Early experience of endoscopy-assisted anterior spinal surgery

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ABSTRACT

Purpose. Endoscopy-assisted anterior spinal surgery is less invasive, resulting in less tissue trauma. It has a shorter recovery period, leads to less morbidity, and is more cost-efficient than conventional surgery. We report our early experience of endoscopic anterior spinal surgery in Thailand, which was performed with a basic laparoscopic instrument set and self-developed instruments for spinal surgery.

Methods. All patients who underwent endoscopic anterior spinal surgery from July 2000 to May 2001 at the Orthopaedic Department, Nakhonpathom Hospital, Nakhonpathom were prospectively documented. The two-portal technique was applied on these patients: the first portal, a 4-cm skin incision, was made as the portal for the surgical instruments; the second portal, a one-cm skin incision, was made as the portal for the endoscope.

Results. Nine patients underwent anterior spinal surgery with the minimally invasive technique. The mean patient age was 51.5 years (range, 17–72 years); 3 patients were females and 6 were males. The procedures included thoracoscopy, retroperitoneoscopy, diaphragmatic crus detachment, discectomy, corpectomy, fusion, and instrumentation. The mean operating time was one hour 58 minutes, and the mean estimated blood loss was 372 ml; there were no serious complications.

Conclusion. Endoscopy-assisted anterior spinal surgery can be performed without spending a high budget; the procedure is not difficult if the surgeon can develop some instruments and has experiences with arthroscopic surgery and anterior spinal surgery.

Key words: anterior spinal surgery; endoscopic assisted surgery

INTRODUCTION

Minimally invasive techniques are becoming more widely use in surgical subspecialties, and standard open surgical procedures are being modified to become less invasive. The explosion in modern endoscopy began in late 1987, when Dubois et al. performed the first laparoscopic cholecystectomy in France, and Semm performed the first laparoscopic appendectomy in Germany. Since then, many procedures and instruments have been developed to facilitate the laparoscopic procedure. The modern era of thoracoscopy, for example, began in 1990 with the addition of video camera assistance.

Anterior spinal surgery is a major and very invasive course of management. A minimally invasive version of the procedure was developed to lessen the
associated morbidity, in the form of anterior endoscopic spinal surgery, which was first described by Obenchain in 1991.\textsuperscript{3} The application of thoracoscopy for diseases of the spine was then reported by Mack et al. in 1993,\textsuperscript{4} and subsequently extended to anterior release of soft tissue for spinal deformity, osteotomy with bone grafting, and corpectomy for tumour, as well as instrumentation for stabilisation.\textsuperscript{5–8} Furthermore, laparoscopic lumbar disectomy—first reported by Obenchain\textsuperscript{3}—has recently been applied successfully to laparoscopic fusion using intervertebral fusion cages.\textsuperscript{9,10} The limitation of laparoscopic lumbar spinal surgery is that it cannot be used beyond L4. The retroperitoneal approach for endoscopy, which was described by Gaur\textsuperscript{11} and popularised by McDougall et al.,\textsuperscript{12} can solve this problem. However, endoscopy-assisted anterior spinal surgery has a very steep learning curve and hence requires a time-consuming training programme; it also demands sophisticated and very expensive instruments.

In this article, we report our early experience of endoscopy-assisted anterior spinal surgery performed with self-developed instruments in Thailand.

**MATERIALS AND METHODS**

From July 2000 to May 2001, 9 patients underwent anterior spinal surgery with the minimally invasive technique at the Orthopaedic Department, Nakhonpathom Hospital, Nakhonpathom. The mean age of the patients was 51.5 years (range, 17–72 years); 3 patients were female and 6 were male. Of the 9 patients, 2 suffered from infection of the lumbar spine, 2 from lumbar instability, one from osteoporosis with vertebral body collapse, 2 from metastatic adenocarcinoma to T9 and T4, one from an old T12 fracture with instability, and one from a burst fracture in L4. The neurological conditions of the patients are shown in Table 1. All cases of surgery were performed with endoscopy-assisted spinal surgery.

