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CASE REPORT

THE GIANT STAGHORN CALCULUS: ANESTHETIC IMPLICATIONS IN DEVELOPING HEALTHCARE SETTING

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Abstract

The giant staghorn calculus represents a serious form of kidney stone disease characterized by the presence of large, bifurcating calculi that occupy the renal pelvis and extend into multiple calyces, resembling the antlers of a stag. Giant staghorn calculi may remain asymptomatic for prolonged periods, and if left untreated can lead to progressive kidney damage, loss of kidney function and life-threatening complications such as urosepsis. Thus, managing a patient with such an extraordinary and advanced renal pathology in a resource-constrained healthcare setting unfolds clinical and anesthetic challenges that demand vigilance and flexibility. We present the case of a 62-years-old male from a rural village near a small city, with an impressive medical history of persistent nephrolithiasis that progressed for years, due to inconsistent follow-up caused by limited financial means. He underwent right nephrectomy for a massive staghorn calculus with negligible functional renal parenchyma. Given the patient's compromised health status and the presence of a large, fully-configurated complete staghorn calculus, which posed a significant surgical challenge due to its sheer magnitude, it was evident that potential anesthetic risks included hemodynamic instability, sepsis, and altered drug metabolism. Nonetheless, a comprehensive preoperative evaluation, continuous intraoperative monitoring and readiness for rapid intervention ensured a stable perioperative course without complications. Alongside the rarity of this pathology, this case highlights the critical role of anesthesiologists in anticipating and managing the complex challenges posed by such unique pathologies, demonstrating that meticulous planning and resilience enable the delivery of solid and life-sustaining care, even when presented with a narrow spectrum of choices.

***Key Words**: nephrectomy; staghorn calculus; urosepsis.*

Introduction

Staghorn nephrolithiasis represents one of the most formidable manifestations of nephrolithiasis, where the process of formation and enlargement of these renal calculi occupying the renal pelvis and calyces is associated with infection and destruction of renal parenchyma. These renal stones, typically composed of struvite and carbonate apatite, can lead to chronic diseases, calyceal distortion and loss of renal function (1). Besides mechanical obstruction and infection, staghorn calculi can promote chronic inflammation leading to perinephric fibrosis and scarring, which further complicates surgical dissection and impacts long-term renal recovery. In resource-limited environments, delayed presentation of this pathology with complete loss of any functional renal parenchyma, often necessitates open nephrectomy, which intensifies the logistical and monitoring challenges (2). From an anesthetic point of view, staghorn nephrolithiasis presents substantial perioperative risks, including significant hemorrhage due to the extensive vascularity and inflammation associated with large calculi. The chronic infectious nature of these stones predisposes patients to perioperative sepsis, requiring ample antimicrobial management. Additionally, fluid and electrolyte imbalances are common due to impaired renal function, complicating intraoperative fluid therapy. Furthermore, accompanying renal and hepatic impairment alter the pharmacokinetics and pharmacodynamics of anesthetic agents, requiring careful selection and dosing to minimize toxicity and ensure hemodynamic stability (3). This paper aims to showcase the specificity of our patient's fully configured giant staghorn calculus, which, despite the theoretical risk, had an unremarkable intraoperative course and remained hemodynamically stable.

Case Presentation

A 62-year-old male from a rural village near Radovish, Republic of North Macedonia, was presented with a history of longstanding nephrolithiasis, with only tamsulosin as his chronic therapy in use. At his young age 37 years ago, he underwent an open right pyelolithotomy for large renal calculi, which was allegedly exhibited in a science display due to its striking size. Nevertheless, the patient continued experiencing symptoms potentially aligned with persisting nephrolithiasis over the years but had limited access to medical check-ups, reflective of the challenges in a developing healthcare setting. In 2022, he underwent emergency surgery for a bleeding gastric ulcer. The following year (2023), he was diagnosed with acute hepatitis B, necessitating a 24-days hospitalization at the University Clinic for Infectious Diseases. Later that year, he developed acute kidney failure, requiring a 10-days admission to the University Clinic for Nephrology. In 2025, the patient was admitted to the University Clinic for Urology with complaints of flank pain, recurrent urinary tract infections and obvious signs of renal insufficiency. Imaging studies revealed a massive calculus occupying the right renal pelvis and calyces with extensive destruction of renal parenchyma, confirmed by markedly reduced

