Thoracoscopy in the Subacute Management of Patients With Thoracoabdominal Trauma*


After the first year and through the fourth decade of life, trauma is the leading cause of death and disability in the United States. As many as one fourth of all trauma deaths occur as a result of chest injuries alone, and respiratory embarrassment is the main contributor to the majority of these deaths. Although many chest injuries are immediately apparent and rapidly compromise the normal physiology of the cardiorespiratory system, other injuries are less obvious and may go undiagnosed for days, weeks, or even years. Complications due to the delayed presentation and diagnosis of diaphragmatic rupture and visceral herniation following either blunt or penetrating thoracoabdominal trauma are well documented in the surgical literature. In addition, incarceration of visceral contents resulting from delayed diagnosis of diaphragmatic injuries following stab wounds has an associated 36 percent mortality rate.

Earlier diagnosis and treatment of many nonurgent thoracic and diaphragmatic injuries could potentially reduce morbidity and mortality following thoracoabdominal trauma. Plain chest radiographs have been reported as diagnostic in only 17 to 46 percent of patients with diaphragmatic rupture due to blunt trauma, depending on which side of the chest is involved. Computed tomography (CT) may be equally unreliable for diagnosing diaphragmatic and other thoracic injuries following either blunt or penetrating trauma. Currently available noninvasive diagnostic strategies remain inadequate for the reliable diagnosis of many nonurgent intrathoracic and diaphragmatic injuries that result from thoracoabdominal trauma.

Recent improvements in endoscopic surgical techniques and instrumentation have fostered a renewed interest in diagnostic and therapeutic thoracoscopy. Credible indications for the application of thoracoscopy are expanding beyond the simple diagnosis of pleural and pulmonary parenchymal diseases. A potential role for thoracoscopy in trauma patients remains undefined. Since 1987, we have performed

FIGURE 1. Left, Initial chest radiograph in case 2 shows right pulmonary contusion and elevated hemidiaphragm. Right, Follow-up chest radiograph obtained several days following injury shows worsening of diaphragmatic elevation with right lower lobe collapse. Ruptured diaphragm was present in this patient and was diagnosed thoroscopically.
thoracoscopy subacutely in four patients with blunt thoracoabdominal trauma who presented difficult diagnosti
c or management dilemmas during their subse-
quent hospital and posthospital courses.

Patients and Methods

Patients

Case 1: A 36-year-old man sustained multiple injuries in a single-
vehicle accident. Included in his injuries was a fracture of the
thoracic spine, which resulted in T10 paraplegia. On the fourth
hospital day, he developed a symptomatic right pleural effu-

sion. Thoracentesis revealed a chylous effusion. A thoracostomy tube was
placed and drained more than 2 L of chylous fluid per day. On the 15th hospital day, the patient was taken to the operating room and
under general anesthesia underwent right-sided thoracoscopy. No diaphragmatic injury was seen. Approximately 2,400 ml of chylous
fluid was aspirated, and no specific chylous leak was identified. The
patient underwent talc pleurodesis. Chest tube drainage decreased
rapidly, and the chest tube was removed on the 10th postoperative
day. He subsequently did well with no recurrence of his effusion.

Case 2: A 22-year-old man was involved in a high-speed motor
vehicle accident. His injuries included right-sided rib fractures and
pulmonary contusion. No abdominal injuries were immediately
diagnosed. The initial chest radiograph revealed a right pulmonary
contusion and elevated hemidiaphragm (Fig 1, left). He did not
require intubation, but over the next 5 to 7 days his respiratory
status worsened, and repeat chest radiographs revealed increased
fluid in the right pleural space and marked elevation of the right
hemidiaphragm with right lower lobe collapse (Fig 1, right).
Computed tomography was nondiagnostic. On the 11th hospital
day the patient underwent diagnostic thoracoscopy to determine
the etiology of the elevated right hemidiaphragm. General anesthe-
sia was administered through a double-lumen endotracheal tube.
Biopsy revealed normal liver and confirmed the diagnosis of
diaphragmatic rupture. The defect was required through a right
posterolateral thoracotomy under the same anesthesia. The patient
was discharged 6 days later and has done well.

