

## Current Trends in Use of Holmium-Yag Laser in Percutaneous Nephrolithotomy

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### Mini Review

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The EAU Guidelines recommend percutaneous nephrolithotomy (PCNL) as the treatment of choice for renal stones >2cm, because of the higher stone free rate compared to extracorporeal shock wave lithotripsy (ESWL) and the lower morbidity compared to open stone surgery [1].

A holmium laser is a pulsed laser system with properties ideal for stone disintegration. Stone fragmentation result mainly from a thermal effect with a secondary shockwave or cavitation effect [2]. Although Holmium-Yag laser has become the treatment modality of choice for ureteroscopy, there is no consensus regarding the best lithotripsy device in PCNL.

Pneumatic and ultrasound lithotripsy devices or combination of both (Master Lithoclast) have almost exclusively been used in the past in PCNL. Pneumatic lithotripsy is more powerful than ultrasonic, but it results in various sizes stone fragments which need retrieval. Moreover, residual fragments often result due to high retropulsion effect and fragment migration to remote calyces. Ultrasound lithotripsy works with vibration and simultaneous suction on the stone surface, but it is less efficient for very hard stones. Moreover, mechanical dysfunction is not unusual due to clogging of stone debris in the suction of the lithotripter or overheating of the probe [3].

Nowadays, Holmium laser has gained popularity as a lithotripsy device in PCNL, mostly due to miniaturization of the instruments and tract sizes used to access the kidney. In mini PCNL, with tract sizes up to 20Ch, 12 to

15Ch nephrosopes are used with 6Ch working channel, requiring holmium laser fibers from 365 to 550 $\mu$ m. In ultra mini-PCNL, with a 7,5Ch nephroscope used, a 365 $\mu$ m laser fiber can only be utilized using power up to 40 W (2.0 J/20 Hz). In microperc, through a 16G microperc needle which is used for calyceal puncture, a 272 $\mu$ m laser fiber is attached to a Touhy-Borst adapter and used for fragmentation [4].

There is no doubt that the pulse energy output of the Ho: YAG laser correlates with the lithotripsy efficiency. The higher-power and higher-frequency setting lead to faster fragmentation and shorter operation time. High power Holmium Yag laser (60-70W, 3-3,5J-20Hz) can significantly decrease the operative time and achieve stone free rates comparable to ultrasound lithotripsy. The high-power Ho: YAG laser works by “vaporizing and bursting” the stone. The potential risk of urothelial wall damage caused by inadvertent contact with the urothelium is prevented by starting fragmentation from the centre of the stone leaving the periphery at the end of the procedure when the pelvic wall collapse due to rapid reduction of stone size. The use of the “painting technique” combined with high power holmium laser also produce stone fragments small enough to pass spontaneously from the amplatz sheath by means of the vacuum effect. A potential disadvantage from the use of a stiff rope-like 800 or 1000 $\mu$ m laser to produce such a high-power energy is the lack of stability at the fiber tip and the retropulsion effect on the stone surface. The recent launch of a handheld device (Lithassist-Cook) with suction properties stabilize the fiber making laser fragmentation precise, fast and secure [5].

Should holmium: YAG laser be the lithotripsy modality of choice for PCNL? Even though most endourologists would still choose ultrasound as the lithotripsy device of choice for PCNL, holmium-Yag laser nowadays play a significant role in PCNL. The limitation of big laser fibers could be obviated with the production of smaller diameter laser fibers producing equal pulse energy with the 800 or 1000  $\mu\text{m}$  fibers. Furthermore, the trend to access the kidney with smaller tracts, make mini PCNL with holmium laser feasible even for larger stones by creating more accesses to the kidney or by the supplementary use of flexible nephroscope from one tract. Holmium laser can also be used in combined PCNL and RIRS surgery alone or in combination with ultrasound lithotripsy, especially when the rigid nephroscope cannot reach inaccessible calyces.

Holmium-Yag laser is an essential tool in the armamentarium of every endourologist and plays an important role in percutaneous nephrolithotomy.

## References

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