function on nuclear renal scans. Given the negligible residual function of the right kidney and the risk of ongoing infection, right nephrectomy was indicated as the definitive treatment. Preoperative assessment highlighted risks related to compromised renal and hepatic function, potential massive intraoperative blood loss and perioperative sepsis. Per institutional protocol, after three minutes of preoxygenation with 8L/min of 100% oxygen, the patient underwent induction of general anesthesia with intravenous midazolam 2mg, fentanyl 0.1mg, and propofol 160mg. Neuromuscular blockade was achieved with rocuronium 50mg to facilitate tracheal intubation using an 8.5mm endotracheal tube. Anesthesia maintenance was secured through sevoflurane and continuous propofol infusion. The surgery proceeded for three hours and 45 minutes, without intraoperative complications. During the nephrectomy, the entire right kidney was excised intact. Upon extraction, the calculus was presented as a full-scale anatomic cast of the renal collecting system, occupying the renal pelvis and extending into all three major calyces. Its architecture had a striking resemblance to the internal renal structure, with branches replicating the superior, medial and inferior calyceal paths. Its size and shape confirmed its classification as a complete staghorn stone, with gross dimensions definitely surpassing 14cm, rivaling the size of the kidney itself (Figure 1: A, B). The patient remained hemodynamically stable throughout the procedure, with no significant bleeding. Medications were carefully chosen to his compromised renal and hepatic function, while fluid balance was meticulously maintained. Vital signs were continuously monitored and documented at regular intervals, ensuring vigilant intraoperative care. Postoperatively, recovery was uneventful, and the patient was discharged in good health after 11-days hospitalization.

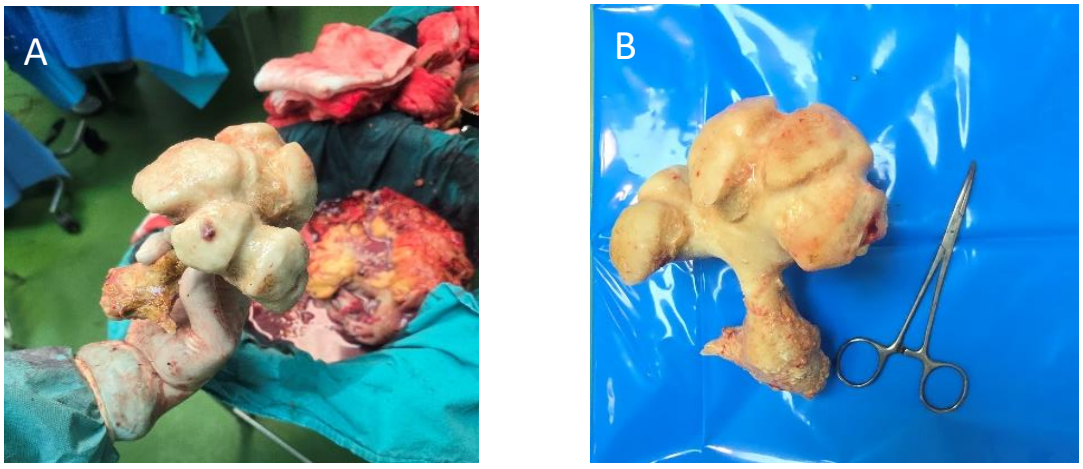

Figure 1. When compared to the surgeon's gloved hand, it nearly fills the palm and extends beyond the grip of the fingers, indicating a size far exceeding common renal stones (A), whereas comparing it to the standard 15cm length of the hemostatic forceps, it measures approximately ~15–17cm along its longest axis, ~9–10cm in width and ~5-7cm in depth, confirming it as a giant intact staghorn calculus, an entity rarely reported in literature (B).

