

Case report

Intraoperative obturator nerve injury reconstructed using a PGA-collagen tube: Three case reports

Atsuhiko Iwao^{*}, Maoko Yagi, Yoshinobu Imamura, Akihito Higashi, Yuki Moriuchi, Kazuya Kashiya, Katsumi Tanaka

Department of Plastic and Reconstructive Surgery, Nagasaki University Hospital, Japan

ARTICLE INFO

Keywords

Uterine cancer
Cervical cancer
Surgical energy device
Iatrogenic nerve defect
Obturator nerve
PGA-collagen tube

ABSTRACT

We herein report three cases of obturator nerve injury, which is rare in gynecological surgery. In all cases, it was difficult to suture both nerve ends without tension. Therefore, we used a PGA-collagen tube to interpose the nerve defect. After follow-ups of at least seven months, all three patients were able to adduct the hip joint and medial thigh sensations also improved. These results suggest the potential of a PGA-collagen tube in the treatment of obturator nerve injury.

1. Introduction

Intraoperative obturator nerve injury is a rare complication of gynecological surgery. It may occur when pelvic lymphadenectomy is performed for uterine or cervical cancer. A previous study reported frequencies of 0.07% for laparoscopic surgery and 0.02% for abdominal surgery (Liang et al., 2020).

If the obturator nerve is damaged, hip adduction is weakened and hypoesthesia occurs in the medial thigh. Minor injuries caused by the compression or extension of this nerve rarely require aggressive treatment; however, permanent sensory and motor impairments may occur if it is amputated, which may lead to a significantly reduced quality of life.

There have been a few cases reports of suturing the obturator nerve end-to-end in open surgical (Vasilev, 1994), laparoscopic (Spaliviero et al., 2004), and robotic-assisted approaches (Nezhat et al., 2012); however, it is often difficult to coaptate the nerve ends without tension. We herein present three cases of iatrogenic obturator nerve injury that were reconstructed using a PGA-collagen tube. The PGA-collagen tube is a nerve conduit that functions as an artificial nerve graft. This tube is made of polyglycolic acid and filled with collagen. It acts as a scaffold for the axons of peripheral nerves to regrow by bridging nerve defects. The PGA-collagen tube is absorbed by the body three months after implantation, leaving only the regenerated nerve.

2. Case reports

2.1. Case 1

A 59-year-old woman was referred to the Gynecology department of our hospital because a cytological examination of the cervix revealed squamous cell carcinoma (SCC). Preoperative magnetic resonance imaging showed tumor invasion of the left parauterine tissue. Intrauterine curettage also diagnosed SCC; therefore, radical hysterectomy was indicated. During surgery, severe bleeding from the pelvic side occurred with dissection of the right paravesical cavity. After confirmation of the site of bleeding, the area was pinched with forceps and ligated; however, the obturator nerve was also unexpectedly ligated. Therefore, plastic surgeons were consulted intraoperatively. Both nerve ends were refreshed up to the undamaged area. The perineural area was adequately dissected; however, it was difficult to anastomose the nerve ends without tension. Consequently, microsurgical repair using a PGA-collagen tube (diameter 4 mm, length 20 mm) was performed. Immediately after surgery, hip adduction was 3/5 in manual muscle testing (MMT) and hypoesthesia was noted in the medial thigh. Three years after surgery, adduction recovered to 5/5 in MMT and perception was restored.

^{*} Corresponding author at: Department of Plastic and Reconstructive Surgery, Nagasaki University Hospital, 1-7-1 Sakamoto, Nagasaki 8518501, Japan.
E-mail address: a-iwao@nagasaki-u.ac.jp (A. Iwao).

