

# Canadian Association of General Surgeons and American College of Surgeons Evidence Based Reviews in Surgery. 18

## Treatment of occult pneumothoraces from blunt trauma

Andrew W. Kirkpatrick, MD; Mary vanWijngaarden Stephens, MD; Tim Fabian, MD; for the Members of the Evidence Based Reviews in Surgery Group\*

### CAGS Evidence Based Reviews in Surgery

The term “evidence-based medicine” was first coined by Sackett and colleagues as “the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients.”<sup>1</sup> The key to practising evidence-based medicine is applying the best current knowledge to decisions in individual patients. Medical knowledge is continually and rapidly expanding, and it is impossible for an individual clinician to read all the medical literature. For clinicians to practise evidence-based medicine, they must have the skills to read and interpret the medical literature, so that they can determine the validity, reliability, credibility and utility of individual articles. These skills are known as critical appraisal skills. Generally, critical appraisal requires that clinicians have some knowledge of biostatistics, clinical epidemiology, decision analysis and economics, as well as clinical knowledge.

The Canadian Association of General Surgeons and the American College of Surgeons jointly sponsor a program entitled “Evidence Based Reviews in Surgery (EBRS),” which is supported by an educational grant from ETHICON and ETHICON ENDO SURGERY, both units of Johnson & Johnson Medical Products, a division of Johnson & Johnson, and ETHICON INC. and ETHICON ENDO-SURGERY, INC. divisions of Johnson & Johnson Inc. The primary objective of this initiative is to help practising surgeons improve their critical appraisal skills. During the academic year, 8 clinical articles are chosen for review and discussion. They are selected not only for their clinical relevance to general surgeons but also because they cover a spectrum of issues important to surgeons; for example, causation or risk factors for disease, natural history or prognosis of disease, how to quantify disease (measurement issues), diagnostic tests and the early diagnosis of disease, and the effectiveness of treatment. A methodological article is supplied that guides the reader in critical appraisal of the clinical article. Both methodological and clinical reviews of the article are performed by experts in the relevant areas and posted on the EBRS Web site. As well, a listserv discussion is held where participants can discuss the monthly article. Members of the Canadian Association of General Surgeons and the American College of Surgeons can access Evidence Based Reviews in Surgery through the Canadian Association of General Surgeons Web site ([www.cags-accg.ca](http://www.cags-accg.ca)) or the American College of Surgeons Web site ([www.facs.org](http://www.facs.org)). All journal articles and reviews are available electronically through the EBRS Web site. We also have a library of past articles and reviews that can be accessed at any time. Surgeons who participate in the monthly packages can obtain Royal College of Physicians and Surgeons of Canada Maintenance of Certification credits and/or continuing medical education credits for the current article only by reading the monthly articles, participating in the listserv discussion, completing the monthly online evaluation and answering the online multiple choice questionnaire. For further information about EBRS, the reader is directed to the CAGS or ACS Web site or should email the administrator, Marg McKenzie, at [mmckenzie@mtsinai.on.ca](mailto:mmckenzie@mtsinai.on.ca).

In addition to making the reviews available through the CAGS and ACS Web sites, 4 of the reviews are published in condensed versions in the *Canadian Journal of Surgery* and 4 in the *Journal of the American College of Surgeons* each year. We hope readers will find EBRS useful in improving their critical appraisal skills and also in keeping abreast of new developments in general surgery. Comments regarding EBRS may also be directed to [mmckenzie@mtsinai.on.ca](mailto:mmckenzie@mtsinai.on.ca).

### Reference

1. Evidence-Based Medicine Working Group. Evidence-based medicine. *JAMA* 1992;268:2420-5.

\*The CAGS Evidence Based Reviews in Surgery Group comprises Drs. J.S.T. Barkun, K. Brasel, G.W.N. Fitzgerald, H.J.A. Hentleff, A.W. Kirkpatrick, S. Latosinsky, H.M. MacRae, T.M. Mastracci, R.S. McLeod, L.A. Neumayer, D. Rogers, M.C. Taylor and E.M. Webber and Ms. M.E. McKenzie.