Case 3: A 23-year-old woman sustained multiple injuries in a
high-speed motor vehicle accident. She suffered a closed head
injury, pelvic fracture, right femur fracture, and right pneumotho-
rax. Diagnostic peritoneal lavage at an outside hospital was negative.
A right chest tube was placed, and she was stabilized and transferred
to our facility 7 days later. Subsequent radiographic evaluations
revealed progressive elevation of the right hemidiaphragm with
right lower lobe and right middle lobe collapse (Fig 2, left).
Computed tomography was nondiagnostic (Fig 2, right). Fluoros-
copy was also unable to rule out diaphragmatic rupture. Ten days
after her injuries (3 days after transfer to our hospital), thoracoscopy
was performed to rule out diaphragmatic rupture. General anesthe-
sia was administered through a double-lumen endotracheal tube.
The diaphragm was clearly visualized and was found to be intact.
Examination of the right hemithorax revealed a right lower lobe
pulmonary contusion and a mediastinal hematoma involving the
phrenic nerve. The procedure was terminated, and a chest tube
remained in place for 3 days. The patient was transferred to a
rehabilitation facility 10 days later, after the respiratory status had
improved, for further management of her neurologic and orthopedic
injuries.

Case 4: A 60-year-old woman suffered multiple left-sided rib
fractures during a fall from a horse. A small left pleural effusion
was present on admission. The rib fractures healed, but the effusion
persisted. Over the next several weeks, the patient developed
symptoms related to worsening of the pleural effusion. Thoracen-
teses revealed initially serosanguineous fluid, which became a clear
exudate after several weeks. After repeated thoracenteses and a
negative evaluation for malignancy, the patient underwent thoraco-
scopy. No diaphragmatic injury was identified, biopsy specimens
of the pleura and lung were benign, and talc pleurodesis of the left
side of the chest was performed. General anesthesia was adminis-
tered through a double-lumen endotracheal tube. A chest tube was
in place for 2 days. The patient's postoperative course was unre-
markable, and the effusion has not recurred.

Operative Technique

The two-trocar technique was utilized in all four patients (Fig 3).
A 10-mm trocar was introduced into the pleural space in the sixth
intercostal space in the posterior axillary line. The thoracoscope
was introduced through this trocar. A second 10-mm trocar for
forceps and operating instruments was inserted more anteriorly
through a separate stab wound. In three of the four patients, a
double-lumen endotracheal tube was placed, allowing for one-lung
ventilation of the nonoperated side. This facilitated the maintenance
of controlled pneumothorax and improved visualization. The pleural
space was drained of fluid, and the entire hemithorax was visually
inspected. When indicated, tissue biopsies were performed with
the endoscopic biopsy forceps.

In the two patients requiring pleurodesis, sterile talc was insuf-
flated into the pleural space through the operating trocar while
under direct vision. Talc was insufflated until the entire visceral
pleura was evenly coated. A chest tube was then placed through
the more anterior of the two stab wounds, also under direct vision,
and the lung was re-expanded. The second stab wound was closed
in one layer.
Injuries followed by proper management could potentially shorten the patient's hospital stay, prevent subsequent hospitalizations, and, most important, reduce overall morbidity and mortality. Unfortunately, reports of delayed diagnosis of intrathoracic or diaphragmatic injuries following thoracoabdominal trauma continue to appear, mostly because currently available noninvasive imaging modalities are inadequate to diagnose many of these injuries.7-10

In examining the frequency of missed injuries following penetrating chest trauma, Hirshberg et al11 reported data from a prospective study involving 234 patients. On the basis of initial physical examination and plain radiographic findings, the diagnosis of diaphragmatic injury was missed in 5 of 14 patients in whom this injury was present. In addition, only 2 of 4 mediastinal vascular injuries were diagnosed, and 11 percent of penetrating pleural injuries were incorrectly diagnosed. Madden et al6 reported on 95 patients with stab wounds to the lower chest and abdomen, in 18 of whom unexpected diaphragmatic injury was found during routine abdominal exploration. These authors concluded that exploratory laparotomy is mandatory in this patient population until a reliable diagnostic alternative becomes available to rule out diaphragmatic injury.6 Unfortunately, even with laparotomy, small, potentially lethal defects in the diaphragm can sometimes be missed and can remain undiagnosed unless complications arise later.4

