VIDEO ARTICLE
Urooncology

Doi: 10.4274/jus.galenos.2025.2025-6-2
J Urol Surg

Intraoperative Risks Associated with Non-absorbable Polymer Ligation Clips in Laparoscopic Radical Nephrectomy: A Case-based Video Report

Ekrem Başaran, Emre Ediz, Ali İbrahim İzula, Dursun Baba, Ahmet Yıldırım Balık, Arda Taşkın Taşkıran

Düzce University Faculty of Medicine, Department of Urology, Düzce, Türkiye

Abstract

Laparoscopic nephrectomy is a widely performed urologic surgical procedure in which non-absorbable polymer ligation (NPL) clips are frequently used for vascular control. We present a case involving a 64-year-old male scheduled for laparoscopic radical nephrectomy due to renal cell carcinoma, during which two Hem-o-lok clips applied to the renal artery unexpectedly reopened intraoperatively. Even when applied by experienced surgeons in accordance with standard protocols, the risk of malfunction remains and must be considered during laparoscopic renal surgery. NPL clips are frequently used to achieve secure vascular control. Although generally considered reliable, these clips may occasionally malfunction leading to potentially life-threatening complications.

Keywords: Laparoscopic nephrectomy, Hem-o-lok, polymer clip failure, renal hilum, intraoperative complication

Introduction

Laparoscopic techniques have become an integral part of modern urologic surgery. Procedures such as adrenalectomy, simple nephrectomy, radical nephrectomy, and nephroureterectomy exemplify minimally invasive approaches. The first laparoscopic nephrectomy, a milestone in renal surgery, was reported by Clayman et al. (1) in 1991.

Renal vascular dissection and ligation represent one of the most technically demanding and complication-prone stages of urologic procedures. Common methods for achieving secure hilar control laparoscopically include endovascular staplers, conventional titanium clips, and non-absorbable polymer ligation (NPL) clips (Hem-o-lok, Weck Closure Systems, Research Triangle Park, NC). Despite their widespread use and general reliability, all mechanical devices carry a risk of malfunction (2).

NPL clips are widely accepted for renal vascular control during laparoscopic nephrectomy. Numerous studies have demonstrated their clinical reliability and applicability, supporting their routine use in minimally invasive urologic procedures (3,4). However, technical failures have also been reported, occasionally necessitating conversion to open surgery. The U.S. Food and Drug Administration's (FDA) Manufacturer and User Facility Device Experience (MAUDE) database includes significant reports documenting such complications (5).

In this video case report, we present a rare but serious intraoperative complication in which NPL clips applied to the renal artery reopened (Video 1).

Case Presentation

A 64-year-old male patient with no comorbidities, regular medications, or prior surgical history presented with lower urinary tract symptoms. Contrast-enhanced computed tomography revealed a 61×58×72 mm right renal mass, which was diagnosed as renal cell carcinoma. Laparoscopic radical nephrectomy was planned.

Under general anesthesia, the patient was placed in a 45° lateral decubitus position. Pneumoperitoneum was established using a Veress needle. A 10 mm camera port and two additional trocars were then placed under direct vision in a triangular configuration.

Correspondence: Emre Ediz MD, Düzce University Faculty of Medicine, Department of Urology, Düzce, Türkiye
E-mail: dr.emreediz@gmail.com **ORCID-ID:** orcid.org/0000-0003-2532-6114
Received: 09.06.2025 **Accepted:** 17.10.2025 **Epub:** 19.06.2026

Cite this article as: Başaran E, Ediz E, İzula Aİ, Baba D, Balık AY, Taşkıran AT. Intraoperative risks associated with non-absorbable polymer ligation clips in laparoscopic radical nephrectomy: a case-based video report. J Urol Surg. [Epub Ahead of Print]

Renal pedicle dissection identified two veins and one artery. Following our standard protocol, a total of three NPL clips were applied to the artery and proximal renal vein (two on the patient side and one on the specimen side).

During re-dissection of the previously clipped renal artery, the first applied clip was found to have reopened. The failed clip was removed, and a new one was applied. Subsequently, another clip was placed between the artery and kidney, but previously applied clip was also found to have reopened and was replaced. The NPL clips used in this case were supplied through the State Supply Office and were manufactured by a China-based local company.

Ultimately, the renal artery was secured with three clips (two on the patient side), while the renal vein was divided using three clips (two on the patient side). The kidney was retrieved using an endobag. Total operative time was 220 minutes, with an estimated blood loss of 150 mL.