**Operative procedure**

Patients were placed in the right lateral decubitus position under general anaesthesia, except for those undergoing a laparoscopic procedure (supine position) or T4 thoracoscopic corpectomy (left lateral decubitus position). The two-portal technique was used. The first portal, a 4-cm skin incision, was made under fluoroscopic imaging. All 3 layers of abdominal muscles or chest wall muscles were split along its fibres, and the retroperitoneal space was dissected using a finger and a balloon dissector, respectively. The second portal, a 1-cm skin incision, was made as the portal for the endoscope. Small retractors were placed in the first portal and the rest of the surgical procedure was done through this portal (Fig. 1). Details of operative procedures for each individual case are shown in Table 2.

**Instruments**

Endoscopy-assisted anterior spinal surgery required the basic laparoscopic instrument set, as well as basic spinal surgery instruments (Fig. 2). Self-developed instruments were as follows (Fig. 3):

<table>
<thead>
<tr>
<th>Case/patient No.</th>
<th>Diagnosis</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Neurological condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tuberculosis of the spine</td>
<td>56</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Collapse L4</td>
<td>68</td>
<td>F</td>
<td>L4, L5 root compression</td>
</tr>
<tr>
<td>3</td>
<td>L4–5 instability</td>
<td>54</td>
<td>F</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>Metastatic adenocarcinoma T9</td>
<td>72</td>
<td>M</td>
<td>Paralysis</td>
</tr>
<tr>
<td>5</td>
<td>L5–S1 instability</td>
<td>62</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>Infection L3 and L4</td>
<td>17</td>
<td>M</td>
<td>Cauda equina compression</td>
</tr>
<tr>
<td>7</td>
<td>Old fracture T12 with instability</td>
<td>51</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>Burst fracture L4</td>
<td>21</td>
<td>M</td>
<td>None</td>
</tr>
<tr>
<td>9</td>
<td>Metastatic adenocarcinoma T4</td>
<td>62</td>
<td>M</td>
<td>Paralysis</td>
</tr>
</tbody>
</table>
(1) Graft impactor:
— Small impactor, made from an 8 mm–stainless steel rod;
— Large impactor, made by reshaping an old impactor;
(2) Graft introducer, made from an 8 mm–stainless steel rod;
(3) Curved curette (small and large), made by connecting a short curettage with an 8 mm–stainless steel rod;
(4) Long cautery, made by connecting an ordinary cauteriser with 2.0 Kirschner wire and a suction drain tube;
(5) Balloon dissector, made from 2 layers of condom, a rubber tube, a sphigmomanometer bulb, and an ordinary 10 mm–laparoscopic port;
(6) Retractor, made by modifying a Myerding retractor;
(7) Cobb’s elevator, made from an 8 mm–stainless steel rod; and
(8) Osteotome.
RESULTS

The operating time ranged from 1.5 to 3.0 hours, and the mean duration was one hour 58 minutes. Estimated volumes of blood loss ranged from 100 to 700 ml (mean, 372 ml). Case 4 had the longest operating time (3 hours), about one hour of which was because of difficulty of bone cement preparation and placement.

The estimated blood loss in case 7 was the greatest (700 ml) because of an accidental injury to the adjacent segmental vertebral vessels during graft size measurement and combined anterior and posterior procedure in one setting. Only one case had a complication associated with the surgery: neuraplexia of the left L3 root may have been due to traction or electric current during cauterisation. The condition resolved 2 days after the operation. No other serious complications were found in this series.

All patients, except for those in cases 4 and 9, were ambulatory 2 to 3 days after the operation (Table 3). Neurological conditions recovered immediately after the operation in cases 2 and 6, but not in cases 4 and 9. Only 8 patients visited for follow-up. Patients in cases 4 and 9 died after 3 months and 2 months, respectively, because of metastatic adenocarcinoma to vital organs including the liver and the lung, respectively. The duration of follow-up ranged from one to 12 months.
(mean, 8.6 months). The fusion successfully healed at the time of 3 to 4 months postoperatively in 5 cases (cases 3, 5, 6, 7, and 8) [Figs. 4–8].

