

Percutaneous endoscopic transforaminal lumbar interbody fusion: is it worth it?

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Received: 15 April 2013 / Accepted: 17 April 2013 / Published online: 9 May 2013
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Abstract

Purpose Interbody spine fusion with cages was first described by Bagby and has been performed for a long time now in a variety of different conditions. We developed a percutaneous endoscopic lumbar fusion technique based on the principles of Kambin and an original titanium cage.

Materials and methods From 2004 to 2010, 57 patients were operated on, 17 patients were male with a mean age of 50.29 years (range 34–71 years) and 40 were female with a mean age of 57.42 years (29–90 years). Nineteen patients had a previous operation. Patients were operated on under local anaesthesia in the prone position under image intensifier and a transforaminal percutaneous endoscopic approach.

Results Fifty cases had a bilateral cage through a bilateral endoscopic approach, and seven cases had a unilateral endoscopic approach only; of those, three cases had only one cage. Eleven patients had a contemporary posterior plate fixation at the same time of the endoscopic cage fusion. Eight patients had a postoperative radicular pain with paresthesias. Asymptomatic migration of the cages occurred in two cases and symptomatic migration requiring a conventional secondary reoperation in 13 cases after a mean delay of eight months (range three to 36 months). The mean ODI after two years or more was 34.3 % (initial ODI 69.4 %).

Conclusions The technique was introduced in our practice to take care of difficult or grave co-morbidity patients, and some patients had excellent lasting results following a very short procedure and hospital stay. However, given the 36 % complication rate in this series, we do not recommend it unless decisive technical improvements are made.

Introduction

Interbody spine fusion with cages was first described by Bagby [1] and has been performed for a long time now in a variety of different conditions. Percutaneous fusion was introduced with the benefit of smaller incisions and lesser operative trauma in difficult patients [2–5]. Whether a patient may have an operation or not as necessitated by his or her condition sometimes depends on his co-morbidities and the aggressiveness of available procedures.

We thus developed a percutaneous endoscopic fusion technique based on the principles of Kambin [6] and an original intersomatic titanium implant that was developed for this purpose (Europa™, Neuro-France Implants, Boursay, France). We hereby report this technique and the clinical results of 52 cases.

Materials and methods

From 2004 to 2010, 57 patients were operated on with a percutaneous endoscopic lumbar interbody fusion technique with intersomatic cages using a titanium implant and an absorbable calcium phosphate substitute.

Patients

Seventeen patients were male with a mean age of 50.29 years (range 34–71 years) and 40 were female with a mean age of 57.42 years (29–90 years). The indication was degenerative disc disease in all cases; 19 patients had a previous operation. The reoperation was done because of adjacent degeneration to a previous fusion in four cases.

Technique

The technique was performed as follows, under local anaesthesia with neuroleptanalgesia and the patient in the prone position. Under image intensifier with a radiolucent operative

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table, the transforaminal percutaneous approach according to the principles of Kambin [7] was performed. Then the intervertebral disc was entirely removed using local hand-held instruments, and the intervertebral space was filled using a percutaneous titanium cage introduced through the endoscopic tube and filled with calcium phosphate substitute. The cage was then rotated to obtain positioning in its larger height in the intervertebral space, inducing an increase in its height of 2 mm. The procedure was done either on one side using one cage only, on both sides with two cages, or on the same side introducing two cages in the intervertebral space through the same approach.

Once the cages were fit into place, instruments were pulled out and the wound was closed using non-absorbable sutures. The patient was woken up immediately and allowed to begin full standing and walking.

Materials

The device was a percutaneous titanium cage developed for this purpose (Europa™, Neuro-France Implants, Boursay, France). It was filled with calcium phosphate putty.

Follow up

Patients were followed up regularly by the operating surgeon for 24 months after the operation. Clinical assessment was done using the visual analog scale and the self-administered Oswestry disability index at one, three, six, 12, and 24 months after the initial operation.

Results

The operation duration was 60 min ± 30. The mean hospital stay was five days (range two to 21 days). Fifty cases had a bilateral cage through a bilateral endoscopic approach. Seven cases had a unilateral endoscopic approach only; of those, three cases had only one cage. Eleven patients had a contemporary posterior plate fixation at the same time of the endoscopic cage fusion; the remaining 46 cases were standalone cages with no fixation and a pure endoscopic procedure.

The fused levels were L3/4 in seven cases, L4/5 in 23, L5/S1 in 19 and other levels in 18 cases. There were no deaths or general complications.

Complications

Seven patients had a postoperative radicular pain with paresthesias, one in L3 in a L3/4 fusion performed for an adjacent level degeneration to a L4/5 fusion, four in L4 in L4/5 fusions and two in L5 in L5/S1 fusions. One patient had a postoperative paradoxical L4 sympathalgia after an L5/S1

endoscopic fusion, which was reported to a L4 furcal nerve, an accessory spinal nerve that has variations and which presence at risk in the foramen was demonstrated by Yeung [8] as a potential provider of this complication in L4/5.

Two cases had infection with a local painful fluid collection. One had to have the posterior plates removed and the cage left in place, without any bacteria growing on laboratory cultures. One case had a local *Staphylococcus aureus* posterior infection, and required ablation of the left plate only.

No DVT or pulmonary embolism occurred.

Secondary complications

Asymptomatic migration of the cages after three months after the operation occurred in two cases and required no further operation; fusion was obtained in both cases after two years postoperatively.

