Application of Multi-Slice Spiral CT Renal Angiography Combined with Intraoperative Ultrasound in Laparoscopic Partial Nephrectomy

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ABSTRACT

This study aimed to evaluate the clinical significance of multi-slice spiral CT renal angiography combined with intraoperative ultrasound in laparoscopic partial nephrectomy. Eighty patients were seen at the Affiliated Hospital of Hebei University from January 2021 to December 2022. The patients were divided into two groups, the experimental group and the control group, with 40 cases in each group. The experimental group received laparoscopic partial nephrectomy combined with intraoperative ultrasound, while the control group received only conventional laparoscopic partial nephrectomy. The experimental group had significantly shorter operative time and intraoperative thermal ischaemia time ($p < 0.05$) and had significant advantage in the detection of microscopic cancer foci ($p = 0.04$). The experimental group also had significantly lower of positive rate of postoperative incisal margin ($p = 0.01$). The experimental group had significantly lower of recurrence rate ($p = 0.03$). The study concluded that multi-slice spiral CT renal angiography combined with intraoperative ultrasound boasts various benefits in the treatment of patients with renal cell carcinoma, it is safe and effective with no significant impact on renal function.

Key Words: *CT renal angiography, Intraoperative ultrasound, Laparoscopic partial nephrectomy, Renal cancer.*

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In clinical practice, renal cell carcinoma with a tumour diameter of less than 4 cm is called small renal cancer. For the treatment of small renal cancer, retrolaparoscopic partial nephrectomy is the preferred treatment method. Because variations in the renal arteries are common, especially in the accessory renal arteries, preoperative understanding of accessory renal artery variations is extremely important for intraoperative management of the renal arteries and tumour resection. Computed tomography angiography (CTA) can clearly display the entire picture of the renal blood vessels, kidneys, and ureters, providing a strong guarantee for the smooth implementation of the operation and the rapid recovery of the patient after surgery.[1] Positive resection margins are the direct cause of postoperative recurrence after nephron-sparing surgery.[2] For some tumours, it is difficult to determine the boundary from the surface of the kidney. At the same time, it is impossible to understand the relationship between the renal blood vessels and the collecting system, which increases the difficulty of surgery.[3]

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Intraoperative ultrasound can be performed by placing the ultrasound probe on the surface of the kidney, which can detect small cancer lesions. This study aims to evaluate the application value of multi-slice spiral CT renal vascular imaging combined with intraoperative ultrasonography in the implementation of retrolaparoscopic partial nephrectomy.

Eighty patients with renal cancer and a RENAL score of less than 7 points, admitted to the Affiliated Hospital of Hebei University from January 2021 to December 2022, were selected and divided into a study group and a control group according to treatment methods. The patients in the study group received laparoscopic partial nephrectomy combined with intraoperative ultrasound examination, while the control group received only conventional laparoscopic partial nephrectomy. There were 40 patients in each group, including 27 males and 13 females in the study group, aged 34 to 68 years old, with an average age of 51.45 ± 11.92 years, and 25 males and 15 females in the control group, aged 33 to 70 years old, with an average age of 51.50 ± 12.15 years. Both groups of patients underwent haematuria routine, liver and kidney function, coagulation, and other laboratory tests before surgery. Urinary system CT plain + enhanced and renal vascular imaging, liver, gallbladder, pancreas, spleen, and retroperitoneal lymph node ultrasound were performed to exclude metastasis. There was no significant difference in the general patient data between the two groups.

Table I: Comparative analysis of observation indicators of two groups ($\bar{x}\pm s$) (n = 40).

Indices	Experimental group	Control group	t/χ^2	p*
Operative time	82.65 ± 23.48	97.66 ± 25.21	2.76	0.01
Thermal ischaemia time	16.73 ± 3.72	21.25 ± 4.59	4.84	0.00
Detection of microscopic cancer foci	4 (10.00)	0 (0.00)	4.21	0.04
Positive incisal margin (%)	0	6	6.49	0.01
Recurrence (cases, %)	1 (2.5%)	7 (17.5%)	5.00	0.03

**p <0.05.*

The two groups of patients were observed for operation time, warm ischaemia time, blood loss, whether micro-cancer lesions were found, and whether they were converted to open surgery. Before the operation and on the second day after the operation, 5 ml of early morning and fasting blood were drawn, and the patient's urea nitrogen (BUN), creatinine (Cr), glomerular filtration rate (GFR), and other indicators were checked using a fully automatic biochemical analyzer. The postoperative conditions of the two groups of patients were compared and analysed, such as pain, fever, positive resection margin, urine leakage, drainage tube removal time, etc. The patients were followed up for 48-60 months, and the recurrence rate and long-term complication rate of the two groups of patients were compared.