DISCUSSION

Because endoscopy-assisted anterior spinal surgery is a minimally invasive procedure, the length of the surgical wound is about 4 cm instead of 20 cm. Furthermore, there is no need to transect muscle—only splitting along its fibres—and the thoracolumbar spine junction can be approached without transecting the diaphragm. Open anterior spinal surgery at the thoracic level may cause rib fracture or lead to the removal of one rib, but these do not occur in endoscopy-assisted surgery. Thus, in the latter technique, the patient tends to have less pain, minimal morbidity, less blood loss, early ambulation, and a lower cost of treatment. Disadvantages of the procedure, however, include a long training period of the surgeon and very expensive instruments. Working under endoscopic visualisation is the major problem of learning; manipulation of very long instruments through the small hole near vital structures (e.g. aorta, vena cava, spinal cord, or lymphatic duct) increases the difficulty in training.

In our view, a surgeon who desires to perform endoscopy-assisted anterior spinal surgery needs to possess at least 2 surgical skills, namely, orientation and working under endoscopic visualisation, and anterior spinal surgery. These 2 skills can be trained separately. Orientation and working under endoscopic

Table 3  
Results and complications of surgery

<table>
<thead>
<tr>
<th>Case</th>
<th>Operating time (h:min)</th>
<th>Blood loss (ml)</th>
<th>Complication</th>
<th>Complication resolution (days)</th>
<th>Ambulation (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2:00</td>
<td>300</td>
<td>Bowel ileus</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>1:45</td>
<td>450</td>
<td>None</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1:30</td>
<td>200</td>
<td>Left L3 root neuraplexia</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3:00</td>
<td>600</td>
<td>None</td>
<td>—</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>2:00</td>
<td>100</td>
<td>None</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>1:50</td>
<td>500</td>
<td>None</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>2:00</td>
<td>700</td>
<td>None</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>1:45</td>
<td>300</td>
<td>None</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>2:00</td>
<td>200</td>
<td>None</td>
<td>—</td>
<td>None</td>
</tr>
</tbody>
</table>

Figure 4  (a) Surgical wound for corpectomy and stout graft at T12 and (b) the corresponding X-ray.
visualisation can be practised by performing a safer diagnostic procedure such as arthroscopy (most orthopaedic surgeons are familiar with arthroscopy). Training in anterior spinal surgery should include the standard open procedure to familiarise the surgeon with the anatomy around the spine, the surgical procedure, and feel for the operation. Endoscopy-assisted anterior spinal surgery can be performed with less difficulty by combining the 2 surgical skills together.

The full set of instruments for endoscopy-assisted anterior spinal surgery includes: (1) visualisation unit: lens, light source, light guide, camera, and monitor; (2) basic laparoscopic surgery instruments (e.g. Maryland’s forceps, grasper, cautery); and (3) special instruments for endoscopy-assisted anterior spinal surgery.

Figure 5  (a) Surgical wound for T4 corpectomy and stout graft fusion and (b) the corresponding X-ray.

Figure 6  (a) Surgical wound for L3–L4 corpectomy and fusion and (b) the corresponding X-ray.

Figure 7  Surgical wound of the patient who underwent debridement tuberculosis T12–L1.
surgery. The whole set of instruments is very expensive, and could be a problem for hospitals with limited budgets. This article shows that some low-budget modifications of ordinary instruments can be used successfully. Arthroscopy or laparoscopy can be used for the visualisation system.

The time needed for endoscopy-assisted anterior spinal surgery in our case series was approximately 2 hours, which is comparable to the open procedure when performed by the same surgeon. Even if the bleeding looks severe because of the magnification of the scope, the blood loss is less than that resulting from an open procedure because of a smaller wound and less soft tissue injury. Complications among the patients in our case series were uncommon; the most severe was neuraplexia from retractor traction, which can also occur in the open procedure.

The results of our early experience of endoscopy-assisted anterior spinal surgery are comparable to those of our experience of standard open spinal surgery in terms of operating time, rate of complications, and blood loss, while the minimally invasive procedure is superior in terms of level of postoperative pain and duration of hospital stay.

REFERENCES