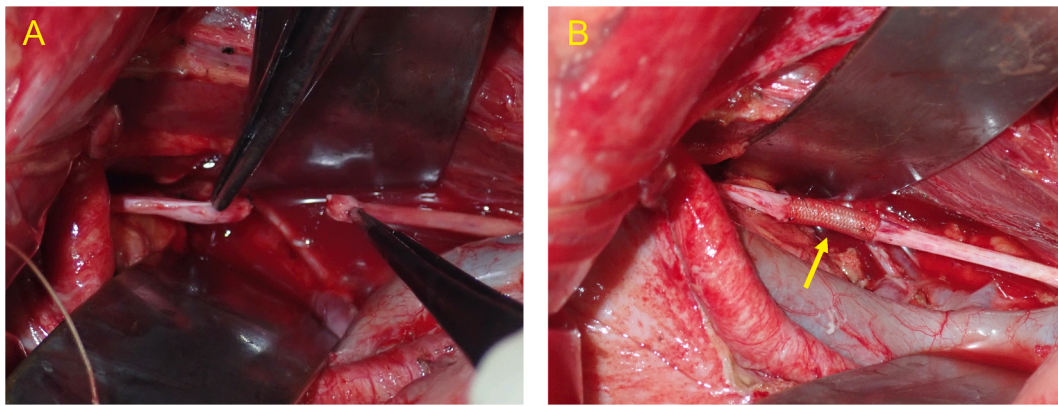


Fig. 1. Intraoperative photograph in case 2. Difficulties were associated with suturing the obturator nerve end-to-end because of the nerve defect (A). A PGA-collagen tube interposed the defect. Arrow indicates the PGA-collagen tube (B).



Fig. 2. Seven months after surgery. The patient was able to adduct the hip joint.

2.2. Case 2

A 58-year-old woman was referred to the Gynecology department of our hospital with a right ovarian tumor. Biopsy results showed high-grade serous carcinoma; therefore, simple total hysterectomy, bilateral salpingo-oophorectomy, omentectomy, pelvic lymphadenectomy, and *para*-aortic lymphadenectomy were planned. During right pelvic lymphadenectomy, the obturator nerve was transected iatrogenically by the surgical energy device. Plastic surgeons were consulted intraoperatively. After a careful analysis and refreshing both nerve ends, a nerve graft was considered to be necessary. An artificial nerve graft was selected, and a PGA-collagen tube (diameter 4 mm, length 9 mm) was transferred (Fig. 1). Immediately after surgery, hip adduction was 2/5 in MMT and hypoesthesia was noted in the medial thigh. After seven months, hip adduction improved to 5/5 in MMT (Fig. 2) and perception was restored.

2.3. Case 3

A 55-year-old female was referred to the Gynecology department of our hospital with bilateral ovarian enlargement and ascites. Histology from ascites revealed serous adenocarcinoma, and the patient was

diagnosed with ovarian cancer and cancerous peritonitis. After six courses of chemotherapy with bevacizumab, carboplatin, and paclitaxel, the ovarian tumor shrank and the levels of tumor markers decreased. Since surgical treatment was considered to be possible at this point, simple total hysterectomy, bilateral salpingo-oophorectomy, omentectomy, pelvic lymphadenectomy, and *para*-aortic lymphadenectomy were planned. During left pelvic lymphadenectomy, the left side obturator nerve was unexpectedly transected by the surgical energy device. Plastic surgeons were consulted intraoperatively. A PGA-collagen tube (diameter 4 mm, length 28 mm) was transferred to achieve tension-free repair. Immediately after surgery, hip adduction was 3/5 in MMT and hypoesthesia was noted in the medial thigh. After ten months, full adduction strength (MMT 5/5) was achieved and there was no sensory deficit.

3. Discussion

The obturator nerve arises from the spinal cord roots L1-L4. It runs longitudinally along the medial side of the psoas major muscle and enters the pelvis. The nerve then passes through the obturator foramen and reaches the medial side of the upper thigh (Katritsis et al., 1980). The obturator nerve is rigidly attached in the pelvic inlet and outlet;

therefore, it is very challenging to anastomose nerve stumps end-to-end if it is severed. Even if the perineural area is sufficiently dissected, it does not effectively provide mobility. In Case 1, we were unable to suture the nerve ends due to this anatomical feature even though the nerve defect was small. Furthermore, obturator nerve injury leads to a defect because a surgical energy device is often used in gynecological surgery. Since this device seals the nerve, both nerve ends need to be refreshed before suturing. This procedure results in the formation of a large nerve defect.