Symptomatic migration, requiring a conventional secondary reoperation, occurred in 13 cases after a mean delay of eight months (range three to 36 months) with no neurological deficit. Of these, two cases were in patients who had additional posterior plate fixation at the same time, a difference not statistically significant in favour of one or the other technique.

Screw migration of the posterior construct occurred in one case in a L1/2 fusion and was treated by a repeat secondary percutaneous fusion.

Adjacent degeneration of the L4/5 level occurred in one case after an eight-month delay in one patient, requiring a repeat conventional fusion extension. The patient had combined sacroiliac pain with arthritis and required a percutaneous sacroiliac fusion [9] that was performed a few months later.

Time to fusion

In the remaining cases with no migration, fusion was obtained in all cases after a mean duration of six months (range three to 12 months). No patient had to be re-operated on for a non-fusion.

Clinical results on pain (VAS) and on ODI

In 57 patients, 13 had conventional reoperations due to cage migration. In the remaining 44 patients, no patient was lost to follow up, but only 25 patients answered the VAS and ODI questionnaire after two years.

The initial VAS was:

Mean lumbar 7.76 (3–10)

Mean radicular 7.22 (1–10)

The VAS after 2 years or more was:

Lumbar 2.45 (0–9)

Radicular 2 (0–9)

The mean initial ODI was 69.4 %; the mean ODI score after 2 years or more was 34.3 %.

Discussion

Percutaneous endoscopic posterior interbody fusion was introduced in our practice eight years ago as a minimally-invasive technique to be used in difficult cases and offered many advantages, e.g. operative duration was less than an hour and a half in all cases and the postoperative course allowed for same-day immediate standing with no additional care, no peri-operative urinary catheter, and a reduced hospital stay. No general complications occurred with no DVT and no pulmonary embolism; the peroperative bleeding was very minimal and no postoperative drainage was used. No CSF leak, no postoperative hematoma and no postoperative cauda equina syndrome were observed. Operative muscle trauma was very minimal at the time of the operation and, due to the reduced duration of the procedure, the anesthesiologic risk was minimal as well. However, the learning curve in this series appeared steep, and complications appeared such as radicular trauma in some cases, a high rate of cage migration, and a relatively long delay to obtain fusion.

Inconveniences of percutaneous techniques are a steep learning curve [10] and the need for preoperative irradiation to the patient and the surgical team [11]. Risks of radicular trauma are real, since the cage, despite being rather small, uses a lot of space while being introduced through the foramen and conflicts may occur. Then, the main complication, postoperative migration of the device, being symptomatic or not, poses a real problem in the clinical setting as an operative failure.

The rationale for using such a percutaneous, minimally-invasive fusion technique, is clearly to expand fusion indications for different patient populations [12], including elderly with grave co-morbidities and a high operative risk with conventional techniques [13]; and patients with deformities who suffer from imbalance or dislocations and are not fit for conventional, state-of-the-art, extensive anterior and posterior fusion [14–16]. Also, in younger patients with no anaesthesiologic contra-indications, the acceptability level of postoperative pain and a long hospital stay precludes the realization of conventional surgery in favour of the minimally-invasive, same-day operation [17, 18]. Other indications were patients with recurrent surgery and spine fibrosis from previous operations [19], where the percutaneous, foraminal endoscopic approach remains the only one that has not been used and a safe route to disc fusion.

Many patients in this short series had excellent results following a very simple procedure and a very short hospital stay. However, this was not the case for all, e.g. secondary

migration of the cages occurred in 13 cases (22.8 %) and perioperative radicular trauma with postoperative paresia and painful syndromes in eight additional patients (14 %). Considering 36 % of the patients in this series had a complication related to the technique, we do not recommend it unless decisive technical improvements can be made.

Most patients in this series had percutaneous fusions using stand-alone cages and no additional fixation. Secondary migrations occurred in either technique equally. This is consistent with the literature. Although stand-alone cages have been accused of increasing the risk of migration when compared to cage fusion with additional pedicle screw fixation, to our knowledge no data in the English literature is in favour of an increased risk with either technique.

Potential ways of improvement in achieving a successful and reliable percutaneous cage fusion technique are many. Improving the patients' compliance in wearing a postoperative contention may lower the rate of migration. Reserving the technique to high-risk patients who are not fit to conventional techniques would also appear as a safe decision. On a technical standpoint, preoperative imaging focused on measuring the foramen's size and the triangle of Kambin would be a plus to achieve good localization of the radicular ganglion and compare the available space to that of the desired cage implant. Peroperative neuromonitoring has been used in different open minimally-invasive fusion techniques [3, 20] through a lateral approach with good results, and we believe such addition to the endoscopic technique may lower dramatically the radicular complication rate to acceptable odds. Using peroperative multiplanar imaging such as the CT-like O-arm (Medtronic, Memphis, TN) [21] may also help lower the rate of inadequacies between the cage and the foramen's size and help reduce the unacceptable radicular complication rate as seen in our series.

Conclusion

Different factors such as the steep learning curve, fear of irradiation for the patient and the surgical team, as well as technical difficulties make the technique controversial, in the absence of pre-existing computerized radiological navigation systems [22]. Permanent per-operative neuromonitoring under general anaesthesia would make the procedure much easier. Advantages of the technique would include fast surgery, absence of blood loss, a very low risk for DVT and pulmonary embolism, absence of risk for compression hematoma, immediate standing and walking, no postoperative drain and no risk for canal fibrosis [23]. However, pending technical improvements, we do not recommend the technique in its current state.

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