Histopathological evaluation revealed type 2 papillary renal cell carcinoma, stage pT1b, with negative surgical margins.

Discussion

Despite the increasing adoption of laparoscopic nephrectomy, complication rates remain significantly high and associated with hilar control (6). There are three main alternative techniques for renal hilar control: endovascular staplers, titanium clips, and NPL clips (7). Each device carries risks of complications such as hemorrhage, transfusion, conversion to open surgery, and, albeit rarely, mortality.

Endovascular staplers, for example, demonstrated low malfunction rates (1-1.7%) in institutional studies such as that by Chan et al. (8). However, according to FDA MAUDE database reports, laparoscopic hemostatic devices account for 63% of failures. The most common issues are staple line malformation (47%) and device locking (29%). These malfunctions led to conversion to open surgery in 27-35% of patients, blood transfusion in 10-15%, and mortality in 1-4%. In addition, operator errors such as misfiring or firing over pre-existing clips were commonly reported (9).

Titanium clips account for 23-33% of hemostatic device failures. Frequent problems include jamming, or feeding difficulties (27%), and closure, shearing issues (26%). Dislodgement or slippage from the vessel was also reported in 6-14% of cases (7).

NPL clips account for 5-13% of hemostatic device failures in the FDA MAUDE database. The most frequently reported complication is clip dislodgement (44% postoperative, 25% intraoperative). Associated outcomes include reoperation (58%) and mortality (17%) (7,10). Furthermore, one study reported 12 cases of NPL clip malfunction during laparoscopic donor nephrectomy, two of which were fatal (10). Sun et al. (11) also described Hem-o-lok clip migration into the renal pelvis following laparoscopic partial nephrectomy, leading to stone formation and necessitating percutaneous nephrolithotomy. This highlights that each technique may present unique and unexpected complications, underscoring the need for vigilance on the part of surgeons.

Recent studies have provided additional insights into the safety of NPL clips. Ordon et al. (12) reported in a large-scale study that the use of three titanium clips on the renal artery and two polymer ligation clips on the renal vein during left laparoscopic donor nephrectomy was safe, with no major bleeding complications in 503 consecutive cases. More recently, Lachkar et al. (13) published a comprehensive systematic review addressing the "clip versus stapler" debate in laparoscopic live donor nephrectomy, providing updated evidence on their comparative safety profiles. In line with this, Fallatah et al. (14) compared donor nephrectomy performed with different approaches and concluded that Hem-o-lok clips remain a reliable method of vascular control across all techniques when appropriately applied.

In our institution, various brands of NPL clips and their compatible appliers—including Click'aV® (Grena®), Click'aV Plus® (Grena), Hem-o-lok® (Weck®, Teleflex®), Lookmed®, and multiple Chinese brands supplied through the state supply office—are routinely used in procedures such as radical prostatectomy, nephrectomy, and cystectomy. In the present case, 11 NPL clips were applied, with two intraoperative failures observed. Prompt recognition and appropriate intervention prevented adverse outcomes, though such failures could otherwise have been fatal.

As large-scale randomized controlled trials are lacking, the choice of hilar control method largely depends on the surgeon's preference and experience. Because all these devices have potential failure mechanisms, careful application by experienced surgeons and awareness of device-specific risks are essential to minimize complications.

Preventive strategies include using certified, high-quality clips and compatible appliers, confirming their functionality preoperatively, and avoiding uncertified or off-brand products. Additional technical precautions include applying multiple clips, leaving a 1-2 mm vascular cuff, preventing tissue entrapment in the locking mechanism, visually confirming full engagement, and selecting appropriately sized clips (10,15,16). Nevertheless, as demonstrated in this case, malfunctions can occur despite adherence to these precautions.

Conclusion

Although NPL clips are widely used and generally considered safe in laparoscopic surgery, meticulous surgical technique and intraoperative vigilance are essential. Even experienced surgeons must remain prepared for device malfunction and adopt preventive strategies to minimize the risk of severe complications.

Video 1. https://www.youtube.com/watch?v=rvbWLyYYOIA

Ethics

Informed Consent: Prior to submission, all relevant data were fully anonymized, and written informed consent for publication was obtained.

