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.

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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.1 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, epicondylitis (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-
Emerging camp has challenged the necessity of various diagnostic modalities used in selective management. Alteberry et al\(^1\) have advocated a strictly nondiagnostic and nonoperative approach for zone II penetrating injuries when there is no “hard clinical finding” of a vascular injury. This approach obviously does not address occult esophageal injury, which is known to be associated with increased morbidity and mortality in penetrating neck wounds. Even though some of the preliminary data from Alteberry et al are encouraging, this expectant management scheme, in which no diagnostic modalities are used, should be cautiously implemented. Preliminary data from our institution also suggest that expectant management of penetrating zone II injuries might be a rational approach in some centers. Although this type of expectant management is curiously similar to the practice several decades ago that resulted in unacceptable morbidity and mortality rates, the alternative approach, which embraces a nonoperative and nondiagnostic approach in penetrating zone II neck injuries, is being received more favorably and is being included in management paradigms based on outcome results (Figure 2).\(^1\)

**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-pleural 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.\(^1\) There have been a plethora of diagnostic studies proposed to detect diaphragmatic rents and thus determine the need for op-

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**Table 1. Clear Indications for Emergency Surgery**

<table>
<thead>
<tr>
<th>Significant neck wound bleeding</th>
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<tbody>
<tr>
<td>Pulsatile and/or expanding hematoma intervention</td>
</tr>
<tr>
<td>Massive hemothorax</td>
</tr>
<tr>
<td>Free air in the peritoneal cavity/retroperitoneal space</td>
</tr>
<tr>
<td>Peritoneal signs</td>
</tr>
<tr>
<td>Evisceration</td>
</tr>
<tr>
<td>Impaled object</td>
</tr>
<tr>
<td>Hemodynamic instability</td>
</tr>
</tbody>
</table>

**Table 2. Clinical Findings Consistent With Significant Injury in Zone II Penetrating Neck Wounds**

| Active bleeding from the wound                   |
| Neck bruise                                       |
| Dysphagia                                         |
| Hoarseness                                        |
| Subcutaneous emphysema                            |
| Expanding and/or pulsatile hematoma               |
| Neurologic deficit                                |
| Neck bruit                                        |

---

**Figure 1. Zone I indicates between the levels of the clavicles and the cricoid cartilage; zone II, between the levels of the cricoid cartilage and the angle of the mandible; and zone III, between the levels of the angle of the mandible and the base of the skull.**

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negative for general anesthesia.\(^{17}\) Phase of minimal-access surgery and circumvent the need in patients. Perhaps gasless laparoscopy will usher in the next effect on the optimal management of this cohort of pa-
ting diaphragmatic injuries (see the “Minimal-Access Sur-
gery was variable. Although the potential indica-
tions for operative intervention. Until recently, mandatory celi-
otomy was the only prudent option, because the like-
hood of detecting a diaphragmatic laceration by chest x-
ray film, diagnostic peritoneal lavage, computed tomography, magnetic resonance imaging, and ultrason-
graphy was variable. Although the potential indications of minimally invasive surgery in the trauma set-
ing are encouraging, this particular diagnostic modality has a clear role in the definitive evaluation of penetrat-
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nerve 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 se-
lected management approach of choice, along with a pos-
sible diagnostic peritoneal lavage.

## PENETRATING ANTERIOR ABDOMEN, BACK, AND FLANK INJURIES

The anterior abdomen is defined within the following boundaries: below the costal margin, above the inguinal ligaments, and anterior to the midaxillary lines. Currently, the most raging controversy in penetrating trauma deals with gunshot wounds to the abdomen and the role of nonoperative or selective management as opposed to mandatory exploration. The concept of nonoperative management of patients with gunshot wounds penetrating and traversing the abdominal cavity highlights a major departure from what has previously been considered sound clinical judgement. With a greater than 95% risk of significant intra-abdominal injury with a gunshot wound to the abdomen (as reported by Moore et al\(^{18}\)), 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 al\(^{19}\) 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 examinable 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 non-
therapeutic 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 se-
lected management approach of choice, along with a pos-
ible diagnostic peritoneal lavage.

## EXTREMITY INJURIES

Extremity injuries in a patient who is asymptomatic and has no hard findings of vascular injury can be safely man-
aged without exploratory angiography.\(^{20}\) Frykberg et al\(^{21}\) 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, mini-
mal-access surgery is an integral component of the al-

### Table 3. Penetrating Anterior Abdominal Injury

<table>
<thead>
<tr>
<th>Type of Injury</th>
<th>Total No. of Laparotomies</th>
<th>NL, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gunshot wounds</td>
<td>442</td>
<td>94 (21)</td>
</tr>
<tr>
<td>Shotgun wounds</td>
<td>7</td>
<td>2 (29)</td>
</tr>
<tr>
<td>Stab wounds</td>
<td>212</td>
<td>48 (23)</td>
</tr>
</tbody>
</table>

\(^{*}\)NL indicates nontherapeutic laparotomy.

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The use of laparoscopy to assess the peritoneal cavity for injury is not a new concept. Reports by Tostivint et al,22 Gazzaniga et al,23 and Carnevale et al24 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 retropitoneum.

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. Ivaturey et al25 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 cavity 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, Ivaturey et al25 looked at patients with abdominal penetrating wounds without obvious cavity 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 al26,27 supported the findings of Ivaturey 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.24,28,29 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 al30 and a preliminary series by Ochsner et al31 touted the technique for its ability to be performed rapidly under local anesthesia and its therapeutic value in evacuating clotted or retained hemothorax. More recently, Scherer et al32 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 al33 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.34-40

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 Shackford31 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. When the...
examination results are equivocal, the patient with a penetrating chest wound is taken to the operating room for 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 “turf” 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 depict 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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REFERENCES