This study used SPSS version 20.0 for data analysis, and measurement data were expressed as ($\bar{x}\pm s$). Two independent-samples t-test was used for data analysis between groups, paired t-test was used for data analysis within groups, c^2 test was used for comparison of rates, analysis of variance was used for repeated measurement data, and LSD test was used for pairwise comparisons. A value of $p < 0.05$ was considered statistically significant.

Comparison between the two groups showed that there was no statistical difference in intraoperative blood loss, opening rate, and renal function before and after the surgery; the operation time and intraoperative warm ischaemia time of the study group were lower than those of the control group, and the difference was statistically significant ($p < 0.05$). Tiny cancer lesions can be found after combining with intraoperative ultrasound ($p = 0.04$); the positive rate of surgical margins in the postoperative study group was significantly lower than that in the control group, and the difference was statistically significant ($p = 0.01$), while pain, fever, and urinary leakage occurred. There was no statistically significant difference between the two groups in terms of rate and drainage tube removal time ($p > 0.05$); the follow-up time of the two groups of patients was in line with the time specified by the institute, with an average of 53.75 ± 9.73 months in the study group and 52.87 ± 8.65 months in the control group. There was no significant difference between the two groups in time ($p = 0.67$). The recurrence rate of the study group was 2.5%, which was significantly lower than the 17.5% of the control group ($p = 0.03$); the long-term surgical complication rate of the study group was 10%, compared with 12.5% of the control group, and the difference was not statistically significant ($p = 0.72$, Table I).

In recent years, with the continuous development of minimally invasive technology, the application of laparoscopy in partial nephrectomy has become very common, and preoperative imaging evaluation of the kidneys is particularly important. Multi-slice spiral CT renal vascular imaging (CTA+CTU) can not only clearly display the blood supply vessels of the kidney, but also clearly display the location of the tumour and its relationship with the collecting system, which is helpful for mastering comprehensive information about the kidney before surgery. The positive rate of postoperative resection margin is the most important factor in postoperative recurrence.[4] Positive margins are associated with higher rates of local recurrence and metastasis. Reducing the positive rate of resection margins is an important method to improve patient survival. Di *et al.* believed that the use of ultrasound probes during laparoscopic partial nephrectomy can enable surgeons to optimise tumour identification,[5] accurately determine the tumour location, shorten operation time, and reduce renal ischemia time (IT). Studies by Yang *et al.* have confirmed that the combined application of intraoperative ultrasound facilitates surgical resection and improves the effect of nephron-preserving surgery.[6]

This study's results confirm that the operation time and intraoperative warm ischaemia time of multi-slice spiral CT renal vascular imaging combined with intraoperative ultrasonography are shorter than those of the control group ($p < 0.05$), and combined with intraoperative ultrasonography has significant advantages in detecting micro-cancer foci ($p = 0.04$); it has lower positive margin rate ($p = 0.01$) and recurrence rate ($p = 0.03$) after the surgery.

In conclusion, multi-slice spiral CT renal vascular imaging combined with intraoperative ultrasonography can clarify tumour edges, shorten operation time, and warm ischaemia time, reduce positive margin rate and recurrence rate, and has no significant impact on renal function. It is safe and effective.

This study was a single-centred retrospective analysis of non-random samples. The sample size was small and follow-up data was insufficient. With the development of laparoscopic technology and endoscopic suturing technology, some larger volumes and in special locations, such as endometriosis tumours within the collecting system, are no longer considered contraindications for partial nephrectomy. However, this study only involves tumours in general locations and has not included such complex cases. In future clinical work, the authors will further expand the sample size and cases of patients with tumours in special locations, and increase

follow-up content. In order to more objectively evaluate the advantages and disadvantages of this technology, so that more patients can benefit from it.

ETHICAL APPROVAL:
This study was approved by the Ethics Committee of the Affiliated Hospital of Hebei University, China (No. HDFY-LL-2022-087; Dated: 28 February 2022).

PATIENTS' CONSENT:
Informed written consent was taken from the patients to publish the data concerning this case.

COMPETING INTEREST:
The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:
TM, WW: Disease diagnosis, statistical analysis, and manuscript writing.
KZ, WY: Research designing and writing of the manuscript.
ZYC: Disease diagnosis, personnel coordination, and case follow-up.
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