Anterior Video-Assisted Thoracoscopic Release With Posterior Fixation In Treating Rigid Thoracolumbar Scoliosis
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Citation

Abstract
Background: Minimally invasive surgical techniques are wide spreading in different surgical subspecialties using different endoscopic techniques in dealing with major surgical problems in spine surgery is replacing open surgery to reduce the morbidity after extensive approaches and to improve the quality of life of the patients. Endoscopic surgeries on the spine are less invasive, it decrease the recovery time, hospital stay and ultimately cost saving. Improved fibro -optics, light sources, and the advent of the 3-dimensional video camera improves the visualization of the structures surrounding the spine.

Methods: This study included 30 cases prospectively by VATS technique and 20 cases retrospectively by open surgery as first stage and the second stage was done by open posterior surgery in both groups, and the final results are compared regarding certain items that included the hospital stay, need for ICU admission, blood loss, cosmetic appearance, patient satisfaction and the surgical time in relation to the first stage surgery in all patients in order to reach a recommendation regarding the use of VATS techniques in treating dorsolumbar scoliosis. Fifty cases, (37 females and 13 males), with congenital scoliosis in 15 cases and idiopathic scoliosis in 35, were operated upon for the treatment of their scoliotic deformity to perform only anterior release (42 cases) or corpectomy (8 cases) with posterior stabilization either through an open thoracotomy (20 cases) or video assisted thoracoscopic surgery with the patient in the lateral decubitus position under fluoroscopic guidance (30 cases). Full pre-operative laboratory and radiological investigations including routine MRI were done. The average operative time in the VATS group (30 Cases) was 3.1 hours the average blood loss was 274cc.

Results: After 24 months of follow-up, 36 patients showed excellent results (22 VATS cases, 14 thoracotomy cases), 12 cases had good results (8 VATS cases, 4 thoracotomy cases), and two thoracotomy cases had fair results according to the Oswestry disability questionnaire, and Cobb’s angle measurements. VATS cases showed less blood loss without major surgical complications, intensive care unit admission was needed in 2 cases only for less than 24 hrs, the average hospital stay was 10 days, and showed better results (excellent 73.3%, good 26.7% ) with patient more satisfaction as compared with open surgery. Open thoracotomy cases showed more blood loss, surgery complications, all cases needed intensive care admission for average of 3 days, and hospital stay (average 18 days), and showed slightly inferior results (excellent 70%, good 20% , fair 10%).

Conclusions: We recommend video assisted thoracoscopic surgery instead of open thoracotomy in anterior release of thoracolumbar scoliosis because of better visualization, wider exposures, greater access to multiple levels, reduced surgical time, less tissue damage, decreased blood loss, reduced postoperative pain, improved postoperative respiratory function, shorter stays in the ICU and hospital, reduced potential for infection and decreased cost.

INTRODUCTION
Anterior spine surgery became more popular over the last two decades. It could be a solo technique or combined with posterior surgery. (Lieberman, 2000)

The applications of video assisted endoscopic spine surgeries are rapidly expanding. Video assisted Endoscopic procedures offer the potential to decrease surgical morbidity associated with conventional open techniques. Thoracoscopic approach to the thoracic spine between the 4th and the 8th thoracic vertebrae is usually done in the lateral decubitus where the initial port is placed at the mid-
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The access to the spine through these ports is rendered difficult by the inflated lung. To overcome this problem, a double lumen intubation is initially done to allow collapse of the corresponding lung, and special long-handled instrument are used. (Regan JJ, 1997)

The advantages of video assisted spine surgery include; minimal incisions and better cosmeses, less morbidity, tissue damage, minimal blood loss, better visualization, wider exposures with greater access to multiple levels, short operative time, reduced postoperative pain, improved postoperative respiratory function, shorter stays in the ICU and hospital, reduced potential for infection, decreased rehabilitation time, and reduced overall medical cost. (Lieberman, 2000)

The aim of this study is to discuss video assisted thoracoscopic release in scoliotic patients and to evaluate the effectiveness of the new technique in treatment of thoracolumbar scoliosis

PATIENTS AND METHODS

This study was conducted from year 2000 to year 2005. This study involved 50 patients with thoracolumbar scoliosis underwent video assisted endoscopic surgery (30 prospective cases) in comparison with open anterior surgery (20 retrospective cases). There were 13 males and 37 females, age group ranging from 6 to 20 years. Their occupations vary from mild activities (students): 30 cases to light duties (clerks, house keepers): 20 cases.

All the patients in this study underwent full general, neurological, and pulmonary function evaluations. Radiological work-up were done for all patients in the form of plain x-rays (antero-posterior views in the standing position: neutral, right bending, and left bending, and lateral view of the dorsolumbar spine), MRI, and CT-scan in severely deformed cases (8 cases).

