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USE OF A FLOWABLE ABSORBABLE GELATIN MATRIX FOR NEPHROSTOMY TRACT HEMOSTASIS DURING TUBELESS PERCUTANEOUS NEPHROLITHOTOMY: A CASE REPORT

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ABSTRACT

Bleeding from the nephrostomy tract remains a recognized concern during percutaneous nephrolithotomy (PCNL), particularly in tubeless procedures. We report the intraoperative use of a flowable absorbable gelatin-based hemostatic matrix for tract hemostasis in a 44-year-old male undergoing tubeless PCNL for a right renal calculus. Following complete stone removal, approximately 8 mL of the gelatin matrix was applied directly into the nephrostomy tract, achieving hemostasis within 2.5 minutes without requiring additional hemostatic measures. Estimated blood loss was minimal, and the patient remained hemodynamically stable throughout the procedure. Postoperative imaging on Day 2 showed no residual haemostatic material. No adverse events or complications, including postoperative bleeding, urinary leakage, or infection, were observed during a 60-day follow-up. This case provides an insight on the applicability of flowable hemostats for effective bleeding control and suggests that their use may represent feasible adjunct for tract hemostasis in selected tubeless PCNL procedures.

KEYWORDS: Percutaneous nephrolithotomy; PCNL; Hemostasis; Gelatin matrix; Tubeless PCNL; Urologic surgery; FLOGEL®

1. INTRODUCTION

Urolithiasis is one of the most common benign urological disorders globally, which substantially contributes to morbidity worldwide. Prevalence of urolithiasis has been increased by 26.7% between 2000 and 2021, China ranking at top (19.1 million cases), followed by 18.6 million cases in India.(Awedew *et al.*, 2024) As urolithiasis increases risk of chronic kidney disease and end stage renal disease,(Gambaro *et al.*, 2017; Kim *et al.*, 2024) intervention is necessary. Percutaneous nephrolithotomy (PCNL) remains the gold standard for management of urolithiasis.(Allam *et al.*, 2025) Hemorrhage is the most common complication of PCNL, which may affect recovery in perioperative period.(Hu *et al.*, 2025; Poudyal, 2022) Hemorrhage may occur at various steps of the procedure, accordingly making bleeding control an important aspect of surgical safety and postoperative recovery.

Multiple factors contribute to risk of hemorrhage during PCNL, including size and position of stone,(J. K. Lee *et al.*, 2013) injury to renal vessels,(Ketsuwan *et al.*, 2020) urinary tract size(Kukreja *et al.*, 2004)and elevated serum creatinine level in term affecting efficient platelet functioning.(Surag *et al.*, 2025) Uncontrolled bleeding may results in perinephric hematoma(Escobar Monroy *et al.*, 2025) and reduced visibility of surgical field.(Haghighi *et al.*, 2017) Given these risks, achieving reliable hemostasis is crucial to ensure procedural efficiency and support favorable perioperative outcomes.

The control of bleeding during urological surgery, topical hemostatic agents can play very important role and also widely preferred and employed by the surgeons.(Choe *et al.*, 2009.; Kommu *et al.*, 2015; Misra *et al.*, 2020). These agents improve postoperative renal function as compared to standard suture closure.(Hidas *et al.*, 2007) They have also been reported to significantly lower pain score, shorter hospital stay and lower post-operative analgesic requirement.(Singh *et al.*, 2008) Gelatin-based flowable matrices represent one such option, designed to conform to tissue surfaces and facilitate clot formation through mechanical tamponade and promotion of platelet aggregation. Their versatility and ability to reach confined areas have encouraged their use across various urologic interventions, including tubeless PCNL.

Although gelatin based hemostatic matrices are increasingly used in renal surgery, clinical evidence of their use in PCNL is limited.(Borin *et al.*, n.d.; D. I. Lee *et al.*, 2004; Luo *et al.*, 2024; Singh *et al.*, 2008). Additional case-based observations can help clarify

role of these agents in urological surgery and supporting postoperative recovery. This case report describes use of gelatin based flowable matrix (FLOGEL®) in tubeless PCNL and outlines its intraoperative handling, hemostatic effectiveness and outcomes.

2. CASE PRESENTATION

A 44-year-old male diagnosed with a right renal calculus underwent elective tubeless PCNL under general anesthesia. Initial cystoscopic placement of a right ureteric catheter was performed in the lithotomy position, followed by repositioning to the prone position for renal access. An infracostal puncture was made into the inferior calyx, and the tract was dilated up to 24 French.

