to identify organ-specific injuries, such as hepatic or splenic lacerations. All sonographic studies were performed with an ultrasound machine (model SSH-140A; Toshiba America Medical Systems, Tustin, Calif) with a 3.75-MHz phased array transducer. For the purpose of quality improvement, sonographic studies were recorded on videotape and were reviewed within 24 hours by an attending surgeon with extensive experience in trauma sonography. For the purpose of this study, initial resident interpretations were not amended or changed after review by the attending surgeon.

Sonographic findings were obtained during a single examination performed immediately after the primary survey of the injured patient. Trauma ultrasound examinations were performed by senior surgical residents (PGY-4 and PGY-5) who had successfully completed the introductory ultrasound course. Intermediate surgical residents (PGY-2 and PGY-3) were encouraged to observe and participate in sonographic evaluations at the discretion of the senior resident. Residents were required to interpret sonographic images as either positive or negative for free fluid. An “equivocal” interpretation was not permitted for the purpose of this study. All sonographic findings were then compared with other standard modalities of clinical assessment (computed tomography [CT], diagnostic peritoneal lavage [DPL], operative exploration, or observation). Data obtained through retrospective review included patient age and sex, mechanism of injury, true-positive studies, false-positive studies, true-negative studies, false-negative studies, and patient outcome. A true-positive study was defined as the demonstration of free fluid in the pericardial or peritoneal spaces as the result of organ injury. A true-negative study was defined as the absence of free fluid confirmed by other diagnostic modality or observation. A false-positive study was defined as an ultrasound examination interpreted as showing free fluid that was not subsequently confirmed by another diagnostic modality. A false-negative study was defined as an ultrasound study interpreted as showing the absence of free fluid but confirmatory studies or observation subsequently documented free fluid. With standard statistical methods, the sensitivity, specificity, accuracy, positive predictive value, and negative predictive value for sonographic examinations performed during each 6-month period after initiation of the study as well as for the entire 24-month study period were calculated. Statistical significance of data was determined by $\chi^2$ analysis.

RESULTS

During the study period, 902 injured patients were examined with ultrasound in the emergency department. All sonographic studies were performed by 1 of 24 senior surgical residents. Attending surgeons were present at the bedside for a minority of the ultrasound examinations. Residents performed an average of 38 sonographic studies, with a range of 24 to 68 studies per resident. The age of the study population ranged from less than 1 year to 98 years, with a mean of 33 years. Of the patients examined, 66% were male and...
The accurate and expedient examination of the patient at risk for thoracic and abdominal injury remains one of the primary goals of the surgeon involved in trauma care. The search for the optimal diagnostic approach to the trauma patient has recently brought sonography to the fore of a field that includes CT, DPL, and several other diagnostic modalities. The value of the focused abdominal sonogram for trauma in the early evaluation of the injured patient has been well documented in numerous series.\(^1\)\(^{20}\) The questions that remain concerning trauma sonography are not directed to the most appropriate method of performing the technique or the advantages of trauma sonography when compared with CT or DPL. Instead, controversy remains concerning issues of training, obtaining credentials, and granting privileges. The American Institute of Ultrasound in Medicine has recommended that at least 500 abdominal ultrasonography examinations be performed with supervision before physicians are allowed to perform sonography independently.\(^27\) However, this suggestion was made in reference to a complete ultrasound examination of the abdomen and would seem to have little relevance to the more limited examination performed for trauma. Others have suggested that trauma sonography should be performed by a technologist with more than 3 years of experience and that these studies should be interpreted only by a radiologist with more than 3 years of training in sonography.\(^28\) It would appear that many such recommendations are influenced by emotional “turf battles” and fear of lost practice domain.

During the past 2 decades, numerous articles from Europe, Asia, and more recently North America have demonstrated the capability of surgeons, emergency medicine physicians, and other practitioners to perform sonographic examinations for trauma with a high degree of skill and accuracy.\(^1\)\(^{26,28}\) Rozycki et al\(^1\)\(^{5,6}\) have demonstrated that attending trauma surgeons, trauma fellows (PGY-6 and PGY-7), and senior surgical residents are capable of performing trauma sonography with sensitivity and specificity comparable with the experience of German and Japanese surgeons. Rozycki et al advocated a training program that consisted of 8-hour training sessions that were held in conjunction with resident rotations on the trauma service. The content of the course of instruction advocated by Rozycki et al included didactic, observation, and practice sessions. Rozycki et al noted the variability of the learning curve for different individuals and suggested that the skill of surgeon sonographers was well developed by the time a surgeon had performed 200 studies.\(^1\)\(^{5,6}\) Rothlin et al documented the implementation of surgeon-performed trauma sonography in a German center. In this experience, a single surgeon sonographer with extensive experience initially performed all stud-

