

5 **Laparoscopic partial nephrectomy in the treatment of renal** 6 **tumors in Thanh Hoa General Hospital**

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15 **Abstract.** To evaluate initial results of laparoscopic partial nephrectomy (LPN) in the treatment of renal
16 tumors in Thanh Hoa General Hospital. During the examination 10 patients (6 females, 4 males) were
17 diagnosed with renal tumors on CT scans. Later they underwent LPN at Thanh Hoa General Hospital
18 from November 2016 to March2018. The mean age is 54.5 years. Average tumor size is 3.5 cm. There
19 are 7 patients in the pT1a stage, 3 - in the pT1b stage. The R.E.N.A.L. nephrometry scoring: 2 patients
20 in 4a; 2 patients in 4p; 3 patient in 5a; 2 patient in 6p; and 1 patient in 8x. Average operative time is
21 125.6 minutes. Average warm-ischaemic time is 29.4 minutes. Blood loss average 85.2 ml.
22 Haemorrhagic complication in 1 patient. Convert to laparoscopic radical nephrectomy in 1 patient.
23 Check for 1 to 3 months without complications, metastases, or local recurrence. LPN is ideal option for
24 tumors in initial stages, because it reduces the possible risk of glomerular filtration decrease. In the
25 treatment of renal tumors it is a surgical procedure that can be performed at provincial hospitals, with
26 initial options for renal tumors of size ≤ 4 cm. However, in order to perform well in this technique, the
27 facility must have adequate equipment, laparoscopic experienced surgeons and intensive training.
28 Anyway this method seems to lead to more post-operative complications, needing longer warm
29 ischemic time with the corresponding renal function deterioration (RFD). Nonetheless, different studies
30 have shown less risk of chronic kidney disease and cardiovascular events after LPN, with a noteworthy
31 improvement in the overall survival rate. One of the main aims of this study is to decrease the loss of
32 renal function associated with LPN. Quantity and quality of the saved renal parenchyma are two
33 fundamental criteria that evaluate post-operative renalfunction.
34

35 **Key words:** renal function; partial nephrectomy; radial nephrectomy; renal tumor;
36 laparoscopic surgery.
37

38 **INTRODUCTION** 39

40 Laparoscopy in humans was first performed more than 100 years ago by
41 Swedish surgeon Hans-Christian Jacobaeus; he named this procedure
42 laparothorakoskopy. The first renal surgery was performed in 1990 in the USA.

43 Nowadays, thanks to the widespread use of imaging tools, such as
44 ultrasound, CT scans, the rate of early detection or accidental detection of small-
45 size kidney tumors is on the rise. According to Vu Nguyen Khai Ca (2015), the rate
46 of kidney tumors discovered by accident with ultrasound accounted for 14.4%.
47 According to Rendon et al. (2014), in 2014 the accidental detection rate of kidney
48 tumors increased by about 2.3% per year. Partial nephrectomy (PN) is a standard
49 treatment option for kidney tumors ≤ 7 cm (stage pT1) with the same cancerous
50 results as radical nephrectomy (RN). The advantage of partial renal resection is that

51 it saves and preserves the functional kidney units, so that in the long term less
52 kidney replacement treatments will be needed than with kidney resection. radical
53 (Guillonneau et al., 2009; Dominguez-Escrig et al., 2011).

54 Along with the trend of developing less invasive surgery, LPN with many
55 advantages: reducing hospital time; increase resilience of the patient; Low blood
56 loss and high aesthetic, is now an appropriate alternative to open partial
57 nephrectomy (OPN) in the treatment of kidney tumors. However, due to the
58 technical and equipment challenges, this type of surgery still needs to be performed
59 at large medical facilities because surgeons have experience in laparoscopic
60 surgery. According to statistics from many data sources in 2007, the 5-year
61 additional survival rate of cancer-free after endoscopic resection surgery was 86%
62 (Wolf , 2010; Dominguez-Escrig et al., 2011). It is generally believed that
63 laparoscopic radical and partial nephrectomy can be performed through both
64 transperitoneal and retroperitoneal approaches, and each approach has its own
65 advantages and limitations.

66 In Vietnam, major surgical centers such as Viet Duc Hospital, Hue Central
67 Hospital, Ho Chi Minh City Medical University Hospital, Cho Ray Hospital, Binh
68 Dan Hospital ... have performed semi-renal endoscopic surgery. in the treatment of
69 kidney tumors relatively early. For provincial hospitals, this is still a challenge and
70 little is being done. Thanh Hoa General Hospital has operated this surgery since
71 the end of 2016, through the cases that we have done, we conducted this study to
72 evaluate the initial results of semi-laparoscopic laparoscopic surgery in Treatment
73 of kidney tumors at the provincial generalhospital.

74 75 **MATERIAL AND METHODS**

76 77 **Subject of research**

78
79 Including 10 patients (6 female, 4 male) diagnosed with kidney tumor on CT
80 scan image and semi-laparoscopic surgery at Thanh Hoa Provincial General
81 Hospital from November 2016 to March 2018.

82 All the participants did agree to take part in this experiment and do not
83 disclaim the results of the study to be shown in the research paper.

84 All manipulations below were in according to the moral standards of the
85 responsible committee on human experimentation (institutional and national) and
86 with the Helsinki Declaration of 1975, as revised in 2000.

87 Bases for choosing to appoint laparoscopic resection surgery:

88 • Kidney tumor at pT1 stage (according to AJCC's stage of kidney
89 cancer classification in 2010 (Rendon, 2014) has: pT1a is kidney tumor with size \leq
90 4cm; pT1b is tumor with size \leq 7cm; pT2 is block tumors that are $>$ 7cm) or smaller
91 and the patient has no contraindications to laparoscopiesurgery.