**Correspondence to:** Ms. Marg McKenzie, RN, Administrative Coordinator, EBRS, Mount Sinai Hospital, 1560- Murray St L3-010 PO Box 23, Toronto ON M5T 3L9; fax 416 586-5932; [mmckenzie@mtsinai.on.ca](mailto:mmckenzie@mtsinai.on.ca)

## Selected article

Brasel K, Stafford RE, Weigelt JA, et al. Treatment of occult pneumothoraces from blunt trauma. *J Trauma* 1999;46(6):987-91.

## Abstract

**Question:** Can occult pneumothoraces be safely observed without the need for a chest tube? **Design:** A randomized controlled trial. **Setting:** Two trauma centres in the United States. **Patients:** Thirty-nine patients with 44 pneumothoraces (defined as a pneumothorax seen on abdominal CT scan but not on an anteroposterior chest x-ray as read by the trauma chief resident or attending staff member) were enrolled. **Intervention:** Within 6 hours of admission, patients were randomized to receive a chest tube ( $n = 18$ , group 1) or observation ( $n = 21$ , group 2). Chest tubes remained in place for a median 3 days (range 1-12 d). **The main outcome measures were:** Respiratory distress, pneumothorax progression, pneumonia, retained hemothorax and chest tube insertion. **Results:** One nonintubated patient with a chest tube developed respiratory distress, and 3 who were being observed had respiratory distress without pneumothorax after these were removed from suction; 3 patients without chest tubes had pneumothorax progression, 2 while being ventilated. No differences were statistically significant. **Conclusions:** Pneumothoraces can be safely observed in patients with blunt trauma regardless of the need for positive pressure ventilation.

## Commentary

The term "occult pneumothorax" (OPTX) describes a pneumothorax (PTX) that is not suspected on the basis of either clinical examination or plain radiograph but is detected with thoraco-abdominal CT.<sup>1-5</sup> This situation is increasingly common in

contemporary trauma care with the increased use of CT. Several authors have reported a remarkably consistent rate of 5.2%-8.0% in injured people presenting to hospital.<sup>2,4,6-10</sup> CT seems to reveal at least twice as many PTXs as plain radiographs. In several series, up to 72% of all traumatic PTXs are now described as occult (OPTX).<sup>3-5,7-9,11-14</sup> Although PTXs are a common and treatable cause of mortality and morbidity, there is significant disagreement regarding the appropriate treatment of the OPTX. The controversy is the greatest in critical care unit populations who require positive pressure ventilation.

Brasel and colleagues performed a randomized controlled trial (RCT) to determine whether tube thoracostomies are necessary in patients with occult pneumothoraces, regardless of the size or requirement for positive pressure ventilation.<sup>2</sup> Of 86 eligible patients, 39 were enrolled in the trial and randomized to either treatment with a chest tube or observation. Patients were enrolled in the study within 6 hours of presentation. This 6-hour window of enrollment might allow a number of OPTXs to declare themselves clinically as requiring treatment, thus identifying those patients likely to have poorer clinical outcomes. Although this was possible, it did not seem to be the case. Further, the investigators are to be commended that they reported the demographic

information of those patients not included in the study. There were no statistically significant differences in the mean age, severity of injury, Glasgow coma scale, size of PTX or mechanism of injury of patients not included in the trial.

In the interest of patient safety, none of the patients, clinicians or study personnel were blinded to the treatment groups. Because this study pushed a traditional boundary of care (that of observing PTXs without a chest tube); distinguishing labels were placed on their beds and, more importantly, identifying signs were placed above their beds announcing the treatment group. This might bias the results with increased vigilance of the observed group and an increased likelihood of chest tube placement for unrelated or brief unsustained episodes of respiratory distress because of anxiety on the part of caregivers.

The primary outcome measures were respiratory distress and pneumothorax progression; pneumonia, retained hemothoraces and a requirement for a chest tube placement were also tracked (Table 1). No significant differences in any outcomes were observed. One non-intubated patient with a chest tube developed respiratory distress from stridor, and 3 patients who were being observed developed respiratory distress without PTX progression. Thus, the rates of respiratory distress were 5.5% (1/18) and 14.3%