Complete stone fragmentation and clearance were achieved. A 6 Fr, 26 cm Double-J ureteral stent was placed for postoperative drainage. Following stone extraction, approximately 8 mL of a flowable absorbable gelatin-based matrix was prepared according to the manufacturer's instructions and applied directly into the nephrostomy tract. No adjunctive hemostatic agents were used.

Hemostasis was achieved within 2.5 minutes. Estimated intraoperative blood loss was approximately 22 mL. The patient remained hemodynamically stable throughout the procedure. No intraoperative complications were observed. Postoperative recovery was uneventful. Postoperative follow-up evaluations were conducted on Day 0, Day 2, Day 28, and Day 60. An abdominal radiograph obtained on Day 2 demonstrated no radiographically visible residual matrix material within the nephrostomy tract as shown in Figure 1 No postoperative bleeding, urinary leakage, infection, or other adverse events were noted during follow-up period.



Figure 1: Postoperative Day 2 abdominal radiograph after PCNL showing no residual gelatin-based matrix.

3. DISCUSSION

Effective control of bleeding is an important component of safe PCNL, particularly in tubeless procedures where nephrostomy tube tamponade is absent. Flowable gelatin-based hemostatic matrices have been previously investigated in renal surgery, including partial nephrectomy and selected PCNL cases, where they have demonstrated the ability to assist with rapid hemostasis.

Previous reports have described the use of gelatin-based matrices, including gelatin-thrombin combinations, for nephrostomy tract sealing with favorable outcomes. The present case adds to this body of evidence by documenting rapid hemostasis and an uncomplicated postoperative course following application of a gelatin-based matrix in tubeless PCNL. Notably, postoperative imaging demonstrated no visible residual material by Day 2, suggesting early absorption.

Bak et al. and others have shown that gelatin-thrombin matrix sealant can achieved hemostasis in the renal parenchyma within 1-2 minutes in all cases of parenchymal vessel control during tumor excision procedures, and these findings indicate the possibility of usefulness in controlling nephrostomy tract bleeding.(Bak et al., 2004). Gill et al. similarly demonstrated that use of a gelatin-thrombin matrix in 63 patients significantly reduced hemorrhagic complications compared with historical controls without sealant.(Gill et al., 2005).

Application of gelatin-based matrices in PCNL has been evaluated in smaller series specifically. In multicenter experience, Borin et al. reported two cases of tubeless PCNL that required the use of FloSeal® injected into the tract to achieve immediate hemostasis and no postoperative bleeding or obstruction^[18]. In another experience with Surgiflo®, it was established that tract sealant may decrease

urine leakage and reduce hospitalization in patients who underwent tubeless PCNL.(Jawad et al., 2025)

The current case adds to the existing clinical experience observed to date on the safe use of gelatin-based matrices in PCNL, specifically with respect to the lack of infection, obstruction, or reintervention. Notably, the time of hemostasis observed in the case (2.5 minutes) is within the range of hemostasis times reported in the literature on PCNL- and partial nephrectomy-based literature which is typically 2 to 10 minute.^[21] Interestingly, no radiographically visible residual matrix material was observed on postoperative day 2 which may reflect product specific characteristic, yet published studies can hardly mention such early radiologic endpoints and absorption kinetics.

This report is limited by its single-patient design and lack of comparative data. Factors such as tract size, access location, stone burden, and surgeon experience may influence bleeding outcomes. As such, conclusions regarding comparative effectiveness or routine clinical application cannot be drawn from this observation alone. Larger prospective studies and comparative evaluations are required to better define the role of flowable gelatin-based matrices in PCNL.

4. CONCLUSION

This case describes the use of a flowable absorbable gelatin-based matrix for nephrostomy tract hemostasis during tubeless PCNL, with rapid achievement of hemostasis and an uncomplicated postoperative course. While this observation supports the feasibility of flowable gelatin-based matrices as an adjunct in selected cases, further clinical studies are required to establish their safety profile, comparative performance, and optimal indications in urological surgery.

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None.

Statement of ethics

The study was conducted following review and approval by the Ethics Committee of Jasleen Hospital at the study site, Abhinav Multispecialty Hospital, Nagpur, India. Written informed consent for anonymous publication was obtained directly from the patient. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standard.

Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Author Contributions

¹PP: study supervision, final manuscript approval, and correspondence with the journal.

²SK: Regulatory assessment, data validation and revision of the manuscript.

³BT: Study concept and design, regulatory strategy, study oversight and critical manuscript review.

⁴DS: Data acquisition, literature review and critical revision of the manuscript.

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Conflict of Interest

The authors declare no conflict of interest.

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