Summary&Conclusion

This is review on diaphragmatic injuries. It has correctly pointed out that identifying these injuries expeditiously remains problematic in spite of the advances in diagnostic technology with resulting potential for serious morbidity and delayed treatment. More significantly, there is a detailed description of the anatomy and physiology of the diaphragm which is important for those who will manage these injuries.

The overall incidence of 0.63% as reported from a query of over 950,000 trauma patients in the NTDB must be viewed critically as these data reflect a wide range of trauma severity and undoubtedly grossly underrepresent patients with a delayed diagnosis. Many series report the incidence of diaphragmatic rupture in those patients with significant thoracoabdominal trauma to be in the 5 to 8% range. They clearly emphasize that associated injuries are very common, some even report up to a 100% incidence, though the severity of these other injuries varies widely. While there are no pathognomonic external signs, the presence of upper abdominal contusions (such as from an improperly placed lap belt or reflecting a direct blow to this area) should raise one's suspicion in patients suffering blunt trauma. Likewise, diaphragmatic injury must always be considered in patients with lower thoracic/upper abdominal penetrating wounds. In the acute phase, signs and symptoms, if present, generally result from the associated injuries.

Diagnosis is easy if there is herniation of the stomach, however, plain films may not be diagnostic in the presence of pulmonary contusion or hemothorax or misinterpreted as diaphragmatic eventration. Ultrasonography, including the FAST exam, may show abnormal diaphragmatic excursion (if the patient is breathing spontaneously) or an abnormal splenic/renal relationship. Multislice CT, especially with

sagittal reconstructions, has been shown to be highly reliable in some centers. Although MRI may clearly show visceral herniation through the diaphragm, it has a limited role in the acute setting with current equipment. It is important to keep in mind that herniation of abdominal viscera may not occur while the patient is on positive pressure ventilation with subsequent delay in diagnosis and treatment of a diaphragmatic laceration.

Both laparoscopy and thoracoscopy have been touted by some as highly reliable for identifying this injury though either approach is dependent upon the skill and thoroughness of the operator. If diagnostic laparoscopy is employed, one must be aware of the potential for developing a tension pneumothorax during creation of the pneumoperitoneum and be prepared to rapidly decompress the pleural space. While some lacerations may be repaired via the laparoscope or thoracoscope, associated injuries often require an open procedure. The importance of a thorough inspection of the diaphragms, whether approached by an open procedure or by minimally invasive techniques, cannot be overemphasized. There are several series reporting missed injuries, even in experienced hands, following laparotomy.

Although a variety of techniques and suture material has been shown to be effective, for example nonabsorbable suture, taking large bites to include both the peritoneal and parietal pleural membranes , closure of small lacerations using horizontal mattress sutures or useing simple running closure for longer lacerations. The vast majority of acute injuries can be closed primarily though significant tissue loss, such as a shotgun wound, may require prosthetic material. The surgical repair for chronic diaphragmatic injuries is usually transthoracic and may be challenging due to adhesions, intestinal strangulation, and atrophy or retraction of the diaphragm. Prosthetic mesh, transposition of the

diaphragmatic thoracic wall attachments, and/or autogenous tissue flaps may be required. The increasing management of both penetrating and blunt abdominal trauma, including patients with known splenic and/or liver lacerations, nonoperatively may result in a higher incidence of late presentations of diaphragmatic injuries in the future.

Surgeons who will manage trauma patients must be aware of the anatomy of the diaphragm and the findings, diagnostic difficulties,and treatment options for diaphragmatic injuries.