EDITORIAL PAPER

UROLITHIASIS

Role of suction in revolutionising endourology: Is it the final frontier – an overview from EAU Endourology

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Kidney stone disease (KSD) has been rising secondary to lifestyle and other dietary and environmental factors [1–3]. Consequently, there has been a technological revolution with newer lasers, smaller scopes, better patient pathways, use of artificial intelligence (AI), and finally the introduction of suction technology in endourology (Table 1) [4–8]. Suction is arguably the final piece of the puzzle in endourological stone management. While advances in energy sources have enabled effective stone fragmentation, the ability to efficiently clear fragments is what ultimately determines the success of the procedure. Suction facilitates superior stone clearance, improves stone-free rates, and enhances procedural safety by maintaining lower intrarenal pressures (IRP) and reducing the risk of sepsis. Without effective fragment evacuation, even a high-quality fragmentation can result in residual and recurrent stones, diminishing the overall efficacy of the intervention [9, 10]. This editorial looks at the role of suction in endourology, the clinical and physiological rationale for its integration, current clinical and technological advances, the challenges and controversies that remain with its use. Finally, looking at the shift towards suction-enabled endourology as a new standard of care.

While the concept of suction in endourology is not new with being used for percutaneous nephrolithotomy (PCNL) for past decades, its systematic application in flexible ureteroscopy (fURS) and miniaturized PCNL (mPCNL) has only recently gained serious traction. The rationale for its use includes but not limited to better IRP regulation, which is mediator for infectious complications. Continuous or intermittent suctioning during the procedure would negate this by mitigating pressure surges. There would also be better vision due to suction of debris, dust, and fragments during the procedure created by laser lithotripsy, possibly leading to a reduction in basketing and operative time. With high-power lasers there is a possibly of temperature rise and potentially damaging the urothelium, but suction would allow dissipation of this thermal buildup. And a better vision without worrying about temperature and pressure would lead to decreased cognitive burden on the surgeon with better efficiency.

Suction during fURS can be achieved through flexible and navigable suction sheath (FANS), direct in-scope suction (DISS), or via a paired pressure-controlled irrigation system. PCNL suction is via the suction probes or via a suction sheath [11–17]. Current evidence on their role suggests improved stone-free rate (SFR), lower infectious complications, reduced operative time and better ergonomics [18], whether it is a FANS or DISS system, although there is more evidence for its use with the former. Although studies still lack standardised outcomes and have a degree of heterogeneity with them. For its wider use and adoption, besides the evidence gap, we will also need to look at the cost and access, learning curve, standardised outcomes, and the effect on the environment with the single-use devices. Perhaps these could be addressed by integration into training curricula, value-based health care, and role of AI and automation of procedural aspects such as irrigation and suction settings [19].

In the future, we will need to consider the Quadrifecta in retrograde intrarenal surgery (RIRS) with suction, irrigation, IRP, and temperature, which are all interdependent variables [20]. Suction would therefore not just be an adjunct but a fundamental aspect of stone surgery by offering dynamic control over IRP, temperature, and visibility, enabling safer and more effective stone surgery. As we move into an era of precision endourology, integrating suction into both flexible and percutaneous procedures may become the rule, not the exception.

The question, therefore, is whether suction will become a new standard or remain just a technical add-on. The growing evidence and clinical experience point towards it becoming an essential part of endourological practice. As with many surgical innovations, its true value lies not just in what it does but in how it reshapes our approach. Embracing suction means committing to more complete stone clearance, improved outcomes, and ultimately, better care for our patients.

Table 1. *Suction in endourology – rationale, devices, evidence, limitations, and future directions*

SUCTION IN ENDOUROLOGY	
Rationale	Clearance of stone fragments and debris
	Intrarenal pressure regulation
	Enhanced visualisation and fragment clearance
	Temperature modulation
	Surgical ergonomics and efficiency
	Decrease operative times
Devices and systems	Flexible and navigable suction sheath (FANS)
	PCNL suction sheaths
	Direct in-scope suction (DISS)
	Pressure-controlled irrigation systems
Evidence and outcomes	Improved stone-free rates
	Reduced operative time
	Lower infectious complications
	Better ergonomics
Limitations and controversies	Cost and access
	Learning curve
	Environmental impact
	Evidence gap
Future directions	Standardized metrics
	Artificial intelligence and automation
	Integration into training curricula
	Value-based health care

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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ETHICS APPROVAL STATEMENT

The ethical approval was not required.

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