Short Communication

Laparoscopic Partial Nephrectomy by Diode Laser with Highly Selective Clamping of Segmental Renal Arterial

Xiao-Feng Zhou, Zhen-Shan Ding, Jian-Feng Wang, Xing Chen, Zi-Lin Fang, Nai-Bo Liu, Guan Zhang, Pei-Yu Zhao
Department of Urology, China-Japan Friendship Hospital, Beijing 100029, China

Key words: Diode Laser; Highly Selective Clamping; Partial Nephrectomy

Introduction

The treatment of small renal masses has shifted from radical nephrectomy to partial nephrectomy, in particular, laparoscopic partial nephrectomy.[1] Renal artery clamping is often necessary to minimize hemorrhage during resection in cases of partial nephrectomy. However, renal artery clamping may lead to greater incidence of renal malfunction after partial nephrectomy. Therefore, novel techniques which could both avoid renal artery occlusion and achieve adequate hemostasis are urgently required. Selective renal segmental artery clamping was one of several common methods that could achieve "zero ischemia." At the same time, a number of reports about laser-assisted partial nephrectomy on humans using multiple kinds of outstanding coagulative specialties of lasers were published.[2] Among facilities with clinical use of lasers, diode laser emitting a wavelength of 980 nm has been recently utilized in the human body operations. The purpose of our clinical research was to evaluate the effectiveness and safety of application of diode laser (980 nm wavelength) in laparoscopic partial nephrectomy with highly selective clamping of the segmental renal arterial.

Methods

We retrospectively reviewed medical records of five patients who received laparoscopic partial nephrectomy with diode laser as well as highly selective clamping of renal arterial branches in the Department of Urology at China-Japan Friendship Hospital from June 2012 to December 2013. Inclusion criteria were a single tumor with size <4 cm, with a minimum distance of 5 mm from the urinary collecting system. Exclusion criteria were American Society of Anesthesiologists (ASA) score >3, centrally located tumor, and functional single kidney. Four men and one woman were included with a median age of 66 years (range from 43 to 74). Small renal masses were diagnosed with ultrasound examination in these patients, and the following computed tomography scan suggested kidney malignant tumors. R.E.N.A.L. nephrometry score based on computed tomography image was used to quantitate renal tumor size, location, and depth. General conditions of these patients were recorded. Perioperative data such as operation time, time of segmental artery clamping, estimated blood loss, postoperative complications (quantified with modified Clavien classification system), pathological results of resected renal mass, and postoperative length of stay were collected. Preoperative and postoperative serum creatinine was tested. Postoperative follow-up information was also recorded.

The kidney was fully mobilized, and the renal mass was explored at first. Then the renal segmental artery, which supplied blood for the renal mass according to preoperative computed tomography angiography, was dissected precisely. The isolated renal segmental artery was closed with the bulldog clamp. The 980 nm wavelength diode laser fiber (Ceralas EVOLVE Hi-Power Diode, Biolitec AG, Germany) was applied through a trocar. The renal mass was resected using diode laser fiber with power settings 150 W along the excision line 0.5 cm outside the mass margin [Figure 1]. After the renal mass was extirpated, 2-0 absorbable suture was used to reconstruct renal parenchyma.

Results

Five patients with small renal mass received successful operations. The median R.E.N.A.L. score of five renal masses was seven (range from 4 to 9). The ASA score of two patients was II, while another three patients was III. The median operation time was 126 min, during

Access this article online

Quick Response Code:

Website: www.cmj.org

DOI: 10.4103/0366-6999.162513

Address for correspondence: Dr. Pei-Yu Zhao, Department of Urology, China-Japan Friendship Hospital, 2 East Road, Chao Yang District, Beijing 100029, China
E-Mail: doctorzxf@126.com

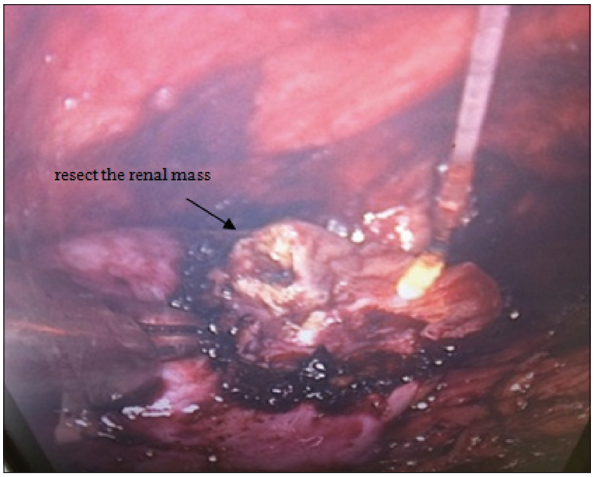

Figure 1: Resect the renal mass.

