“Alternative” surgery in the trauma discipline essentially means nonoperative or a selective approach to the injured victim. Such an approach is a critical part of the trauma management options. However, it is unlikely that the term “alternative surgery” will be liberally used to depict this growing trend of nonoperative, selective, and minimally invasive trauma management because of its less than favorable connotations and biases with respect to alternative medicine. Although there are still clear indications for emergency operative intervention, the nonoperative or selective approach in both penetrating and blunt trauma is the state of the art.

Alternative medicine, as it applies to trauma management, might be safely considered an oxymoron. Its role in the evolving critical care pathways and management guidelines in trauma and critical care is essentially nonexistent. The National Institutes of Health has established an Office of Alternative Medicine that facilitates research and evaluation of unconventional medical practices. Alternative medicine is spiritedly discussed in some academic circles. Acupuncture therapy, an ancient Chinese art, is now acknowledged throughout the world, including the United States, as a valid clinical therapeutic modality. Recently, the National Institutes of Health convened a 12-member panel to weigh the scientific merit of acupuncture. A statement was issued by the panel supporting the integration of acupuncture into conventional medicine’s therapeutic regimen for certain conditions, including several pain conditions, stroke rehabilitation, headache, menstrual cramps, epididymitis (tennis elbow), low back pain, carpal tunnel syndrome, and asthma. With more and more legitimate academicians beginning to carefully review the merits and science of alternative medicine, this discipline can no longer be summarily dismissed as quackery.

With respect to “alternative” surgery in trauma management, the indications have become clearer and the great debates over the futility of alternative or nonoperative trauma management have become academic discussions of evidence-based data. Alternative surgery in the trauma discipline essentially means nonoperative or selective management. After military campaigns such as World War II, the Korean War, and the Vietnam War, the urban trauma centers that were spawned from these efforts endorsed many of the established trauma management paradigms. Aggressive operative intervention, including mandatory exploration, was the accepted approach to such injuries as penetrating central (zone II) neck, anterior abdominal, and back and flank injuries. As resuscitative and diagnostic capabilities improved, the acceptance of a high incidence of negative explorations, associated with a mandatory operative policy, began to be challenged. This evolving alternative management appropriately coincided with an era of high technology that included advanced endoscopic fiberoptics, computed tomography, ultrasonography, transesophageal echocardiography, and minimally invasive surgery. Currently, the trauma surgeon is afforded state-of-the-art diagnostic options that makes selective and nonoperative management very efficacious. This concept is not just applicable to certain subsets of victims of penetrating trauma, but has also been successfully incorporated in the management paradigm of blunt trauma. In fact, the ac-
acceptance of nonoperative management has become the rule rather than the exception in respect to both blunt hepatic and splenic injuries. The essential component of successful management remains good clinical judgement; however, evidence-based practice guidelines are being established by the major trauma organizations to provide a template for decision making.3,4 Although nonoperative management is now a critical part of the trauma management options, there are still clear indications for emergency operative intervention (Table 1).

### PENETRATING NECK INJURIES

For penetrating wounds in zone II (Figure 1), the dictum of mandatory operative exploration of any injury that penetrated the platysma was initially strongly advocated.4 However, the significant rate of negative explorations, particularly in the face of no clinical findings of an injury to a vital structure, prompted many to challenge this surgical dogma and endorse a more selective management. By definition, the selective approach requires that the trauma patient is indeed hemodynamically stable and has no physical findings consistent with an injury of the aerodigestive or neurovascular axis (Table 2). What is crucial to success of selective management is the trauma patient is indeed hemodynamically stable and has no physical findings consistent with an injury to a vital structure, prompted many to challenge this surgical dogma and endorse a more selective management. By definition, the selective approach requires that the trauma patient is indeed hemodynamically stable and has no physical findings consistent with an injury of the aerodigestive or neurovascular axis (Table 2). What is crucial to success of selective management is the trauma patient is indeed hemodynamically stable and has no physical findings consistent with an injury of the aerodigestive or neurovascular axis (Table 2). What is crucial to success of selective management is the trauma patient is indeed hemodynamically stable and has no physical findings consistent with an injury of the aerodigestive or neurovascular axis (Table 2). What is crucial to success of selective management is the trauma patient is indeed hemodynamically stable and has no physical findings consistent with an injury of the aerodigestive or neurovascular axis (Table 2).