An important factor in the repair of peripheral nerve injury is the suturing of nerve endings end-to-end without tension. If this is not possible, the nerve defect needs to be interposed. An autologous nerve graft is the first choice for the reconstruction of peripheral nerve defects. Previous studies reported the reconstruction of obturator nerve injury using a sural nerve graft (Benes, 1999; Ghaemmaghami et al., 2009).

However, an autologous nerve graft does not prevent donor site morbidities, such as pain caused by the amputated neuroma, hypoesthesia, numbness, and scarring. Other options include a processed human nerve allograft or nerve conduit. A processed human nerve allograft has already been commercialized (Avance®; Axogen), but is not currently available in Japan. The economic analysis demonstrated nearly identical costs for woven polyglycolic acid conduit and autogenous vein conduit because the cost of extra operating time necessary for vein harvesting is almost the same as the price of the artificial conduit (Rinker and Liau, 2011). This fact could also be true for autologous nerve graft (Kehoe et al., 2012).

It was reported that the repair using a PGA-collagen tube was effective for both sensory and motor nerve. A multi-center study using the PGA-collagen tube for the repair of digital nerve defect reported a meaning recovery in 90% with an average nerve gap of 17 mm (Kusuhara et al., 2019). In addition, two cases report using 20 mm or 25 mm length of the PGA-collagen tube for the repair of facial nerve defect reported the improvement of frontal muscles movement (Nakamura et al., 2020). Mackinnon et al. reported that peripheral nerve defects up to 30 mm in length may be reconstructed with a nerve conduit (Mackinnon and Dellon, 1990). These reports suggested that the PGA-collagen tube may also be effective for a repair of mixed nerve defect within 30 mm in length. Therefore, we applied the PGA-collagen tube as a nerve conduit for the reconstruction of obturator nerve injury. This nerve is a mixed nerve, and the length of the implanted tube was less than 30 mm in all cases.

PGA-collagen tube is always holden in our hospital because of many opportunities to treat nerve defects caused by trauma. From this reason, rapid use was possible in present cases.

To the best of our knowledge, we are the second group to report the reconstruction of obturator nerve injury with a nerve conduit. Tsujimoto et al. were the first and used a nerve conduit for obturator nerve injury caused by extensive surgery for intrapelvic advanced or recurrent colorectal cancers (Tsujimoto et al., 2011). All cases achieved good outcomes, similar to the present cases.

Although the present cases underwent abdominal surgery, microsurgical reconstruction was very difficult because of the location of the obturator nerve in the pelvic cavity. Artificial nerve grafts did not require the harvesting of autologous nerves, and only two epineural horizontal mattress sutures were needed for each nerve end. However, the procedure added an average of 30 min to the surgical time. A previous study reported the fixation of obturator nerve ends with a fibrin sealant instead of suturing in the case of autologous nerve grafts (Scaletta et al., 2019). This method may be useful in the future.

There are some limitations that need to be addressed. In the present cases, the recovery of motor and sensory functions was not completely attributed to obturator nerve regeneration. Some of the hip adductor muscles are innervated by the femoral or sciatic nerve, and hip motion is compensated by the pelvic muscles; therefore, difficulties are associated with accurately assessing obturator nerve recovery itself, particularly motor function (Bischoff and Schönle, 1991). Furthermore, electro-neuromyography was not conducted on all cases. It was also not possible to histologically assess the regenerated nerve in the nerve conduit. However, postoperative improvements in MMT and the recovery of medial thigh sensations suggested that PGA-collagen tube interposition was beneficial for the treatment of obturator nerve injury.

