**Effective Use of Percutaneous Cholecystostomy in High-Risk Surgical Patients**

*Techniques, Tube Management, and Results*

Clark A. Davis, MD; Jeffrey Landercasper, MD; Lincoln H. Gundersen, MD; Pamela J. Lambert, RN

**Hypothesis:** Percutaneous cholecystostomy (PC) is an effective, safe treatment in patients with suspected acute cholecystitis and severe concomitant comorbidity.

**Design:** Retrospective medical record review from March 1989 to March 1998.

**Setting:** Referral community teaching hospital (450 beds) in rural Wisconsin.

**Patients:** Twenty-two consecutive patients underwent PC tube placement over a 10-year period. Twenty procedures were for acute cholecystitis (14 calculous, 6 acalculous) and 2 were for diagnostic dilemmas. Nineteen (86%) of 22 patients were American Society of Anesthesiologists class 4; 3 (14%) were class 3.

**Interventions:** Pigtail catheters (8F-10F) placed by means of ultrasound or computed tomographic localization, with or without fluoroscopic adjunct.

**Main Outcome Measures:** Thirty-day mortality, complications, clinical improvement as determined by fever and pain resolution, normalization of leukocytosis, further biliary procedures required, and outcome after drain removal.

**Results:** Twenty-two patients underwent PC for presumed acute cholecystitis based on ultrasound and clinical findings. All patients received antibiotics prior to PC for 24 or more hours. Thirty-day mortality was 36% (8 patients), reflecting severity of concomitant disease. Minor complications occurred in 3 of 22 patients. Clinical improvement occurred in 18 (82%) of 22 patients—15 (68%) within 48 hours. Follow-up of fourteen 30-day survivors is as follows: 7 (50%) had drains removed because the gallbladder was stone free, 4 (29%) had drains remaining due to persistent stones, 2 (14%) underwent cholecystectomy, and 1 (7%) awaits scheduled surgery. Only 1 (12.5%) of 8 patients developed biliary complications after drain removal, requiring endoscopic retrograde cholangiopancreatography 9 months after drain removal. One patient required urgent cholecystectomy after failure to respond to PC. This patient died of a perioperative myocardial infarction.

**Conclusions:** Percutaneous cholecystostomy is an effective, safe treatment in patients with suspected acute cholecystitis and severe concomitant comorbidity. Laparoscopic cholecystectomy is recommended as definitive treatment for patients whose risk for general anesthesia improves in follow-up. Drains can be safely removed once all gallstones are cleared. In patients with severe concomitant disease, drains can be left with a low incidence of complications if stones remain.


**Emergent Surgery for Acute Cholecystitis in the Elderly**

For acute cholecystitis in the elderly, a mortality rate as high as 14% to 19% has been reported. In contrast, elective surgery in this same age group has mortality as low as 0.7% to 2%. General anesthetic risk for patients with significant comorbidities has been determined by the American Society of Anesthesiologists (ASA) classification. Mortality per 1000 patients has been calculated to range from 18.2 to 77.6 for ASA class 3 and 4, respectively. Acute acalculous cholecystitis is commonly associated with critical illness, and mortality rates up to 67% have been documented after cholecystectomy. To lower mortality, Shirai et al advocated percutaneous cholecystostomy (PC) as the preferred treatment for acute acalculous cholecystitis. No deaths were reported in 15 patients.

*See Invited Critique at end of article*

Percutaneous cholecystostomy has been shown to be effective treatment for acute cholecystitis in the elderly and critically ill by several authors. However, there have

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

A retrospective chart review of 22 consecutive patients undergoing PC from March 1989 to March 1998 in a tertiary, 450-bed, rural hospital in La Crosse, Wis, was con-ducted. Patients were reviewed for demographic features, co-morbidity, and ASA class. Risk factors for acute cholecystitis were determined. Approximately 3000 cholecystectomies were performed during this time, resulting in an approximate 0.7% ratio of PC tube placement compared with cholecystectomy. There were 14 men and 8 women with mean age of 77 years (range, 58-97 years). All patients had significant comorbidity, as shown in the tabulation below.