Blunt trauma can also be a cause of undiagnosed intrathoracic or diaphragmatic injuries. Here, too, currently available imaging modalities are less than optimal for the comprehensive diagnosis of many of these injuries. Right diaphragmatic rupture following blunt trauma, for example, is particularly difficult to diagnose on the basis of radiographic studies, even though the plain chest radiograph is probably the most sensitive and reliable noninvasive test available at the present time to make this diagnosis.13 Gelman et al10 reviewed the data on 50 patients with surgically documented diaphragmatic rupture due to blunt trauma. Plain chest radiographs were diagnostic in 46 percent of the patients with left-sided rupture and in only 17 percent of the patients with right-sided rupture.

Even less favorable results have been documented by many other authors reporting data on similar studies.7,8,14 Rhea et al14 reported on a series of 174 multiple-trauma patients undergoing abdominal CT for evaluation of potential intra-abdominal injuries. Twenty-four percent of these patients had evidence of chest injuries at the base of the thorax, as determined by abdominal CT scan, which were not evident on plain radiographs. Unfortunately, CT in and of itself cannot be used to diagnose many diaphragmatic and intrathoracic injuries that result from blunt trauma.
In the study by Gelman et al., CT alone could be used to diagnose diaphragmatic rupture in only one of the seven cases in which it was performed. A similar result was reported by Chen and Wilson, who reported no diagnostic CT scans in 11 patients with surgically proven diaphragmatic rupture following blunt or penetrating trauma.

Our results in blunt trauma suggest that diagnostic thoracoscopy may be of benefit when routine radiographic studies are inconclusive. In our limited experience, thoracoscopy has provided valuable and accurate information concerning the integrity of the hemidiaphragm and the etiology of pleural effusions in certain patients with blunt trauma. In three patients no diaphragmatic injury was detected, and alternative reasons for radiographic abnormalities were established or verified. In two of these three patients, a problematic effusion was successfully treated through thoracoscopic talc pleurod. The fourth patient had a ruptured right hemidiaphragm, which was accurately diagnosed by thoracoscopy, and appropriate surgical management was undertaken.

Very little has been written documenting the utility of diagnostic and therapeutic thoracoscopy in the management of blunt or penetrating thoracic trauma. In 1975, Jackson and Ferreira documented the efficacy of diagnostic thoracoscopy in identifying penetrating wounds to the lower part of the chest in patients in whom radiologic examinations were unremarkable. In their series of 11 patients undergoing thoracoscopy, the diaphragm was seen in only 6, but in 2 of these 6 patients, an unexpected diaphragmatic injury was seen. In 1981, Jones and colleagues reported data on diagnostic emergency thoracoscopy in 36 patients with hemothoraces following chest trauma. In this latter series, 35 of the 36 patients had thoracic injuries that were accurately defined with diagnostic thoracoscopy; there were no complications. In addition, based solely on the thoracoscopic findings, clinical management was altered in 44 percent of the 36 patients. Both of these series concluded that thoracoscopy was useful in the diagnostic evaluation of patients following thoracic trauma.

We believe that thoracoscopy is best utilized, not necessarily as an emergency procedure, but in the subacute treatment of selected patients who develop difficult diagnostic or management problems following blunt and possibly even penetrating trauma. Major complication rates following thoracoscopy for all indications are less than 2 percent, and mortality from these same procedures is less than 1 percent. The safety of this procedure compares favorably with the morbidity and mortality rates of undiagnosed diaphragmatic and thoracic injuries. With the recent improvements in video-assisted thoracoscopic surgery, we believe that this procedure should be utilized more often during the subacute management of selected patients with thoracoabdominal trauma. The incidence of delayed diagnosis of diaphragmatic injury and the subsequent herniation of visceral contents should be minimized as thoracoscopy becomes more widely available to supplement routine radiographic studies in the management of patients with thoracic trauma.

References