### Table 1. Sensitivity, Specificity, Accuracy, Positive Predictive Value, and Negative Predictive Value for Ultrasonography Performed During 4 Periods

<table>
<thead>
<tr>
<th>Period</th>
<th>No. of Examinations</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Accuracy</th>
<th>Positive Predictive Value</th>
<th>Negative Predictive Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>143</td>
<td>0.818</td>
<td>0.977</td>
<td>0.965</td>
<td>0.750</td>
<td>0.985</td>
</tr>
<tr>
<td>2</td>
<td>194</td>
<td>0.636</td>
<td>0.989</td>
<td>0.969</td>
<td>0.778</td>
<td>0.978</td>
</tr>
<tr>
<td>3</td>
<td>152</td>
<td>0.714</td>
<td>0.966</td>
<td>0.954</td>
<td>0.500</td>
<td>0.986</td>
</tr>
<tr>
<td>4</td>
<td>413</td>
<td>0.750</td>
<td>0.990</td>
<td>0.981</td>
<td>0.750</td>
<td>0.990</td>
</tr>
<tr>
<td>Total</td>
<td>902</td>
<td>0.733</td>
<td>0.984</td>
<td>0.971</td>
<td>0.702</td>
<td>0.986</td>
</tr>
</tbody>
</table>

34% were female. The mechanism of injury was penetrating in 6.5% of patients and blunt in the majority of patients, 93.5%. Prehospital trauma scores ranged from 1 to 15, with a mean of 8. Injury severity scores ranged from 1 to 50, with a mean of 8. In the study group of 902 sonographic examinations for trauma, there were 33 true-positive, 843 true-negative, 14 false-positive, and 12 false-negative studies. Almost one half (n = 5) of the false-negative examinations involved patients with hollow viscus injuries who were examined soon after the injury had occurred. No deaths occurred in patients with false-negative examinations. In 1 patient judged to have a false-positive examination, a large quantity of ascitic fluid was found in the absence of intra-abdominal injury.

Sensitivity, specificity, accuracy, positive predictive value, and negative predictive value for periods 1 through 4 as well as for the entire study group is listed in Table 1. No statistically significant differences were noted for any of the variables when the 6-month blocks were compared with each other or the values calculated for the entire study population. A trend toward significance was noted when specificity values from period 3 were compared with those from period 4; however, a P value of less than .05 was not present. During the 24-month study period, institutional use of CT of the abdomen and DPL was noted to decrease markedly. During the 18-month period before the introduction of trauma sonography, 25% of acutely injured patients admitted by the trauma service were examined with abdominal CT and 3% underwent DPL. During the study period, CT use was reduced to a rate of 14% of trauma patients, and only 0.2% had DPL performed. Diagnostic peritoneal lavage was not used in the assessment of any trauma victim during the final 12 months of the study period. During the second 12 months of the study period, the frequency of CT scan use continued to decrease by 34% as compared with the initial 12 months of the study period.