Consent.

Informed consent was obtained from the patients described herein.

Author contributions.

All authors substantially contributed to the drafting of the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- Benes, J., 1999. Immediate grafting of the damaged obturator nerve by gynaecological surgery. *Acta. Neurochir. (Wien)* 141 (4), 435–436.
- Bischoff, C., Schönle, P.W., 1991. Obturator nerve injuries during intra-abdominal surgery. *Clin. Neurol. Neurosurg.* 93 (1), 73–76.
- Ghaemmaghami, F., Behnamfar, F., Saberi, H., 2009. Immediate grafting of transected obturator nerve during radical hysterectomy. *Int. J. Surg.* 7 (2), 168–169.
- Katritsis, E., Anagnostopoulou, S., Papadopoulos, N., 1980. Anatomical observations on the accessory obturator nerve (based on 1000 specimens). *Anat. Anz.* 148 (5), 440–445.
- Kehoe, S., Zhang, X.F., Boyd, D., 2012. FDA approved guidance conduits and wraps for peripheral nerve injury: A review of materials and efficacy. *Injury* 43 (5), 553–572.
- Kusuhara, H., Hirase, Y., Isogai, N., Sueyoshi, Y., 2019. A clinical multi-center registry study on digital nerve repair using a biodegradable nerve conduit of PGA with external and internal collagen scaffolding. *Microsurgery* 39 (5), 395–399.
- Liang, C., Liu, P., Cui, Z., Liang, Z., Bin, X., Lang, J., Chen, C., 2020. Effect of laparoscopic versus abdominal radical hysterectomy on major surgical complications in women with stage IA–IIB cervical cancer in china, 2004–2015. *Gynecol. Oncol.* 156 (1), 115–123.
- Mackinnon, S.E., Dellon, A.L., 1990. Clinical nerve reconstruction with a bioabsorbable polyglycolic acid tube. *Plast. Reconstr. Surg.* 85 (3), 419–424.
- Nakamura, Y., Takanari, K., Ebisawa, K., Kanbe, M., Nakamura, R., Kamei, Y., 2020. Repair of temporal branch of the facial nerve with novel polyglycolic acid-collagen tube: a case report of two cases. *Nagoya J. Med. Sci.* 82 (1), 123–128.
- Nezhat, F.R., Chang-Jackson, S.R., Acholonu Jr., U.C., Vetere, P.F., 2012. Robotic-assisted laparoscopic transection and repair of an obturator nerve during pelvic lymphadenectomy for endometrial cancer. *Obstet. Gynecol.* 119, 462–464.
- Rinker, B., Liau, J.Y., 2011. A prospective study comparing woven polyglycolic acid and autogenous vein conduits for reconstruction of digital nerve gaps. *J. Hand Surg. Am.* 36 (5), 775–781.
- Scaletta, G., Bizzarri, N., Lauretti, L., Scambia, G., Fagotti, A., 2019. Obturator nerve regeneration using a genito-femoral graft placed only by fibrin sealant (Tisseel®). *Gynecol. Oncol.* 153 (3), 703–704.
- Spaliviero, M., Steinberg, A.P., Kaouk, J.H., Desai, M.M., Hammert, W.C., Gill, I.S., 2004. Laparoscopic injury and repair of obturator nerve during radical prostatectomy. *Urology* 64 (5), 1030.e11–1030.e12.
- Tsujimoto, H., Nakamura, T., Miki, T., Kubo, T., Otsuji, E., Yamagishi, H., Hagiwara, A., 2011. Regeneration and functional recovery of intrapelvic nerves removed during extensive surgery by a new artificial nerve conduit: a breakthrough to radical operation for locally advanced and recurrent rectal cancers. *J. Gastrointest. Surg.* 15 (6), 1035–1042.
- Vasilev, S.A., 1994. Obturator nerve injury: A review of management options. *Gynecol. Oncol.* 53 (2), 152–155.