Discussion

When viewed against published literature, the sheer size of this staghorn calculus places it among the largest reported, emphasizing both its rarity and clinical challenge. Thus, this paper provides an opportunity to reflect not only on the anesthetic approaches required for such extreme pathology, but also on the realities of delivering complex surgical care in a developing healthcare setting. It is important to emphasize that staghorn calculi are associated with substantial renal parenchymal loss, often leading to non-functioning kidneys if left untreated (4). Figure 1 depicts an unusual morphology with a cast-like configuration, exhibiting a full 3D negative mold of the renal collecting system. The multiple lobulated protrusions mimic calyceal structures, indicates that the stone grew by mineral deposition within each calyx. Its surface is characterized by a pale yellow-white color and orange-red discoloration, which consists of struvite (magnesium ammonium phosphate) and/ or carbonate apatite composition (common in infection stones). Smooth but lobulated surface indicates long-term formation within a fluid-filled system (rather than rough, spiculated stones seen in rapid crystallization). Absence of sharp points suggests slow, uniform mineral growth in a dilated collecting system. Staghorn calculi, especially ones composed of struvite and carbonate apatite, are infection stones resulting from urease-producing organisms (5). These stones are associated with chronic infection and can harbor embedded bacteria, posing a risk of systemic inflammatory response during surgical manipulation, which makes the surgical choice of treatment, as well as the anesthetic approach, more crucial (2, 3). While making important decisions, it is also essential to note the remarkable size of our patient's staghorn calculus. This specimen (Figure 1), with approximately ~16×10×6cm, stands alongside - or even surpasses - many of those previously reported in the literature. A case report by Thapa et al. (2023), describes an asymptomatic staghorn calculus measuring approximately 11.8×8.8×6.9cm, removed by open pyelolithotomy, which suited resource-limited settings (6). A similar case report by Kesharwani et al. (2022), discusses another asymptomatic 8cm diameter staghorn stone, managed via open pyelolithotomy, again far exceeding the sizes typically managed by PCNL (7). Literature shows cases of very large stones managed by PCNL as the gold standard, but intact removal without fragmentation in constrained settings remains exceptional. According to Winoker et al., staghorn calculus management requires more than assessing size; it needs standardized morphometric frameworks and awareness of anatomical challenges to guide effective treatment in nephron-sparing procedures such as PCNL - the first line of treatment (8), already defined by guidelines of the European Association of Urology (EAU) and the American Urological Association (AUA). However, the already mentioned cases highlight the choice for open surgery, due to stone size**,** thin renal cortex and limited local resources (6,7). Now, reflecting on our case, comparing it to the common PCNL-manageable staghorn calculi (typically 3–5cm in size) (8), the extracted specimen in this case far surpasses these norms. Such extreme morphology and volume are associated with near-total renal parenchymal replacement, often rendering the affected kidney non-functioning and justifying definitive

surgical removal (4). Nephrectomy may not only be justified but also appropriate and sometimes even the safest solution for the patient. While surgical technique often depends on stone size and location, the type of staghorn calculus, whether struvite, calcium oxalate or cystine, can significantly inform anesthetic planning, infection control and postoperative risk management (9, 10). Struvite staghorn calculi, composed of magnesium ammonium phosphate, are commonly represented as “infection stones”, often formed in infected and obstructed systems, immediately predisposing a high urosepsis risk (11). Whereas calcium oxalate calculi and cystine calculi have lower to non-infection risk. Stone type isn't just a chemical detail; it's a predictor of sepsis risk, surgical complexity and anesthetic strategy. In particular, struvite stones warrant heightened pre-op vigilance, infection control and anesthetic preparedness for hemodynamic instability. Bringing these points together, the successful management of this rare and massive staghorn calculus is especially significant in a developing healthcare setting, where limited resources and delayed presentations dictate the choice for open surgery. Similar reports from other developing countries confirm that, despite such constraints, safe outcomes are achievable through solid planning and good care (12, 13). Looking alike published cases allow us to see where our experience fits within the broader clinical landscape. It highlights not only the rarity and scale of this pathology but also the practical challenges of managing such a case in a developing healthcare setting. Such citations therefore enrich the discussion, reinforcing the relevance of our findings while contributing to the collective understanding of managing extreme cases safely and effectively.

Conclusion

This case highlights the successful management of a rare, giant staghorn calculus in a resource-limited setting, where delayed care and limited access shaped both the pathology and treatment approach. Despite the risks posed by infection, hemodynamic instability and impaired organ function, careful anesthetic planning and intraoperative attention ensured a stable and complication-free outcome. While open nephrectomy is less common in high-resource centers, in this case, it was the most appropriate option given the extent of renal damage and local limitations. Ultimately, this case emphasizes the value of teamwork and solid clinical judgment in safely managing complex conditions, even in less-than-ideal environments.