There were 42 cases with idiopathic scoliosis in the two groups (25 in VATS patients and 17 in open thoracotomy group), while 8 had congenital anomalies in the form of hemivertebrae and unsegmented bars (5 in VATS patients and 3 in open thoracotomy group).

Preoperative scoliotic curve for all patients was 43° -76° (Av= 62 ± 5), while the Postoperative curve was 15° -25° (Av= 21± 2), table {1} and {2}.

Out of 30 patients who had video assisted thoracoscopic
technique, 25 had thoracoscopic release while only 5 had corpectomy. While the 20 patients who had open thoracotomy; 17 patients needed only release while 3 patients had corpectomy.

For second stage posterior instrumentation; pedicular screws & hooks were used in 22 cases of the VATS group and in 12 cases of the open thoracotomy group, while posterior Hartichell rectangles system was used in 8 cases of the VATS group and in 8 cases of the open thoracotomy group, figure {1}.

**Figure 3**
Figure 1: Left: Hartichell rectangles system. Right: pedicular screws & hooks

**OPERATIVE TECHNIQUE**

The entire procedure was carried out under general anaesthesia using double-lumen endotracheal tube. The classical thoracoscopic position utilizing the lateral decubitus to access the thoracic spine is used, figure {2}.

A skin incision (not more than 3 cm) was done just medial to the medial border of the scapula at the level that produced direct exposure of the spinal lesion. The intercostals muscles and parietal pleura were split with scissors. A self-retaining retractor was then inserted. The incision of the trocar was done cranial or caudal to the main working area. The lung was partially deflated until a malleable retractor was inserted anterior to the vertebral column. The parietal pleura was divided longitudinally at appropriate levels. The lesion site was identified and displayed on the video monitor. A guide pin was then inserted in the adjacent disc space or vertebrae and a C-arm was used to ensure the localization. The segmental vessels at the operated level were ligated and divided. The disc spaces were accessed and discectomy was done at multiple levels to have the maximum release, and corpectomy for wedged vertebrae was done in eight congenital cases.

Thus in our study, two portals are used; the first one is the working area and is not more than 3 cm in length and is medial to the scapular medial border while the other one is just for illumination by the scope. This allows both direct and endoscopic visualization; also it allows easy use of instrumentations which the surgeon is already familiar with, and the medially placed working area allows adequate visualization of the spine without the need of complete single lung collapse; only partial single lung collapse is used.

In all the video assisted thoracoscopic cases, posterior stabilization of the affected segments was done in the same setting, using pedicular screws & hooks in 22 cases and Hartichell rectangles system in 8 cases, after repositioning the patient in prone decubitus. Wake-up test to detect any...
neurological deficit was used in these cases with no neurologic deficit detected.

The 20 cases of open thoracotomy were done in the conventional method using the classical lateral decubitus, and posterior stabilization was done after 2 weeks from the open anterior release using pedicular screws & hooks in 12 cases and Hartichell rectangles system in 8 cases. Also the wake-up test to detect any neurological deficit was used in these cases with no neurologic deficit detected.

Radiological examination was repeated at the immediate postoperative period and at 3 month intervals for 1 year. Further follow-up was done at 18 and 24 months postoperative.

RESULTS

The operative time for the whole procedure (VATS) ranged from 2.6 to 5 hours (mean 3.1). The total blood loss ranged from 210 cc $^3$ to 390 cc $^3$ (mean 274) compared to mean of 420 in open surgery. No intraoperative complications were encountered. One patient developed postoperative surgical emphysema that resolved spontaneously 3 days after the operation. Conversion to open techniques was not needed. The period of follow up ranged between 18 to 24 months. No neurological complications related to the surgical procedure were encountered.

The preoperative scoliotic angle of the affected segments improved, (from $62 \pm 5^\circ$ to $21 \pm 2^\circ$) in VATS compared to $23 \pm 2^\circ$ in open surgery, along the postoperative period. No instances of metal failure or pseudoarthrosis were encountered, table {1} and {2}, and figure {3}, {4}, and {5}.

Excellent results were encountered in 36 patients (22 VATS cases, 14 thoracotomy cases), 12 cases had good results (8
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VATS cases, 4 thoracotomy cases), and two thoracotomy cases had fair results according to the Oswestry disability questionnaire, and Cobb's angle measurements.

VATS cases showed less in blood loss, surgery complications, immediate post operative complications, intensive care unit admission (2 cases, less than 24 hrs), and hospital stay (average 10 days), and showed slightly better results (excellent 73.3%, good 26.7%). Open thoracotomy cases showed more in blood loss, surgery complications, immediate post operative complications, intensive care unit admission (all cases, average 3 days), and hospital stay (average 18 days), and showed slightly inferior results (excellent 70%, good 20%, fair 10%), table 3.