<table>
<thead>
<tr>
<th>Comorbidity</th>
<th>No. (%) of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac disease (coronary artery disease,</td>
<td>17 (77)</td>
</tr>
<tr>
<td>congestive heart failure, recent myocardial infarction)</td>
<td></td>
</tr>
<tr>
<td>Respiratory disease</td>
<td>11 (50)</td>
</tr>
<tr>
<td>(chronic obstructive pulmonary disease, respiratory failure)</td>
<td></td>
</tr>
<tr>
<td>Renal failure/insufficiency</td>
<td>10 (45)</td>
</tr>
<tr>
<td>Sepsis/multisystem organ failure</td>
<td>6 (27)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>3 (14)</td>
</tr>
<tr>
<td>Abdominal aortic aneurysm rupture</td>
<td>1 (4)</td>
</tr>
</tbody>
</table>

Nineteen (86%) of 22 patients were ASA class 4, and 3 (14%) were ASA class 3. Eight (36%) patients had undergone other surgery within 30 days of PC tube placement, and 10 (45%) of 22 had been receiving total parenteral nutrition. The patients included in this study had all been few descriptions detailing the management, follow-up, and long-term outcome of patients discharged with drains in place.

Our techniques, results, complications, and recommendations for the long-term treatment of high-risk surgical patients with acute cholecystitis are discussed.

RESULTS

Percutaneous cholecystostomy tube placement for presumed acute cholecystitis based on ultrasound and clinical findings was performed in 20 patients. Two additional patients underwent PC for sepsis of unknown source thought likely to be biliary related. All patients received intravenous antibiotics prior to PC for 24 or more hours with failure to improve clinically. Of the patients with acute cholecystitis, 14 had calculous disease and 6 had acalculous disease. Ultrasound findings in these patients included 15 with wall thickening (>3 mm), 9 with pericholecystic fluid, 6 with gallbladder distention, and 7 with a positive sonographic Murphy sign.

Figure 1 and Figure 2 illustrate the clinical course of all 22 patients. Clinical improvement occurred in 18 (82%) of 22 patients—15 (68%) within 48 hours. All non-responders died within 30 days of PC. Deaths were not believed to be related to PC or biliary sepsis and are further characterized below. Of the responders to PC, 12 patients had fever resolution and 6 had resolution of leucocytosis within 48 hours. Complications of PC tube placement occurred in 3 (14%) of 22 patients, including bile leakage around the skin in 2 patients and tube dislodgment that required replacement in 1 patient. Nine (43%) of 21 bile cultures were positive. Two patients had 2 organisms present. Organisms are listed in the tabulation below.

<table>
<thead>
<tr>
<th>Organism</th>
<th>No. of Cultures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli</td>
<td>2</td>
</tr>
<tr>
<td>Enterobacter</td>
<td>2</td>
</tr>
<tr>
<td>Enterococcus</td>
<td>2</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>1</td>
</tr>
<tr>
<td>Salmonella</td>
<td>1</td>
</tr>
<tr>
<td>Bacteroides</td>
<td>1</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>1</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>1</td>
</tr>
<tr>
<td>No organism cultured</td>
<td>12</td>
</tr>
</tbody>
</table>
30-DAY MORTALITY GROUP

Eight (36%) patients died within 30 days of PC tube placement. Three (38%) had acalculous cholecystitis, 2 (25%) had sepsis of unknown origin, and 3 (38%) had calculous cholecystitis. The average time from PC to death was 9.4 days (range, 4-15 days). The average duration of hospitalization prior to PC was 18.1 days (range, 9-30 days). All patients received intravenous antibiotics before PC for a mean of 15.6 days (range, 9-27 days). Five (62.5%) of 8 patients underwent PC within 30 days of prior surgery. Three patients underwent coronary artery bypass grafting (1 with aortic valve replacement), 1 underwent colectomy for ischemic bowel, and 1 had an amputation for necrotizing fasciitis. All deaths were the result of comorbid illness. Four patients died of multisystem organ failure, 2 died of myocardial infarction, 1 died of sepsis of uncertain origin, and 1 patient had an unknown cause of death. No patient’s death was believed to be biliary related. One of the deaths attributed to an acute myocardial infarction occurred after an emergent open cholecystectomy was performed because of failure to respond to PC (Figure 2).