### COMMENT

The accurate and expedient examination of the patient at risk for thoracic and abdominal injury remains one of the primary goals of the surgeon involved in trauma care. The search for the optimal diagnostic approach to
ies. Gradually, additional surgeons were trained in the clinical setting by the initial surgeon sonographer. Before neophyte sonographers were permitted to perform independent ultrasound examinations, they were required to have performed 100 to 200 proctored examinations. Furthermore, this group indicated that sonographer skill continued to improve until 400 examinations were performed. Rothlin et al reported a slightly higher sensitivity and specificity for the most experienced sonographer compared with the “beginners,” although this improvement did not appear to achieve statistical significance. Hoffman et al reported excellent sensitivity, specificity, and accuracy for surgeon-performed sonography in Germany, where sonographic training is mandatory for surgical residents. They stated that attending an ultrasound course and the routine performance of ultrasound studies in the emergency department under the supervision of an experienced sonographer for a few weeks will enable junior residents to determine the presence of free fluid in the abdomen. Ma et al described the rapidity with which emergency physicians and residents learned basic sonographic skills. They described a training program that included a 10-hour introductory course including didactic session, review of videotaped trauma ultrasound examinations, and practice sessions. Emergency physicians participating in this study were then required to perform 15 to 20 sonographic studies on normal patients before using this technique in the trauma setting. Ma et al suggested that the learning curve for new sonographers plateaued at around 50 examinations. Other studies have suggested that less extensive introductory programs are required. Tso et al described a course of instruction that consisted of 2 hours of didactic and hands-on training. Kern et al reported that senior surgical residents who attended an introductory course of 11.5 hours that included 10 practice examinations on patients with positive findings produced sensitivity, specificity, and accuracy comparable with those in other studies in the literature. Thomas et al documented the de novo establishment of a surgeon-performed trauma ultrasound program in a level I trauma center. In this center, trauma surgeons and fellows attended an 8-hour introductory course and were subsequently credentialed through the Department of Surgery. Thomas et al reported that sensitivity, specificity, and accuracy improved after each sonographer had successfully performed 100 studies. They concluded that surgeons achieved competency in trauma sonography rapidly and that sonography significantly reduced the cost of examination of trauma patients. More recently, Buzzas et al compared trauma ultrasound studies performed by surgery residents, trained in basic sonographic techniques, with studies performed by certified ultrasound technologists and radiologists. They found no significant differences in the sensitivity, specificity, and accuracy of ultrasound examinations performed by surgeons or radiologists. Buzzas et al concluded that a concise introductory course in trauma sonography was adequate to prepare new surgeon sonographers to perform this study independently. A consistent component of successful trauma sonography programs is the involvement of a core of instructors with substantial experience in sonographic skills and instrumentation. The focused ultrasound examination for trauma is not difficult to learn, but neither does it fall into the category of “see one, do one, teach one.” At the present time, the credential offered by the American Registry of Diagnostic Medical Sonographers for abdominal sonography aids in giving surgeon sonographers credibility to serve as teachers of this technique.

Despite the contributions to the literature previously cited, objections to surgeon-performed trauma sonography still persist in some centers. The hesitation to permit nonradiologists to perform trauma sonography seems to be based on concerns of inadequate training and lack of familiarity with ultrasound instrumentation and technology. O’Connor suggested that ultrasound skills are not easily acquired and that caution should be used in allowing new practitioners to use this diagnostic modality. Recently, McGahan et al suggested that trauma sonography has a definite learning curve and that this examination should be performed only by ultrasound technologists with more than 3 years of experience and interpreted only by radiologists with more than 3 years of training in sonographic techniques. Unfortunately, in making this recommendation, McGahan did not differentiate between a focused ultrasound examination for the detection of free fluid and a more extensive ultrasound examination in which organ-specific injury was sought. Certainly the ability to detect and delineate organ injuries, such as splenic or hepatic lacerations or hollow viscus injury, is far greater than the skill required to determine the presence of free fluid in the pericardial space or the peritoneal cavity. However, it should be reemphasized that the purpose of bedside sonography in the trauma resuscitation suite is merely the detection of fluid in these areas.

Before the analysis of our data, we hypothesized that a learning curve for trauma ultrasound would be demonstrated. This hypothesis was not proved; conversely, our data suggest that a basic technique for a focused ultrasound examination in the trauma setting was easily learned and practiced with a high degree of skill and accuracy. Since other investigators have suggested that adequate trauma ultrasound skills are not obtained until 200 to 400 studies have been performed, it is possible that none of our resident sonographers gained enough experience to reach the end point of the learning curve. However, this seems unlikely in that we previously reported that the sensitivity, specificity, and accuracy for trauma ultrasound examinations performed by surgical residents equals that of radiologists performing the study in the same community. On the basis of the work of others, it may be reasonable to assume that more difficult ultrasound examinations, such as the identification of specific organ defects, do indeed require extensive experience. It should be emphasized that our study did not attempt to assess the
ability of surgeons to perform these more extensive and difficult examinations. One of us (W.R.F.) (unpublished data, 1997) has proposed a grading scale to predict the difficulty of different sonographic studies (Table 2).