Footnotes

Authorship Contributions

Surgical and Medical Practices: E.E., E.B., D.B., A.Y.B., Concept: E.E., E.B., A.Y.B., Design: E.E., E.B., A.Y.B., Data Collection or Processing: E.E., E.B., D.B., A.T.T., Analysis or Interpretation: E.E., A.İ.İ., E.B., Literature Search: E.E., E.B., Writing: E.E., E.B.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declare that they received no financial support for this study.

References

1. Clayman RV, Kavoussi LR, Soper NJ, Dierks SM, Merety KS, Darcy MD, Long SR, Roemer FD, Pingleton ED, Thomson PG. Laparoscopic nephrectomy. N Engl J Med. 1991;324:1370-1371. [Crossref]
2. Deng DY, Meng MV, Nguyen HT, Bellman GC, Stoller ML. Laparoscopic linear cutting stapler failure. Urology. 2002;60:415-419; discussion 419-420. [Crossref]
3. Baumert H, Ballaro A, Arroyo C, Kaisary AV, Mulders PF, Knipscheer BC. The use of polymer (Hem-o-lok) clips for management of the renal hilum during laparoscopic nephrectomy. Eur Urol. 2006;49:816-819. [Crossref]
4. Kapoor R, Singh KJ, Suri A, Dubey D, Mandhani A, Srivastava A, Kumar A. Hem-o-lok clips for vascular control during laparoscopic ablative nephrectomy: a single-center experience. J Endourol. 2006;20:202-204. [Crossref]
5. Meng MV. Reported failures of the polymer self-locking (Hem-o-lok) clip: review of data from the food and drug administration. J Endourol. 2006;20:1054-1057. [Crossref]
6. Wille AH, Roigas J, Deger S, Tüllmann M, Türk I, Loening SA. Laparoscopic radical nephrectomy: techniques, results and oncological outcome in 125 consecutive cases. Eur Urol. 2004;45:483-488; discussion 488-489. [Crossref]
7. Hsi RS, Saint-Elie DT, Zimmerman GJ, Baldwin DD. Mechanisms of hemostatic failure during laparoscopic nephrectomy: review of food and drug administration database. Urology. 2007;70:888-892. [Crossref]
8. Chan D, Bishoff JT, Ratner L, Kavoussi LR, Jarrett TW. Endovascular gastrointestinal stapler device malfunction during laparoscopic nephrectomy: early recognition and management. J Urol. 2000;164:319-321. [Crossref]
9. Food and Drug Administration (FDA). Medical Device Reporting for Manufacturers; Guidance for Industry and Food and Drug Administration Staff [guidance document]. Rockville (MD): U.S. Food and Drug Administration; 2016 (original draft 2013). [Crossref]
10. Hsi RS, Ojogho ON, Baldwin DD. Analysis of techniques to secure the renal hilum during laparoscopic donor nephrectomy: review of the FDA database. Urology. 2009;74:142-147. [Crossref]
11. Sun J, Zhao LW, Wang XL, Huang JG, Fan Y. Migration of a Hem-o-Lok clip to the renal pelvis after laparoscopic partial nephrectomy: a case report. World J Clin Cases. 2022;10:3188-3193. [Crossref]
12. Ordon M, Sowerby RJ, Ghiculete D, Djuimo M, Kroczak T, Lee JY, Honey RJD, Pace KT. Clips can be safely used for vascular control of the renal vessels during laparoscopic donor nephrectomy. Urology. 2021;147:150-154. [Crossref]
13. Lachkar S, Boualaoui I, Ibrahimi A, El Sayegh H, Nouini Y. Clip or staple in laparoscopic live donor nephrectomy? A systematic literature review. Fr J Urol. 2024;34:102656. [Crossref]
14. Fallatah M, Aldughiman AW, Binjawhar AS, Melaibary BA, El-Tholoth HS, Al-Gadheeb AS, Alzahrani AY, Zahrani TM, Alakrash HS. Renal pedicle control in laparoscopic donor nephrectomy: evaluation of a single-center experience. Urol Ann. 2022;14:152-155. [Crossref]
15. Saki Z, Kallidonis P, Noureldin Y, Kotsiris D, Ntasiotis P, Adamou C, Vagionis A, Liatsikos E. Experimental studies of nonabsorbable polymeric surgical clips for use in urologic laparoscopy. J Endourol. 2019;33:730-735. [Crossref]
16. Grigore N, Pirvut V, Mihai I, Mitariu SIC, Sava M, Hasegan A. Polymer ligating clips in urologic laparoscopic surgery. Mater Plast. 2017;54:295-297. [Crossref]