30-DAY SURVIVORS

Fourteen (64%) of 22 patients survived beyond 30 days of PC with a mean follow-up of 1.9 years (range, 49-2750 days). Three (21%) of 14 patients underwent PC within 30 days of prior open heart surgery. Mean antibiotic usage was 12.6 days (range, 5-35 days) prior to PC. In follow-up, 4 patients have drains remaining, 8 had drains removed, and 2 underwent successful cholecystectomy.

Of the 4 patients with drains remaining, 1 died at home of comorbid disease 49 days after PC. Two patients have gallstones remaining that could not be removed percutaneously. One patient developed persistent symptoms after successful stone removal. Symptoms were relieved with tube reinsertion. Drains have remained from 6 to 18 months in these patients. Of the 8 patients with drains removed, 3 had acalculous cholecystitis, 4 had successful percutaneous stone extraction, and 1 awaits elective cholecystectomy. One patient with initial acalculous cholecystitis developed choledocholithiasis requiring endoscopic retrograde cholangiopancreatography 9 months after drain removal. One patient developed asymptomatic gallstones 4½ years after drain removal.

Two patients underwent successful cholecystectomy. One patient developed recurrent biliary colic 7 days after PC, which required surgery. This patient initially had acute cholecystitis and congestive heart failure. He underwent successful surgery after resolution of congestive heart failure. The second patient underwent cholecystectomy 5 years after PC for recurrent cholecystitis.

Percutaneous cholecystostomy avoids the use of general anesthesia, invasive surgery, and attendant risk while effectively managing gallbladder disease in critically ill patients. Percutaneous cholecystostomy was technically successful in all patients and clinical improvement occurred in 82% of our patients treated with PC. Thirty-day mortality was 36%, with all 8 patients dying as a result of comorbid disease. No deaths were related to biliary sepsis.

Published reports describing PC have shown promising results with both the short- and long-term management of cholecystitis in high-risk and critically ill surgical patients.8-12 Institutional data detailing the outcome of 17 to 33 patients have reported rapid clinical improvement in 67% to 94% of patients.8-12 Mortality rates in these series ranged from 5% to 55%.8-12 Recent Japanese surgical literature advocates PC as the initial treatment choice for acute acalculous cholecystitis, citing 93% improvement and no mortality in 15 patients.7 One patient in this Japanese series required emergent cholecystectomy, however, for uncontrolled bleeding. No patient had disease recurrence after drain removal. Sugiyama et al13 studied the use of PC for treatment of acute cholecystitis in the very elderly (defined as >80 years old). Thirty-seven (97%) of 38 patients had prompt improvement and only 1 (3%) patient died.13 Ten patients in this series subsequently underwent elective cholecystectomy and 2 had percutaneous stone extraction. Four of 12 patients with stones remaining developed recurrent cholecystitis once the tube was removed. None of the 12 patients with acalculous disease developed further problems in a 1.8-year follow-up. In our series, 1 patient with acalculous cholecystitis developed a common duct stone requiring endoscopic retrograde cholangiopancreatography 9 months after drain removal.

Recurrent cholecystitis and biliary colic was found in 2 patients in our series. One patient was an 87-year-old admitted with congestive heart failure and acute cholecystitis. Percutaneous cholecystostomy was an effective bridge to open cholecystectomy for this patient, and adhesions from PC did not interfere with the surgery. Previous reports have also described low mortality rates us-

**Figure 2. Outcomes of percutaneous cholecystostomy in 22 patients.**
ing PC as a bridge to elective cholecystectomy. Weigelt et al. found no difference in mortality rates for patients treated with PC followed by cholecystectomy compared with elective cholecystectomy. One 70-year-old patient in our series had a retained gallstone that was unable to be extracted percutaneously. This patient had significant pulmonary and cardiac comorbidities. The drain was removed 1 month after placement and the patient had no further gallbladder problems until 4½ years later. He then developed recurrent biliary colic that was treated electively by open cholecystectomy.