References:

1. Diri A, Diri B. Management of staghorn renal stones. Ren Fail. 2018 Nov;40(1):357-362. doi: 10.1080/0886022X.2018.1459306. PMID: 29658394; PMCID: PMC6014528.
2. Assimos D, Krambeck A, Miller NL, Monga M, Murad MH, Nelson CP, Pace KT, Pais VM Jr, Pearle MS, Preminger GM, Razvi H, Shah O, Matlaga BR. Surgical

Management of Stones: American Urological Association/Endourological Society Guideline, PART I. J Urol. 2016 Oct;196(4):1153-60. doi: 10.1016/j.juro.2016.05.090. Epub 2016 May 27. PMID: 27238616.
3. Sladen RN. Anesthetic considerations for the patient with renal failure. Anesthesiol Clin North Am. 2000 Dec;18(4):863-82, x. doi: 10.1016/s0889-8537(05)70199-1. PMID: 11094695.
4. Mahat A, Duwadi B, Yadav GK, Mishra U. A large Staghorn calculus occupying the entire collecting system. *Eurorad*. 2023 Aug 24 [cited 2025 Aug 17]. doi:10.35100/eurorad/case.18276.
5. Schwaderer AL, Wolfe AJ. The association between bacteria and urinary stones. Ann Transl Med. 2017 Jan;5(2):32. doi: 10.21037/atm.2016.11.73. PMID: 28217697; PMCID: PMC5300853.
6. Thapa B, Bhomi KK, Shrestha R, Lamichhane D, Rijal A, Subedi N, Khadka M, Adhikari S, Joshi BR. A silent, giant staghorn calculus managed with open surgery: a case report. Ann Med Surg (Lond). 2023 Mar 14;85(4):999-1002. doi: 10.1097/MS9.0000000000000294. PMID: 37113920; PMCID: PMC10129240.
7. Kesharwani D, Samaddar S, Ghose A, Omorphos NP. A silent giant staghorn renal calculus managed successfully with open pyelolithotomy: a case report. J Surg Case Rep. 2022 Jan 13;2022(1):rjab601. doi: 10.1093/jscr/rjab601. PMID: 35047181; PMCID: PMC8759461.
8. Winoker JS, Chandhoke RA, Atallah W, Gupta M. Morphometry scores: Clinical implications in the management of staghorn calculi. Asian J Urol. 2020 Apr;7(2):78-86. doi: 10.1016/j.ajur.2019.06.001. Epub 2019 Jun 12. PMID: 32257799; PMCID: PMC7096674.
9. Healy KA, Ogan K. Pathophysiology and management of infectious staghorn calculi. Urol Clin North Am. 2007 Aug;34(3):363-74. doi: 10.1016/j.ucl.2007.05.006. PMID: 17678986.
10. Espinosa-Ortiz EJ, Eisner BH, Lange D, Gerlach R. Current insights into the mechanisms and management of infection stones. Nat Rev Urol. 2019 Jan;16(1):35-53. doi: 10.1038/s41585-018-0120-z. PMID: 30470787.
11. Flannigan R, Choy WH, Chew B, Lange D. Renal struvite stones--pathogenesis, microbiology, and management strategies. Nat Rev Urol. 2014 Jun;11(6):333-41. doi: 10.1038/nrurol.2014.99. Epub 2014 May 13. Erratum in: Nat Rev Urol. 2014 Jun;11(6):page after 341. PMID: 24818849.
12. Kumar A, Gogoi S, Kapoor R, Srivastava A, Mandhani A. Management of complete staghorn stone in a developing country. Indian J Urol. 2003 Jan-Mar;19(1):42-9. doi: 10.4103/0970-1591.10587.

13. Ali SKS, Chatterjee A, Mukhopadhyay NN. A huge right staghorn renal calculi: a case report of inevitable open surgery. *Int J Res Med Sci*. 2023 Jan;11(1):375-377. doi:10.18203/2320-6012.ijrms20223667.