### THORACOABDOMINAL INJURIES

The thoracoabdominal region is the ultimate “blind spot” in respect to penetrating torso wounds and diaphragmatic perforations. Unfortunately, there is no predictable timetable for the possible development of traumatic diaphragmatic hernia. Because the abdominal cavity has persistent positive pressure, as compared with the relatively negative intrathoracic pressure, the potential for herniation through a diaphragmatic laceration is real. Emphasis is placed on left-sided diaphragmatic injuries and the likelihood of herniation; however, complications can also occur as a result of right-sided diaphragmatic injuries, including the development of biliary-enteric fistulas and possible hepatic herniations. Because there is no set timetable for when such a herniation can occur, initial recognition and treatment of this injury is important in avoiding long-term sequelae.5,6 There have been a plethora of diagnostic studies proposed to detect diaphragmatic rents and thus determine the need for op-
greater than 95% risk of significant intra-abdominal injury with a gunshot wound to the abdomen (as reported by Moore et al18), the role of alternative surgery (nonoperative management) is questionable. Even if the nontherapeutic (or negative) exploration rate is higher, the advocacy of mandatory laparotomy is still justified, although Chmielewski et al19 have also emphasized the role of nonoperative management of gunshot wounds to the abdomen.

Selective or nonoperative management has been more widely accepted in the management of stab wounds to the anterior abdomen in hemodynamically stable and examineable patients with no peritoneal signs, evisceration, or gross blood coming out of any orifice. With this particular mechanism of injury, there are 2 basic management options of alternative surgery: expectant management (observation) or selective management (local wound exploration for determination of peritoneal penetration). Recent data analysis at our institution revealed that local exploration of stab wounds to confirm peritoneal penetration in a patient with no stigmata of an intra-abdominal injury yields an unacceptably high nontherapeutic laparotomy rate (Table 3).

Although there is some interest in selective management of gunshot wounds to the back and flank, with no clinical or radiographic evidence of peritoneal penetration the criterion standard approach is still operative intervention. However, selective management is the rule when the mechanism is a stab wound to the back and flank of a patient who is hemodynamically stable and has no peritoneal signs or evisceration. A triple-contrast assessment (intravenous, oral, and rectal or colonic contrast-enhanced computed tomographic scan) is the selective management approach of choice, along with a possible diagnostic peritoneal lavage.

**EXTREMITY INJURIES**

Extremity injuries in a patient who is asymptomatic and has no hard findings of vascular injury can be safely managed without exploratory angiography.20 Frykberg et al21 have recently advocated expectant management alone, without invasive or noninvasive studies, in penetrating extremity trauma with no evidence of a vascular injury. Therefore, alternative surgery also plays a key role in the successful management of extremity injuries.

**MINIMAL-ACCESS SURGERY**

Along with nonoperative and selective management, minimal-access surgery is an integral component of the al-
ternal surgery management paradigm. The addition of videoendoscopic technology to intracavitary endoscopy has led to a tremendous expansion of indications for minimal-access procedures in all fields of surgery. Trauma surgeons have sought to apply this technology to the care of their patients as well. As previously mentioned, the primary areas of focus have been the use of laparoscopy for the evaluation and treatment of thoracoabdominal injuries and abdominal injuries, and video-assisted thoracoscopy for the evaluation of the diaphragm in thoracoabdominal penetrating injuries and treatment of posttraumatic thoracic complications.

The use of laparoscopy to assess the peritoneal cavity for injury is not a new concept. Reports by Tostivint et al., Gazzaniga et al., and Carnevale et al. discussed the possibilities of using this minimally invasive approach to evaluate the peritoneal cavity for injuries. Opinion was varied as to its applicability. Interest in the technique waned; it was cumbersome and only the surgeon was able to visualize and manipulate the anatomy. Also, the advent of computed tomography provided more detailed information, including better delineation of the retroperitoneum.

In the last 8 years several investigators have examined the role of minimal-access surgery in evaluating injured patients. The goals, as with diagnostic peritoneal lavage and computed tomography, have been to avoid nontherapeutic laparotomies and their associated morbidity. Ivatury et al. reported 2 series of patients in which they demonstrated the utility of diagnostic laparoscopy (DL) in penetrating injury.

The first series looked at thoracoabdominal penetrations only. Hemodynamically stable patients having sustained penetrating thoracoabdominal injury underwent DL in the operating room under general anesthesia. A laparotomy was performed if a hollow viscous injury, diaphragmatic laceration, or significant hemoperitoneum was suspected. Diagnostic laparoscopy demonstrated that 20 of the 40 patients had not sustained a cavitary penetration. Hemoperitoneum was identified on DL in the other 20 patients. Seven patients were found to have diaphragmatic injuries on DL and this was confirmed at laparotomy. Five patients had nontherapeutic laparotomies, and 1 patient recovered uneventfully without laparotomy following identification of a nonbleeding liver laceration.