No patient in our series developed recurrent gallstones after successful stone extraction. One patient with the original diagnosis of acalculous cholecystitis based on cholangiography and ultrasound did develop a common duct stone 9 months after drain removal. Donald et al. reported a series of 100 patients treated with percutaneous stone extraction in which the gallbladder was left in situ. They found gallstone recurrence rates of 7%, 19%, 28%, 35%, and 44% at 6, 12, 24, 36, and 48 months, respectively. With our follow-up of 25 months in 8 patients, 1 patient with acalculous disease developed stone recurrence. Patients who have successful stone extraction but remain at high surgical risk can be effectively managed with repeated PC if cholecystitis recurs. If a patient’s operative risk improves after treatment of comorbid conditions, then operative treatment with open or laparoscopic cholecystectomy should be considered. A planned cholecystectomy is probably not necessary in patients with acalculous gallbladders who remain asymptomatic. Only 1 of 6 patients with an acalculous gallbladder developed further gallstone disease over 2.9 years. Furthermore, it has been shown that in those who develop stone recurrence, fewer than half will have symptomatic disease.

Few complications of PC were found in our series. All were minor complications of leakage or tube dislodgment and they were treated effectively with drain replacement. Reports of uncontrolled bleeding by transhepatic tube placement and colonic perforation leading to emergent laparotomy have been reported. Duodenal puncture has also been reported but this case was effectively managed with observation alone. Tube placement must be done using localization techniques such as ultrasound or computed tomography to avoid inadvertent organ injury. Tube dislodgment risk is decreased by using pigtail catheters. We prefer a subcostal approach to reduce bleeding risks and to avoid hepatic seeding from an infected gallbladder. Furthermore, stone extraction is more difficult with transhepatic PC due to the need for tract dilation.

Our recommendations for drain removal are based on our institutional experience and a literature review and include the following:

1. The PC tube should probably not be removed until the drainage tract is mature enough to prevent intra-peritoneal biliary leakage after PC tube removal. The time until maturation occurs has not been well established, but 7 to 10 days should be sufficient in most patients.
2. The patient should be asymptomatic prior to PC tube removal.
3. Cystic duct patency should be verified by cholangiography before PC tube removal.
4. Percutaneous gallstone extraction should be considered in patients with calculus disease before PC tube removal. After successful stone extraction, a PC tube is left in the gallbladder for a short time before removal to decrease the likelihood of intraperitoneal leakage.
5. Percutaneous cholecystostomy tubes are removed if they become nonfunctional and plugged with debris that cannot be removed with irrigation.

Percutaneous cholecystostomy is an effective, safe treatment in patients with suspected acute cholecystitis and severe concomitant comorbidity. Laparoscopic cholecystectomy is recommended as definitive treatment for patients whose risk for general anesthesia decreases in follow-up. Drains can be safely removed once gallstones are extracted by percutaneous techniques and cystic duct patency has been verified by cholangiography. If stones remain but patients have severe ongoing comorbid conditions, drains can be left with a low risk of drain-related complications.

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REFERENCES


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**DISCUSSION**

**James A. Madura, MD, Indianapolis, Ind:** It is appropriate that this paper is presented in Indianapolis, since it is not a new treatment. As a matter of fact, cholecystostomy was first performed here in Indianapolis by Dr John S. Bobbs in 1867 at the corner of Meridian and Washington streets, the current site of our Circle Center Mall. So, it is not new, but the techniques have changed somewhat and I think this report should be filed under the category of good ideas that never die. Dr Lander casper operated on a series of very ill patients, apparent from his high mortality. In reviewing the current literature, I was surprised at how many recent papers are available concerning this topic. However, the techniques have changed and the physicians in charge have changed as well. In this current series, we need to know whether surgeons, radiologists, or a team of physicians actually did the procedure, chose the route, and so on. It is obvious that in La Crosse a percutaneous rather than a transhepatic route is utilized. That is not the case in many series being reported.

