A 74-year-old woman presented at our hospital with severe low-back pain and intermittent claudication. Conservative therapies of several kinds were done at another hospital, but they were ineffective. Radiographs and MRI studies showed multiple stenoses and degenerative scoliosis (Figs. 1 and 2).

First Operation

In June 2010, a posterior decompression, correction, and fusion surgery was performed using the corrective transforaminal lumbar interbody fusion (TLIF) technique. After pedicle screw insertion and decompression, the right L4–5 disc space was shaved via a transforaminal approach. Maximal opening of the right L4–5 disc space was obtained using our special spreader. A 12-mm titanium cage was filled with autologous iliac bone graft and was tapped into the disc space. Because of obscured vision with blood in the field, monotonous shape, and multiple similar scale lines of the introducer, the operator could not keep the depth under control and tapped the cage to an excessive depth. After taking off the introducer, a radiograph was taken. It showed the cage passing anteriorly through the anulus to the retroperitoneal space (Fig. 3). After several vain attempts to capture the cage with its introducer, the surgeon decided to remove it via an anterior retroperitoneal approach to the right L4–5 disc space. In the second surgery, which was performed via an anterior retroperitoneal approach to remove the migrated cage, massive torrential bleeding occurred because of IVC injury. The laceration in the posterior wall of the IVC necessitated ligation of this vessel and both common iliac veins by a vascular surgeon. Postoperative edema of the lower extremities after ligation of the vessels was well tolerated, and the patient showed almost full recovery.

For removal surgery of an anteriorly migrated cage, the surgeon should be well prepared for the risk of IVC injury, including requesting the attendance of a vascular surgeon. Ligation of the infrarenal IVC is an acceptable solution in irreparable IVC injury.
Initial Postoperative Course

After the operation the patient rested in bed, in good general condition. Enhanced CT scans showed that the anteriorly migrated cage placed in front of the L4–5 disc verged on the IVC and abdominal aorta. No hematoma was observed around the cage (Fig. 5).

Second Operation

On postoperative Day 7, surgery to remove the migrated cage was performed. The L4–5 region was accessed through a right retroperitoneal approach. The cage was identified easily; it was pulled carefully and gently. When the cage was lifted slightly, bleeding started gradually but strongly. We suspected IVC injury and decided to remove the cage and repair the vein. Because the tear was located on the back side of the IVC, it seemed difficult to repair. We called a vascular surgeon for assistance.

Emergency laparotomy was performed through another median incision, which revealed that the perforation of the IVC was immediately adjacent to both common iliac veins. The aorta and both iliac arteries were taped for temporary tightening to reduce bleeding from the injured vein. The resultant defect over the posterior aspect of IVC could not be repaired, primarily because of its size and location. Blood pressure dropped to a degree that was...
not measurable using a noninvasive device. Aggressive re-
suscitation with blood transfusion and constant infusion
of vasopressor agents such as epinephrine and dopamine
were continued. Finally, the vascular surgeon decided to
ligate the IVC and both common iliac veins for rescue.
After ligation, the vital parameters became stable. Meticu-
lous hemostasis was performed for another hour to stop
the oozing blood. She received a total of 90 U of packed
red blood cells, 70 U of fresh frozen plasma, and 60 U of
fresh platelets. The estimated total blood loss was approxi-
mately 20,000 ml.

Second Postoperative Course

After the operation, the patient was intensively treated
with a respirator and massive postoperative blood transfu-
sion. Her general condition improved gradually. Although
temporary pulmonary edema and anasarca occurred, the
endotracheal tube was extubated smoothly on the 5th day
after the second operation. Postoperative edema of the
lower extremities was well tolerated (Fig. 6), and preoper-
ative deformity was well corrected (Fig. 7). When she was
discharged 3 months after the second operation she was
walking without any assistance, and her ambulation abil-
ity showed significant improvement in 1 year compared
with her preoperative status. Although no further analysis
of deep venous thrombosis was done, we found no circu-
lation problems with continuous warfarin administration.
Solid bony fusion of TLIF segments was confirmed by ra-
diograph at 1.5 years postoperatively.

Discussion

With the advent of spinal instrumentation of various
kinds, the number of anterior lumbar interbody fusion
(ALIF), posterior lumbar interbody fusion (PLIF), and
TLIF procedures, as effective and safe treatment for vari-
ous lumbar spinal diseases, has been increasing. Some re-
ports describe the existence of severe vascular comp-
lications resulting from these procedures.

As described in this paper, we reported a rare case of
IVC ligation during surgery for removal of an anteriorly
migrated TLIF cage. This experience provided an impor-
tant lesson: we should consider the risk of major vessel
injury by a migrated cage, even without obvious mas-
sive bleeding. In addition, we recognized the importance
of having a vascular surgeon not only available, but also helping with the anterior portion in this kind of procedure from the very beginning.

In our case, ligations of the IVC and the common iliac veins were unavoidable. They presented an acceptable solution to a major disruption of these veins that might otherwise have required several hours to repair, in addition to the necessity of multiple blood transfusions. Although we were not aware of it, these ligations have been performed before the introduction of an IVC filter for the control of recurrent pulmonary emboli in instances in which anticoagulant therapy had failed. The procedure was not associated with surgery-related death or further embolism. Although early postoperative leg edema was common, later leg complications proved to be minor if the legs were carefully managed.3,10

For ligations of the IVC, whether done proximal to the renal vein or distal to it, the level of ligation is an important determinant of resultant death. Injury to the IVC as a result of trauma has a high mortality rate. Nevertheless, some survivors of ligation of infrarenal IVC performed as a rescue operation do exist. Moreover, none of the survivors had significant long-term edema or extremity dysfunction. In contrast, ligation of the suprarenal IVC has few survivors.7,8 Consequently, ligation of the infrarenal IVC might be an acceptable damage control procedure, in cases presenting no realistic alternative for preservation of the IVC. Ligation of the suprarenal IVC should be avoided to the greatest degree possible.

Conclusions
For removal of an anteriorly migrated cage, the surgeon should be well prepared for the risk of IVC injury, including requesting the attendance of a vascular surgeon. Ligation of the infrarenal IVC is an acceptable solution in irreparable IVC injury.

Acknowledgments
We thank Dr. H. Tsubata for his great support in perioperative intensive care of this patient.

References

Disclosures
The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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Conception and design: Sano. Acquisition of data: Ariyoshi. Drafting the article: Ariyoshi, Kawamura. Critically revising the article: Sano, Kawamura. Reviewed submitted version of manuscript: all authors. Study supervision: Sano, Kawamura.

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