Comments on Thermal effect of holmium laser lithotripsy under ureteroscopy

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To the Editor: We appreciate the work Wang *et al*[1] have done on thermal effect of holmium laser lithotripsy under ureteroscopy. Holmium laser is considered as the optimum lithotripter for ureteroscopy due to its effectiveness.[2] With the application of high-power laser system, the potential risk of ureter thermal injury increases. Several *in-vitro* and animal experiments have been carried out to assess temperature changes of lavage solution during laser activation recent years. To the best of our knowledge, this is the first human study revealing temperature changes of ureter lavage solution during holmium laser ureteroscopic lithotripsy.

However, several questions need to be further discussed. Lavage solution played an important role in taking away heat generated by laser activation. According to Aldoukhi *et al*,[3] higher irrigation flow rates resulted in lower temperature increases. However, Wang *et al* did not provide flow rate settings in their study. Another important factor affecting temperature change is the duration of laser activation; this data was absent as well. If these two parameters were not standardized before study, the comparison between groups would be of great bias. And without the details of the two major factors, the results might be unrepeatable by other surgeons.

The peak temperature and the exposure time are the two contributors for thermal cytotoxic effect. Sapareto and Dewey[4] developed a formula, also known as cumulative equivalent minutes at 43°C (CEM43), to calculate thermal dose as an exposure time at the temperature of 43°C. In their paper, they stated that a reference temperature of 43°C was arbitrarily chosen, without mentioning that thermal damage will occur when the biological tissue is in an environment of 43°C for more than 120 min. In fact, threshold for thermal damage differs among tissues and organs.[5]

Although this study is not perfect, it provides us the preliminary results of temperature profile of ureter lavage during ureteroscopic laser lithotripsy.

Authors' reply

Thanks for your letter and talking about some of your points.

The flow of perfusion and the excitation time of holmium laser were considered in the design of this study. However, in the practical experience, the actual exchange of perfusate during the actual operation cannot be accurately monitored, in particular, the monitoring of outflow (Some may enter the ureter and pelvis near the stones. Some may return to the bladder, and some flow from the ureteroscope to the outside). Therefore, the effect of perfusion flux on temperature can be better understood in *in vitro* experiment. Similarly, for the holmium laser excitation time, it is difficult to carry out standardized quantitative design due to its intermittent excitation and irregular excitation time in the actual lithotripsy process. Therefore, we designed this as an observational study to understand the temperature changes of perfusion fluids during actual surgery (without intervention, the surgeon adjusts the flow rate of the perfusate and the excitation time and frequency of the holmium laser according to the interpretative condition). However, we have also carried out *in vitro* studies. We have specified the flow rate of the perfusate, the laser excitation time, and the measures to decrease the thermal effect. The research has been done and the article is being written.

As for the threshold of thermal damage in various animal tissues, no uniform conclusions have been drawn at present. Our study did deviate from the choice of thermal damage threshold. Sapareto and Dewey[4] proposed the concept of CEM43, and Haveman *et al*[6] observed a transient reduction in bladder capacity and high levels of azotemia after 1 h at 44°C (120 CEM43) in rats. Aldoukhi *et al*[3] also used 120 CEM43 as the threshold for the study. Therefore, our study is based on the existing literature results of 43°C as a threshold for discussing thermal

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damage in human tissue, but the thermal damage threshold of human ureter tissue remains to be determined.

Our research is indeed imperfect. More research is required to clarify the threshold for thermal damage in human tissues. It is also expected that more studies to confirm if the presence of thermal damage in holmium laser lithotripsy and whether it is one of the possible causes of post-operative ureteral stricture.

Conflicts of interest

None.

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