My questions are as follows, Dr Davis and Dr Lander casper: Who actually did these procedures? Did you go to the x-ray suite or stay at the bedside to do this? I can recall very clearly the first operation I ever saw, which paradoxically turned me on to surgery, was a bedside cholecystostomy under local anesthesia on an open 20-bed ward. Did you do immediate cholangiograms to make sure that the cystic and common ducts were patent? I have always thought that you should do this to be sure that the duct is open. How did you know that you did not have gangrenous cholecystitis? I think that might have changed your series a little. We have seen some patients with acalculous cholecystitis who have had gangrenous gallbladders, which could create disastrous results. You obviously did not take the stones out immediately, and I would like to know, how long did you wait before this was done? You alluded to this in your paper. It is obvious in the acalculous gallbladders that you did not have stones to remove. Did you wait 2 weeks or 4 weeks, or 6 months before you attacked the stones? Did you try any stone dissolution agents?

In the literature, again, there are several reports that describe using methyl-tert-butyl ether and other agents to dissolve the stones in order to avoid cholecystectomy. During the same period of time, did any equally sick patient undergo cholecystectomy or laparoscopic cholecystectomy? If so, what was their morbidity and mortality? Of the patients who are surviving, some with tubes and some without, are they all going to get cholecystectomy or are you going to wait until they develop new symptoms? The papers in the literature suggest that stones are inevitable if you do not treat these patients with cholecystectomy.

Finally, I am intrigued by the sonographic Murphy’s sign. I assume that overzealous sonographers are producing the Murphy’s sign with the ultrasonic probe.

**Mitchel Byrne, MD, Evanston, Ill:** The clearing of the stones that is described is something that in our institution we do not routinely do. Our criteria is that the cystic duct is patent, patients are over their acute problem, and at that point we usually remove the tube and at a later time plan their elective cholecystectomy after their acute medical condition is resolved. I question whether it is essential that the stones be removed, and I would like your thoughts on that.

**Lawrence Koep, MD, Phoenix, Ariz:** With the direct puncture of the gallbladder, did you begin irrigation of the tube early? Did you have any patients with hepatic dysfunction?

**Dr Lander casper:** These procedures were done by an interventional radiologist. None of these percutaneous cholecystostomy tubes were placed by the surgeon. Immediate cholangiograms were done after placing the tube to assure correct position of the pigtail catheter within the gallbladder. Cholangiography was done later if the patient was asymptomatic and we wanted to remove the tube and assure cystic duct patency. Cholangiography was also sometimes performed if a patient was not doing well after placement of the tube. The cholangiogram was performed to make sure there was not a perforation of the gallbladder or that the pigtail catheter had migrated out of the gallbladder.

Dr Madura, stone retrieval was not done in any patient less than 2 weeks after the placement of the tube. It was felt that the tract should be allowed to mature for at least 2 weeks before attempting stone manipulation. The earliest stone manipulation was probably at 2 to 3 weeks. Some stone manipulations and removal of stones were not done for several months.

In no patient did we use Jonathan Thistle’s technique of dissolving the stones with methyl-tert-butyl ether. We did not study the patients undergoing open or laparoscopic cholecystectomy during the same 10-year time period. There were about 3000 cholecystectomies performed during this time period. We imagine that there were sick patients who did undergo a general anesthetic during that time and part of the reason that this technique has been chosen at our institution is because we have seen some postoperative myocardial infarctions and some bad outcomes related to the general anesthetic in patients undergoing an open or laparoscopic cholecystectomy for acute cholecystitis. The patients presented here are our sicker patients who develop acute cholecystitis. I think this is evidenced by the one patient who came into the hospital with an acute myocardial infarction, subsequently developed acute cholecystitis, was treated with a percutaneous cholecystostomy tube, had failure of improvement of his symptoms, and then underwent open cholecystectomy. He then died after the open cholecystectomy from another myocardial infarction.

The sonographic Murphy’s sign is a term used to indicate the patient complaining of tenderness when the ultrasound is placed over the gallbladder. Of the survivors, they are not all scheduled to undergo cholecystectomy. Those with calculous disease will be followed and cholecystectomy recommended if they develop symptomatic calculous disease. Of the patients with stones whose risk for general anesthetic continues to be prohibitive, those patients are not scheduled to undergo elective cholecystectomy. Only those patients who failed percutaneous stone removal and who developed symptoms are the ones planned for cholecystectomy or those patients whose risk for general anesthetic improves in follow-up.