**Table 1**

| Outcomes of interest with 95% CIs |                                   |                                    |                                 |
|-----------------------------------|-----------------------------------|------------------------------------|---------------------------------|
| Outcome measure                   | Group; no. (and %)                |                                    | Observed difference, % (95% CI) |
|                                   | Group 1 (chest tube) ( $n = 18$ ) | Group 2 (observation) ( $n = 21$ ) |                                 |
| Respiratory distress              | 1 (5.5)                           | 3 (14.2)                           | 8.7 (18.2)                      |
| Pneumothorax progression          | 4 (22.2)                          | 3 (14.2)                           | 8.0 (24.3)                      |
| Pneumonia                         | 2 (11.1)                          | 0 (0)                              | 1.1 (14.7)                      |
| Retained hemothorax               | 0 (0)                             | 1 (4.8)                            | 4.8 (9.1)                       |
| Chest tube insertion              | 4 (22.2)                          | 2 (9.5)                            | 12.7 (22.9)                     |
| CI = confidence interval.         |                                   |                                    |                                 |

(3/21) for the respective groups. This is actually a relative risk increase of 233% for the observation group, even though the difference was not statistically significant. Confidence intervals (CIs) are a way of measuring the precision of an estimate.<sup>15</sup> They provide the range of values within which the true difference is likely to reside. If the range is wide, even though "0" lies within the range, the clinician is less likely to consider 2 treatments equivalent. The CI may be calculated with a formula or estimated with the "rule of 9." In the observed group of patients, the estimated upper limit of the 95% CI for respiratory distress could be as high as  $9/21 = 0.429$ , or 43% of patients. If, indeed, this were the true rate of respiratory distress in the observed group, there would be significant clinical concern about observing this group of patients without the insertion of a chest tube, and this management would not appear to be equivalent to tube thoracostomy, since it would constitute a relative risk increase of respiratory distress of 715%.

The other primary outcome was PTX progression. Four patients with chest tubes placed on enrollment had PTX progression after the chest tubes were removed from suction, requiring the re-application of suction. Three patients in the observation group had PTX progression, constituting an event rate of 14%. In the latter, the upper boundary of the 95% CI may be as high as 43% (9/21), precluding the ability to be certain, from these study results, that observed OPTXs do not progress.

The observed differences in rates between the 2 groups for the various outcomes and the calculated 95% CI around these differences, which are wide in all instances, are shown in Table 1. Additionally, this trial was too small to detect differences in patient survival and differences in complications, particularly those

associated with chest tube insertion, such as empyema, lung injury and iatrogenic hematoma. This is an important consideration because complication rates of up to 21%<sup>16</sup> have been reported with the placement of chest tubes.

The authors concluded that it is possible to safely observe patients regardless of positive pressure ventilation or pneumothorax size, because no patient had clinically significant pneumothorax progression or respiratory distress related to the occult pneumothorax. However, there remains substantial probability that there could be meaningful differences in all the important outcomes of death, respiratory distress or pneumothorax progression, because the study had too few patients to be able to conclude equivalence. In fact, one other small RCT showed contrary results to this study. Enderson and colleagues<sup>17</sup> randomized 40 trauma patients with occult pneumothorax to management with tube thoracostomy (19) or observation (21). Eight of the 21 observed patients had progression of their pneumothoraces on positive pressure ventilation, with 3 developing tension pneumothoraces. None of the patients with tube thoracostomy suffered major complications as a result of the procedure. These authors concluded that even small pneumothoraces should have the placement of a chest tube, especially if the patient is on positive pressure ventilation.

Thus, in conclusion, Brasel and colleagues are to be commended for carrying out a difficult study that challenges an accepted but unproven standard of care; however, further trials are necessary to conclusively answer this question. Future studies should probably separate patients who do and do not require positive pressure ventilation.