which the median clamping time was 23 min (range from 21 to 29 min). The median estimated blood loss was 60 ml (range from 50 to 85 ml), and blood transfusion was not requested in any patients. The median preoperative and postoperative serum creatinines are shown in Table 1. Postoperative creatinine had a higher trend than preoperative creatinine, but we did not observe any postoperative renal insufficiency. No postoperative complications were observed. The median postoperative length of stay was 7 days.

Pathological examination suggested renal clear cell cancer and surgical margins negative for malignancy in all five cases. The median pathological tumor diameter was 2.5 cm. None of the patients developed tumor recurrence or metastasis during 12–18 months follow-up. In addition, no one was diagnosed with renal insufficiency after surgery.

Discussion

Laser techniques have been introduced in laparoscopic partial nephrectomy due to its outstanding coagulative and hemostasis properties. Kyriazis *et al*.[2] have reviewed the clinical experience with laser-assisted nephron-sparing surgery. Thanks to the recent evolvement of 980 nm wavelength diode laser adopted in prostatic vaporization, this type of laser recently entered into laparoscopic partial nephrectomy. Laser function is achieved through absorption of its energy on chromophores. In surgery, the most often used chromophores are hemoglobin and water. The 980 nm wavelength diode laser is simultaneously absorbed in water and hemoglobin. Therefore, it is proposed to possess the ability of precise incision and excellent hemostasis. In this study, we successfully resected renal mass using 980 nm wavelength diode laser with little blood loss in all five patients. The median pathological tumor diameter was 2.5 cm. Negative pathological margins confirmed the precise cutting property of diode laser. Ogan *et al*. have reported the first experience with diode laser 980 nm laparoscopic partial nephrectomy in pigs, coming to the conclusion that clinical trials in humans should be limited to small exophytic tumors.[3] Knezevic *et al*. have reported 17 cases with diode laser 980 nm laparoscopic partial nephrectomy, and the median size of the tumor was 3 cm. They concluded that laser laparoscopic partial nephrectomy is feasible and offers the benefit of shorter warm ischemia time with effective tissue coagulation and hemostasis.[4]

Table 1: Preoperative and postoperative serum creatinines (μoml/L)

Case No.	Preoperative serum creatinines	Postoperative serum creatinines
1	53	60
2	70	85
3	59	85
4	60	95
5	58	70

Unlike global renal parenchymal ischemia caused by conventional renal artery clamping, a major portion of the kidney, whose feeding segmental artery was not occluded, had normal blood perfusion to prevent from warm ischemic damage caused by hypoxia-induced oxidative radicals in our study. The postoperative renal function was barely affected based on the slightly increased postoperative serum creatinine.

What's more, we just clamped selected segmental artery instead of renal artery and did not observe any complications including hemorrhage, infection, urinary leak, postoperative renal insufficiency, and so on. The major disadvantage of the laser 980 nm is remarkable smoke. Our operation time was delayed because of intermittent gas suction. We are going to try some methods to improve visibility. There will be a good method for dealing with this situation after more cases accumulated in future.

The small number of patients, lack of control group, single-center study, and short-term follow-up are the drawbacks of this research.

In conclusion, our initial experience demonstrated that 980 nm wavelength diode laser-assisted laparoscopic partial nephrectomy with highly selective clamping of segmental renal arterial was a safe and valid therapeutic method for small renal mass. This minimal invasive therapy provided benefits of effective hemostasis, little hemorrhage, unaffected renal function, and avoidance of complications. Further studies with larger sample size and longer follow-up are required to verify its wide feasibility, disease-free survival, and overall survival.

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Received: 18-06-2015 **Edited by:** Xiu-Yuan Hao
How to cite this article: Zhou XF, Ding ZS, Wang JF, Chen X, Fang ZL, Liu NB, Zhang G, Zhao PY. Laparoscopic Partial Nephrectomy by Diode Laser with Highly Selective Clamping of Segmental Renal Arterial. Chin Med J 2015;128:2262-4.

Source of Support: Nil. **Conflict of Interest:** None declared.