**Figure 8**

Table 3: Comparison of results of both groups

<table>
<thead>
<tr>
<th></th>
<th>VATS group</th>
<th>Thoracotomy group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (mL)</td>
<td>274</td>
<td>420</td>
</tr>
<tr>
<td>Complications in surgery</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Immediate post operative complications</td>
<td>Delayed lung expansion</td>
<td>No</td>
</tr>
<tr>
<td>Intensive care unit admission</td>
<td>2 cases, less than 24 hrs</td>
<td>all cases, average 3 days</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>average 10 days</td>
<td>average 18 days</td>
</tr>
<tr>
<td>Angle of correction</td>
<td>21° ± 2°</td>
<td>23° ± 2°</td>
</tr>
<tr>
<td>Late Complication</td>
<td>No</td>
<td>Wound infection in 1 case</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Minimally invasive surgical techniques are becoming more widely spreading in the surgical subspecialties. Standard open surgical procedures are modified to become less invasive, with the hopes of decreased recovery time, lessened morbidity, and ultimately, cost savings. (Regan, 1997)

VATS has now become an effective tool in the management of different spinal disorders and is rapidly expanding. The thoracic cavity offers an ideal environment for performing endoscopically video assisted surgery. Magnification, better illumination, and alternative angles of visualization all facilitate surgery through a minor access, the improvements in the appearance of the scar, the reduced surgical trauma, and the rapid recovery make thoracoscopic surgery one of the greatest advances in spine surgery in recent years. (Rosenthal and Dickman, 1999)

Thoracoscopic surgery is a really demanding surgical technique in comparison to open conventional techniques; these demands include the required equipments and surgical expertise. Gaining the appropriate experience to carry on thoracoscopic intervention involves a large investment of time and effort on the part of the surgical team and operating theatre supporting staff. Part of the required experience is to learn the technique on cadavers and experimental animals before carrying thoracoscopic procedures on humans. (Dickman, and Fessler, 1999)

McAfee reported about difficulties in managing thoracolumbar pathology (T11-L2) due to the high riding of the dome of the diaphragm; he performed additional ports for diaphragmatic retraction downward to clear the field at this level. (McAfee and Regan, 1997)

Rosenthal stated that thoracoscopic corpectomy of T12 is not difficult in comparison with open technique; he added that thoracic spine can be accessed thoracoscopically at T12-L1 disc space. (Rosenthal, 2000)

In the present study difficulties encountered in video assisted thoracoscopic approach to T12-L1 level and were managed by partial detachment of the diaphragm from the lumbar spine using Cobb's elevator followed by ligation of bleeding segmental vessels. This approach has no post operative morbidity as the detached area is localized over the disc space level.

Complications of posterior approach and instrumentation as pedicle screws malpositioning, implants failure, deep wound infections and neural compromise during corrective osteotomy were recorded by Huang et al apart from thoracoscopic complications. (Huang et al., 1997)

Tracheal mucous plug after prolonged single lung anesthesia, lung atelectasis, pneumothorax, were reported complications in study done by Benumof JL, et al. in 1987. (Benumof JL, et al., 1987)

In the current study the only recorded complication were superficial wound infection recorded in one case at the posterior approach (3%) and three cases of mild intercostal neuralgia (9%), there was no need for revision surgery.

In our study, two portals are used; the first one is the working area and is not more than 3 cm in length and is medial to the scapular medial border while the other one is just for illumination by the scope. This allows both direct and endoscopic visualization; also it allows easy use of instrumentations which the surgeon is already familiar with, and the medially placed working area allows adequate visualization of the spine without the need of complete
single lung collapse; only partial single lung collapse is used. This approach is easy for the spine surgeon to use with no need for the aid of an endoscopic surgeon and only one assistant is needed by the surgeon. The learning curve of this procedure is not difficult as both direct and endoscopic visualizations are used, and the surgeon uses the same instruments that he is familiar with.

Thus unlike other endoscopic transthoracic approaches where at least three to four separate skin incisions are needed the prescribed endoscopic technique utilizes one or maximally two channels. This approach avoids some disadvantages commonly encountered with endoscopic transthoracic approaches; for example: single lung-anaesthesia with its poor tolerance in old people, and some technical problems related to placing the working port far from the spinal lesion.

The results of this study show that this approach is relatively safe and effective with superior advantages over the classical endoscopic and open methods and maintaining the principals of minimal invasive surgery. Thus we recommend the usage of this technique in thoracoscopically approached spine surgeries.

References

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