Other investigators have pointed out that sonography performed soon after injury has occurred is not a reliable diagnostic modality for the detection of hollow visceral injuries. Unfortunately, our data confirm the difficulty encountered in the detection of bowel injuries with a single sonographic examination. In our experience, 5 of 12 false-negative studies were secondary to blunt trauma of the small bowel. For the purpose of this study, residents were not permitted to interpret an ultrasound examination as equivocal. The majority of the false-positive examinations in our study seem to indicate the tendency of new sonographers to be extremely conservative in the interpretation of studies and to “overread” trivial or nonexistent findings.

Our experience has demonstrated that surgeons are capable of performing a focused sonographic examination for trauma with skill and accuracy after a brief introductory course. Analysis of our data did not demonstrate an obvious learning curve in a single institution for surgeons performing this diagnostic study. In fact, the sensitivity, specificity, and accuracy for trauma sonographic examinations performed during the first six months of the study period were not significantly different from results obtained in the last six months of the study. On the basis of our experience, we believe that it is inappropriate to require surgeons trained in this technique to undergo an extensive period of proctoring before they are allowed to use this diagnostic modality independently. We suggest that an introductory course that includes the opportunity to perform 10 practice examinations followed by 25 proctored examinations performed in the clinical setting is a reasonable requirement. Additionally, we believe that efforts to restrict the use of this diagnostic modality to any one specialty are unwarranted and can only delay the introduction of trauma sonography into the diagnostic armamentarium of the surgeons and emergency medicine physicians who care for the acutely injured patient on a regular basis.

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**Table 2. Grading Scale for Ultrasound Examination Difficulty***

<table>
<thead>
<tr>
<th>Category</th>
<th>Intraoperative</th>
<th>Transcutaneous</th>
<th>Laparoscopic/Endoscopic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of Difficulty</td>
<td>Examination</td>
<td>Examination</td>
<td>Examination</td>
</tr>
<tr>
<td>1 Vascular</td>
<td>1 Trauma</td>
<td>1 Colon</td>
<td></td>
</tr>
<tr>
<td>2 Breast (localization)</td>
<td>2 Breast</td>
<td>1 Rectal</td>
<td></td>
</tr>
<tr>
<td>2 Biliary</td>
<td>2 Thyroid</td>
<td>1 Vascular (B-mode)</td>
<td></td>
</tr>
<tr>
<td>2-3 Pancreas</td>
<td>3 Biliary</td>
<td>2 Endoscopic (bowel)</td>
<td></td>
</tr>
<tr>
<td>2-3 Liver</td>
<td>3 Renal</td>
<td>3 Biliary</td>
<td></td>
</tr>
<tr>
<td>2-3 Colon/rectum</td>
<td>4 Liver</td>
<td>3 Liver</td>
<td></td>
</tr>
<tr>
<td>2-4 Lymph node</td>
<td>5 Pancreas</td>
<td>4 Endoscopic (gastric)</td>
<td></td>
</tr>
<tr>
<td>5 Vascular</td>
<td>5 Vascular</td>
<td>5 Vascular (duplex)</td>
<td></td>
</tr>
</tbody>
</table>

*For degree of difficulty, 1 indicates least difficult, and 6, most difficult. Category scores are 1 for intraoperative, 2 for transcutaneous, and 3 for laparoscopic/endooscopic. Study difficulty is derived by multiplying category score by degree of difficulty.

**REFERENCES**


**DISCUSSION**

David H. Wisner, MD, Sacramento, Calif: This paper is a continuation of Dr Smith’s work in this area. He has been one of the pioneers in making ultrasound useful and available in the trauma setting.

Several important assumptions and assertions of the paper are that ultrasound is a useful tool in the early management of trauma patients and that acceptable sensitivity, specificity, and accuracy rates can be achieved by personnel with limited ultrasound training and experience. I will not contest one of the authors’ major conclusions that there were minimal changes over time with respect to their institutional experience with trauma ultrasound. I do, however, have a number of questions for the authors.

1. An original ultrasound curriculum of 11.5 hours was reduced to 8 hours based on feedback from the original trainees. Could they tell us what 3.5-hour part of the original curriculum was, after initial experience, considered unnecessary?

2. The authors state that ultrasound examination performed by attending surgeons were present for only a minority of the ultrasound. What determined the presence of attending surgeons, who presumably were all reasonably competent in doing and interpreting ultrasound? Were these attendings present for a disproportionately number of the sickest patients? Could it be that the false-negative rate was affected by the fact that attending surgeons with extensive ultrasound experience were more likely to be present during the ultrasound in patients most likely to have intraperitoneal fluid?