In the second series, Ivatury et al. looked at patients with abdominal penetrating wounds without obvious cavitary penetration as well as those with thoracoabdominal wounds. This second larger series confirmed the utility of DL in demonstrating diaphragmatic injuries and intracavitary penetration in patients with potentially tangential wounds. Forty-three patients had no peritoneal penetration on DL. Fifty-seven patients had peritoneal penetration. The authors reported an excellent diagnostic accuracy in the detection of hemoperitoneum, solid-organ injuries, diaphragmatic lacerations, and retroperitoneal hematomas. The technique was less reliable in its ability to detect hollow visceral injury, with 3 patients having multiple hollow visceral injuries found at laparotomy that were not detected on DL (although all had laparoscopic indications for laparotomy).

Sosa et al. supported the findings of Ivatury et al in a similarly paired series of patients with penetrating trauma to the abdomen.

Both DL and computed tomography can detect hemoperitoneum, with the latter being able to identify some solid-organ injuries. However, computed tomography cannot reliably rule out a hollow visceral injury. Thoracoscopy has also been used to evaluate diaphragmatic injuries as a result of thoracoabdominal penetration. An early series by Jones et al. and a preliminary series by Ochsner et al. touted the technique for its ability to be performed rapidly under local anesthesia and its therapeutic value in evacuating clotted or retained hemoperitoneum. More recently, Scherer et al. have advocated the use of video-assisted thoracic surgery to treat posttraumatic empyema. Fourteen patients with empyema were successfully managed with this technique, with only 3 necessitating an open thoracotomy for better drainage. Carrillo et al. shortened the hospital stay in patients with persistent posttraumatic pneumothorax by undertaking video-assisted thoracic surgery. Patients with posttraumatic pneumothorax, after 72 hours of traditional chest tube drainage, underwent thorascopic evaluation with stapled resection of identified sources of pneumothorax or thorascopic chemical pleurodesis.

ULTRASONOGRAPHY

Mostly because of the application of computed tomography, nonoperative management is now the mainstay in blunt trauma. Although not the case 10 to 15 years ago, operative intervention of hepatic or splenic injuries in patients who are hemodynamically stable, examinable, and without coagulopathy is the exception and no longer the rule.

Ultrasonographic examination in the evaluation of the injured patient is another excellent diagnostic adjunct. There has been a proliferation of courses to teach surgeons the physics, technique, and interpretation of ultrasonography as applied to trauma. In the routine application of ultrasonographic technology by surgeons in their daily practice, US surgeons are behind their European and Asian counterparts who have used this diagnostic modality for the last 2 decades. The accuracy of ultrasonography has been addressed by several authors.

The focused abdominal (or acute) sonogram for trauma involves 4 views of the abdomen and pericardium looking for free fluid. Presence of free fluid in the trauma setting is interpreted as being blood. The views obtained are the right upper quadrant (Morrison pouch), subxiphoid (pericardium), left upper quadrant, and pelvis (pouch of Douglas). The algorithms put forward by Rozycki and Shackford for penetrating chest wounds and blunt abdominal trauma provide a rational and easily remembered sequence for evaluating the injured patient with ultrasonography. The absence of free fluid on the focused abdominal sonogram allows for observation (including follow-up ultrasonographic examination). Definite free fluid in the pericardium warrants immediate operative exploration. Free intraperitoneal fluid warrants operation in the unstable patient and abdominal computed tomography to diagnose solid-organ injury in the stable patient.
examination results are equivocal, the patient with a penetrating chest wound is taken to the operating room for a pericardial window. The patient with blunt abdominal trauma who is hemodynamically stable undergoes further evaluation with diagnostic peritoneal lavage or computed tomography. The unstable patient with blunt abdominal trauma undergoes either diagnostic peritoneal lavage or operative exploration.

As with any new diagnostic modality, there is a learning curve in using ultrasonography for the evaluation of injured patients. An adequate didactic experience followed by proctored clinical experience with comparison of results with a known standard (diagnostic peritoneal lavage, computed tomography, or operative exploration) should be undertaken prior to reliance on surgeon-performed ultrasonography for clinical decision making. Although each individual institution and practitioner will have to address “true” or credentialing issues, ultrasonographic examination is now an integral component of a trauma surgeon’s armamentarium and is an excellent diagnostic tool for alternative surgery in the trauma setting.

CONCLUSIONS

Because of the less than favorable connotations and biases in respect to the description “alternative,” it is doubtful that the term “alternative surgery” will be liberally used to describe the growing trend of nonoperative, selective, and minimally invasive management of the injured patient. However, such treatment paradigms are the definition of an alternative approach to conventional operative intervention. Expeditious and mandatory operative exploration still has a pivotal role in optimal trauma management. Also, there are inherent disadvantages to selective management including cost, demand on the staff, demand on the physicians, and demand on hospital revenues. Even when the superiority selection approach has been well documented, all management paradigms should be based on the hospital and personnel resources. In respect to trauma management, alternative surgery is clearly here to stay.

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