**Competing interests:** None declared.

## References

1. Ball CG, Hameed SM, Evans D, et al. Occult pneumothorax in the mechanically ventilated trauma patient. *Can J Surg* 2003;46:373-9.
2. Brasel KJ, Stafford RE, Weigelt JA, et al. Treatment of occult pneumothoraces from blunt trauma. *J Trauma* 1999;46: 987-91.
3. Tocino IM, Miller MH, Frederick PR, et al. CT detection of occult pneumothoraces in head trauma. *AJR Am J Roentgenol* 1984;143:987-90.
4. Rhea JT, Novelline RA, Lawrason J, et al. The frequency and significance of thoracic injuries detected on abdominal CT scans of multiple trauma patients. *J Trauma* 1989;29:502-5.
5. Wall SD, Federle MP, Jeffrey RB, et al. CT diagnosis of unsuspected pneumothorax after blunt abdominal trauma. *AJR Am J Roentgenol* 1983; 141:919-21.
6. Garramone RR, Jacob LM, Sahdev P. An objective method to measure and manage occult pneumothoraces. *Surg Gynecol Obstet* 1991;173:257-61.
7. Wolfman NT, Myers MS, Glauser SJ, et al. Validity of CT classification on management of occult pneumothorax: a prospective study. *AJR Am J Roentgenol* 1998;171:1317-23.
8. Hill SL, Edmisten T, Holtzman G, et al. The occult pneumothorax: an increasing entity in trauma. *Am Surg* 1999;65:254-8.
9. Neff MA, Monk JS, Peters K, et al. Detection of occult pneumothoraces on abdominal computed tomographic scans in trauma patients. *J Trauma* 2000;49:281-5.
10. Omert L, Yeane WW, Protech J. Efficacy of thoracic computerized tomography in blunt chest trauma. *Am Surg* 2001;67:660-7.
11. Trupka A, Waydhas C, Hallfeldt KKJ, et al. Value of thoracic computed tomography in the first assessment of severely injured patients with blunt chest trauma: results of a prospective study. *J Trauma* 1997;43:405-12.
12. Guerrero-Lopez F, Vasquez-Mata G, Alcazar-Romero P, et al. Evaluation of the

- utility of computed tomography in the initial assessment of the critical care patient with chest trauma. *Crit Care Med* 2000; 28:1370-5.
13. Rowan KR, Kirkpatrick AW, Liu D, et al. Traumatic pneumothorax detection with thoracic US: correlation with chest radiography and CT - Initial experience. *Radiology* 2002;225:210-4.
  14. Kirkpatrick AW, Sirois M, Laupland KB, et al. Hand-held thoracic sonography for detecting post-traumatic pneumothoraces: The extended focused assessment with sonography for trauma (EFAST). *J Trauma* 2004;57:288-95.
  15. Montori VM, Kleinbar J, Newman TB, et al. Tips for learners of evidence-based medicine: 2 measures of precision (confidence intervals). *CMAJ* 2004;171: 611-5.
  16. Etoch SW, Bar-Natan MF, Miller FB, et al. Tube thoracostomy: Factors related to complications. *Arch Surg* 1995;130:521-6.
  17. Enderson BL, Abdalla R, Frame SB, et al. Tube thoracostomy for occult pneumothorax: a prospective randomized study of its use. *J Trauma* 1993;35:726-30.

## Canadian Medical Association



## Association médicale canadienne

### 2007 Special Awards – Call for Nominations

The Canadian Medical Association invites nominations for the 2007 special awards.

- Medal of Honour
- F.N.G. Starr Award
- Medal of Service
- May Cohen Award for Women Mentors
- Sir Charles Tupper Award for Political Action
- Award for Excellence in Health Promotion
- Award for Young Leaders
- Dr. William Marsden Award in Medical Ethics

Refer to the “Awards from CMA” section on [cma.ca](http://cma.ca) for detailed criteria on each of the awards or contact the awards co-ordinator at 800 663-7336 x2280.

Nominations should be submitted to:

**Chair, Committee on Archives and Awards  
c/o Committee Co-ordinator  
Corporate Affairs  
Canadian Medical Association  
1867 Alta Vista Dr.  
Ottawa ON K1G 3Y6**

Closing date for receipt of nominations is Nov. 30, 2006.

### Prix spéciaux pour l'an 2007 – Appel de candidatures

L'Association médicale canadienne sollicite des candidatures à ses prix spéciaux pour l'an 2007.

- Médaille d'honneur
- Prix F.N.G. Starr
- Médaille de service
- Prix May-Cohen pour femmes mentors
- Prix Sir-Charles-Tupper d'action politique
- Prix d'excellence en promotion de la santé
- Prix des jeunes chefs de file
- Prix Dr-William-Marsden d'éthique médicale

Voir «Prix et distinctions de l'AMC» sur le site [amc.ca](http://amc.ca) pour les critères détaillés de chaque prix ou contacter la coordonnatrice des prix au 800 663-7336, poste 2280.

Les candidatures doivent être soumises à la :

**Présidente, Comité des archives et des distinctions  
a/s Coordonnatrice des comités  
Affaires générale  
Association médicale canadienne  
1867, promenade Alta Vista  
Ottawa (Ontario) K1G 3Y6**

Les candidatures doivent être présentées au plus tard le 30 novembre 2006.