3. There were only 12 false-negative exams out of a total of 902, and that is a very commendable rate of only 1.3%. One of the things I learned from Dr Bill Blaisdell, however, is that it is most important to look at the number of false-negatives compared to the total number of patients who actually had an injury. If this ratio is done for the data in the present study, it is discovered that a full 27% of the patients with intraperitoneal fluid had a false-negative ultrasound exam done by a resident. Even if the patients with bowel injury are excluded as acceptable false-negatives, 16% of the patients with intraperitoneal fluid had false-negative exams. These are worrisome numbers. There were no deaths in the false-negative group, but could the authors let us know if any of the false-negative patients had complications or untoward outcomes as a consequence of delay in diagnosis?

4. Is surgeon-performed ultrasound appropriate for level II community hospital trauma centers? Assuming that level II centers admits approximately 900 patients per year and there are 7 surgeons on the trauma call panel, each surgeon would see at most only about 6 patients per year with intraperitoneal fluid, or only 1 every 2 months. Is this enough experience per surgeon to maintain skills if one assumes that the most important errors in this setting are false-negative exams? Upon graduation, are your residents trained well enough to practice at these volumes for the rest of their careers?

5. Finally, a question about peritoneal lavage. Are we abandoning a test with an extremely low false-negative rate (ie, DPL) for a test (ultrasound) with a significantly higher false-negative rate and a higher level of operator dependence? Perhaps even more important, are we producing a generation of surgeons who don’t know how to do diagnostic peritoneal lavage, a test that can be used in all hospitals and does not require any specialized equipment or resolution of turf issues? Do you have any information about how many of your graduating residents are currently using trauma ultrasound? Are there some recent graduates who in their new institutions have had to learn how to do a DPL from their emergency medicine colleagues?

In spite of my somewhat reactionary questions, I enjoyed the paper very much.

Jay K. Harness, MD, Oakland, Calif: We really need more studies like this in order to continue to establish the legitimacy of surgeons performing ultrasound. I have 2 brief questions for Dr Smith. One is whether he can extrapolate from the experience in trauma ultrasound, which is relatively easy to learn, what it will take to train surgeons in other aspects of ultrasound. My second question is, as a member of the American College of Surgeons’ Ultrasound Users’ Group, can you share with us where you see the College of Surgeons going in the area of accreditation of surgeons in performing ultrasound?

Ernest E. Moore, MD, Denver, Colo: Could you clarify how you documented the performance of the residents? First, a question about the environment. In addition to the attending surgeon’s expertise, in most level I trauma centers the emergency medicine attendings and residents also have interest and experience. When the ultrasound was done, did the residents fill out a form in isolation and commit themselves to the diagnosis at that time?

Second, I assume your CT scan was done to qualify whether there was fluid or not, but, as you know, there are increasing reports of the relative weakness of ultrasound in identifying solid organ injuries. I am curious: during this time period, how many significant splenic or liver injuries were identified by a CT in patients in whom there was no fluid identified?

Charles J. Filipi, MD, Omaha, Neb: I have 2 questions. One, have there been any studies to compare the ability of radiology residents with that of surgical residents when interpreting ultrasound results in the emergency room? You mentioned the practical skills test used during the course. Could you specifically tell us the components of that test?

Dr Smith: Dr Wisner, I certainly think that diagnostic peritoneal lavage is a useful technique and shouldn’t be thrown out...
Concluding the modifications in the course from 11.5 hours to 8 hours, this was done primarily because, from the standpoint of both the instructors and the students who were attending the course, the students seem to achieve a significant amount of competence within an 8-hour period and, quite frankly, were getting a little bit bored with doing these studies when we had the 11.5-hour course. We didn’t exclude any of the lectures that I initially listed, but we did shorten some of the lectures and shortened the hands-on time as well.

Concerning the presence of the attendings, and I will answer Dr Moore’s question regarding emergency medicine attendings as well: the presence of surgery attendings at the trauma activation was somewhat random. We did not, for example, respond only to the most seriously injured patients, but in fact this was based more on the immediate availability of the attending at the time that the trauma patient came in. Most of the trauma patients came in at night, and we do not currently as attendings take in-house trauma call.