Dr Madura asked a very pertinent question. How do we know that our deaths in this series are not secondary to failure of this technique, development of a gangrenous gallbladder, perforation, and ongoing sepsis? There were no postmortem examinations in the 8 patients who did die in this series. One patient clearly was a failure of the percutaneous cholecystostomy and that is a patient who was admitted with a myocardial infarction, underwent placement of the tube, then worsened. At the time of open surgery, he did have a perforated gangrenous gallbladder. He died from the postoperative myocardial infarction. Of the remaining 7 patients by chart review, it seemed clear to us that they had other more likely probable causes of death. Two of these occurred in patients having ongoing complications after open heart surgery, including mediastinal sepsis and multiple organ failure. Half of the patients who died in the series had renal failure. Two patients died from myocardial infarction. Two patients had...
Dr Byrne, we cannot state that our study has shown that stones must be cleared because we have not compared techniques of clearing stones or not clearing stones and outcome. The literature suggests that the rate of recurrent cholecystitis may be higher if stones are left in place.

Dr Koep, we do not routinely irrigate these catheters after they are placed. I am aware of no patients in the study who had severe hepatic dysfunction or cirrhosis.

Surgically cleared stone: The rate of recurrent cholecystitis or cases of sepsis including necrotizing fasciitis of the arm with gangrene and ischemic colitis.

A controlled clinical trial is organized and carried out.

Laparoscopic cholecystectomy should be performed in high-risk patients with acute cholecystitis until a prospective multicenter trial is organized and carried out.

The diagnosis is often uncertain, even when the patient’s condition improves after the procedure. A prospective trial comparing cholecystostomy with laparoscopic cholecystectomy is needed and, given the high mortality and morbidity rates, is justified. Enrollment criteria and objective measures of success or failure must be developed. Risk stratification using a system more sensitive than American Society of Anesthesiologists classification is necessary. Finally, long-term follow-up and measures of quality of life are necessary. We shall not know whether percutaneous cholecystostomy or laparoscopic cholecystectomy should be performed in high-risk patients with acute cholecystitis until a prospective multicenter trial is organized and carried out.

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Impact of Same-Day Screening Mammography Availability: Results of a Controlled Clinical Trial
Nancy C. Dolan, MD; Mary McGrae McDermott, MD; Monica Morrow, MD; Luz Venta, MD; Gary J. Martin, MD

ARCHIVES OF INTERNAL MEDICINE
Impact of Same-Day Screening Mammography Availability: Results of a Controlled Clinical Trial
Nancy C. Dolan, MD; Mary McGrae McDermott, MD; Monica Morrow, MD; Luz Venta, MD; Gary J. Martin, MD

Background: We conducted a prospective controlled clinical trial in an urban academic general medicine practice to test the effect of same-day mammography availability on adherence to physicians’ screening mammography recommendations.

Patients and Methods: Participants were a consecutive sample of 920 female patients aged 50 years or older who had received a physician’s recommendation for screening mammography at an office visit and had no active breast symptoms, history of breast cancer, or a mammogram within the previous 12 months. Women were assigned to same-day screening mammography availability (intervention group) or usual screening mammography scheduling (control group).

Main Outcome Measures: Three-, 6-, and 12-month rates of adherence to physicians’ recommendations for screening mammography.

Results: Twenty-six percent of women in the intervention group obtained a same-day screening mammogram. At 3 months, 58% of the women in the intervention group underwent the recommended screening mammography compared with 43% of the women in the control group (P<.001), increasing to 61% and 49% at 6 months (P<.001), and 268 (66%) of 408 vs 287 (56%) of 512 at 12 months (P=.003). The difference between the intervention and control groups 3-month adherence rates was most marked among women aged 65 years or older (38% vs 34%; P<.001), women who were not employed (34% vs 36%; P=.001), and women with a history of having had either no mammograms (39% vs 20%; P=.02) or only 1 to 2 mammograms (57% vs 38%; P<.001) within the last 5 years.

Conclusions: Same-day mammography availability increased 3-, 6-, and 12-month screening mammography adherence rates in this urban academic general medicine practice. The effect was most marked among women aged 65 years or older, women who were not employed, and those who had had fewer than 3 mammograms in the last 5 years. The efficacy of this intervention in other settings still needs to be demonstrated. (1999;159:393-398)

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