Our emergency medicine faculty, although they are interested in sonography, are not actively practicing it and, as far as I know, have no training in it at this point. I am sure that that will change in the near future.

Concerning the amount of intraperitoneal fluid missed with sonography, this a significant concern, particularly with the hollow viscus injuries. Studies in Japan have shown that it probably requires about 150 cc of free fluid in the peritoneal cavity before the ultrasound will be reliably positive. Dr Moore’s group in a study has documented that it may take 450 cc if you are simply watching peritoneal lavage fluid go in.

Concerning the complications of the false-negative examinations, again we did not have any deaths in the false-negative examinations, but in 1 patient the diagnosis of hollow viscus injury was not made until after 24 hours, and this patient had a course of acute respiratory distress syndrome which required placement in the intensive care unit for mechanical ventilation for approximately 5 days.

Concerning the question about a level II trauma center, I do think that this skill is no different from any other skill. You have to practice it on a regular basis to be good at it. I do think that for 7 surgeons performing sonography relatively infrequently, they might be better off, quite frankly, sticking with techniques that they are more familiar with.

Dr Harness, I firmly believe that the sonographic examination for trauma is the least difficult ultrasound technique for surgeons to master. Other techniques, such as laparoscopic, endoluminal, and vascular ultrasound, are a different story. However, I believe trauma sonography is a logical starting point.

Concerning the American College of Surgeons’ commitment to ultrasound, the College is the ideal organization to provide ultrasound education and credentials to surgeons. While I do not presume to speak for the College, the plan for ultrasound education consists of introductory courses followed by advanced modules for breast, trauma, operative sonography, etc. Until the College program is mature, interim certification of surgeons by the American Registry of Diagnostic Medical Sonographers may be very useful. Dr Moore, residents were required to complete a data form at the time the ultrasound examination was performed. This was done before the attending surgeon’s input was obtained. Sonography is less useful for the identification of specific solid organ injuries in hepatic or splenic lacerations.

Dr Filipi, our group recently compared trauma sonography performed by surgical residents with studies performed by radiologists. There were no statistically significant differences in sensitivity, specificity, or accuracy.

Estrogen Replacement Therapy and Mortality Among Older Women: The Study of Osteoporotic Fractures

Jane A. Cauley, DrPH; Dana G. Seeley, PhD; Warren S. Browner, MD, MPH; Kristine Ensrud, MD, MPH; Lewis H. Kuller, MD, DrPH; Ruth C. Lipschutz, MPH; Stephen B. Hulley, MD, MPH

Background: Most previous studies of estrogen replacement therapy (ERT) and mortality have focused on younger women. Recently, it has been suggested that the effect of ERT on mortality may represent a “healthy-user” effect, ie, those with healthier lifestyles having a greater likelihood of receiving ERT.

Methods: Nine thousand seven hundred four women, 65 years or older, participated; 1258 (14.1%) reported current use of ERT for at least 1 year at entry. During an average follow-up of 6.0 years, 1054 women (11.8%) died.

Results: After adjusting for multiple variables, mortality rate was lower among current (relative risk [RR], 0.69; 95% confidence interval [CI], 0.54-0.87) and past users (RR, 0.79; 95% CI, 0.66-0.95), mainly due to reductions in deaths due to cardiovascular disease. The protective effect of ERT was greatest among women younger than 75 years (RR, 0.55; 95% CI, 0.40-0.76) compared with women from 75 to 84 years of age (RR, 0.93; 95% CI, 0.62-1.41) and 85 years or older (RR, 1.33; 95% CI, 0.43-4.12). The RR for overall mortality was 0.95 (95% CI, 0.68-1.32) among short-term users (1-9 years) compared with 0.55 (95% CI, 0.40-0.75) among long-term users (≥10 years). Deaths considered unrelated to ERT tended also to be reduced in current users younger than 75 years (RR, 0.72; 95% CI, 0.49-1.06) and current long-term users (RR, 0.75; 95% CI, 0.51-1.10).

Conclusions: Estrogen replacement therapy is associated with lower overall mortality rates and reduced deaths due to cardiovascular disease. Women using ERT had healthier lifestyles, and the risk for death thought to be unrelated to ERT also tended to be lower in ERT users, suggesting in part a healthy-user effect. Arch Intern Med. 1997;157:2181-2187

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