92 • Calculating tumor complexity score according to the RENAL system
93 of Kutikov and Uzzo in 2009 (this system is based on 5 criteria: tumor size; tumor
94 convexity on the kidney surface; distance from tumor to pyelonephritis system; the
95 tumor is located on the front or the back; the tumor location is related to the kidney

96 pole. each criterion has from 1 to 3 points) (Kutikov and Uzzo, 2009) is low
97 and moderate.

99 **Research method**

100
101 Research according to the method of descriptive data research. The patients
102 were diagnosed and performed according to a procedure, on Karl Storz's Full HD
103 laparoscope by the same surgeon. Using the Harmonic scalpel Gen 11 ultrasound
104 scalpel from Ethicon Endo-Surgery. Use Hem-o-lock clips of size 5 and 10mm.
105 Collect data using a general research sample.

106 Patient preparation: All patients underwent endotracheal anesthesia, gastric
107 catheterization, urethral catheterization and intestinal cleansing prior to surgery.

108 Surgical procedure: All patients underwent laparoscopic endoscopic surgery
109 to cut the kidneys in the opposite position to 900 with padded waist area.

110 Place the first trocar by the open method, create cavity with a glove of
111 600ml air pump glove, the rest of the trocar are placed under the observation of the
112 lens, the position of the trocar at the front, middle and back axillary lines. Pump
113 CO₂ gas with pressure ≤ 12 mmHg, initial pump speed 2 - 3 l/min.

114 For the right kidney surgery: the surgery reveals the kidney artery, reveals
115 the kidney with tumor (it is best to show it to completely move the kidney),
116 marking the boundary to cut around the tumor with an electric knife. monopolar
117 (about 2 - 3mm from the edge of the u) Use a rubber strap to slip through the tight
118 kidney artery and clamp with Hem-o-lock. Once the kidneys have softened, use
119 scissors to cut tumor at the margin of the benign kidney (enucleation). Sutures of
120 pyelonephritis with vicryl 3-0 or 2-0 only. Place the bolster with a rolled surgical
121 plate. The kidney is restored with 2-0 or 1-0 vicryl stitches that use Hem-o-locks to
122 secure the thread head. Release the rubber strap on the renal artery, check the
123 sectional hemostasis and additional hemostasis. Place drainage near the kidneys,
124 close the 2-layer trocar.

125 For left side kidney surgery: same.

126 * Care and indicators to consider: Patients were monitored for pulse, arterial
127 blood pressure, breathing, temperature and drainage postoperative status.

128 Antibiotics use the β lactamine group in combination with the quinolon group.
129 Reduce non-steroidal and morphine pain. Records were recorded: time of surgery,
130 time of anemia, control of blood vessels, technique of renal rehabilitation, amount
131 of blood lost, number of trocar, time of draining duct, time of hospitalization. ,
132 urine leakage, complications - complications. Check back in 1, 3 months (clinical,
133 ultrasound).

135 **RESULTS**

137 **Some pathological characteristics**

138
139 Ten patients successfully underwent LPN and completed one year follow-up
140 according to our protocol. Each patient was found to have a kidney tumor by

141 accident, 2 patients had vague pain in the lumbar area, none had hematoma
 142 symptoms or palpable lumbar tumor. Patients screened for kidney tumors by
 143 ultrasound. Determine the stage of disease and the complexity of the tumor
 144 (nephrometry points) before surgery by CT scan.

145
 146

Table 1. Pathological characteristics

Variable	Mean (range) or n or %
Age (years)	54,5 (38 – 67)
Sex (male/female)	4/6
Located side (right/left)	6/4
Size of tumor (cm)	3,5 (3 – 5)
Location of tumor	
Upper polar	3
Middle part	3
Lower polar	4
Nephrometry score *	
4a	2
4p	2
5a	3
6p	2
8x	1
Staging**	
pT1a	7
pT1b	3
≥ pT2	0
Histology	
Clear cell	5
Papillary	2
Chromophobe	1
Angiomyolipoma	2

147 * Using nephrometry score of R.E.N.A.L. system

148 ** Staging follow AJCC 2010

149
 150

Table 2. Surgical characteristics

Variable	Mean (range) or n
Amount of trocars	
3	7
4	3
Operative time (minutes)	125,6 (90 – 185)
Warm-ischaemic time * (minutes)	29,4 (20 – 43)
Main renal artery clamping	10
Hilar clamping en block	0
Blood loss (ml)	85,2 (50 – 250)
Time to drain (day)	5(4–6)
Hospital stay (days)	6(5–7)

Intraoperative complications **	1
Postoperative complications	0
Examine postoperatively ***	
01 month	10 patients
03 months	6 patients

151 *. Warm-ischaemic time is duration from clamping of the renal vessels to
152 the releasing of the renalvessels.

153 **. Hemorrhage during operation due to the tumor located in the middle of
154 the kidney invaded deep into the sinuses of the kidney, later turned to radical
155 laparoscopic nephrectomy.

156 ***. The patients were screened after surgery by ultrasound, kidney function
157 tests and on-site examination. No patients showed urine leakage, trocar infection or
158 local recurrence.

159 In this series of patients, we observed that RFD depended on tumor size,
160 warm ischemic time, duration of the surgery. The prognosis of renal tumor mainly
161 depends on histology. As abdominal imaging is getting more and more popular the
162 amount of small renal tumors has increased in recent decades.

163 Operative time is highly connected to other points, such as patient’s weight
164 etc., which may require a longer surgery time.

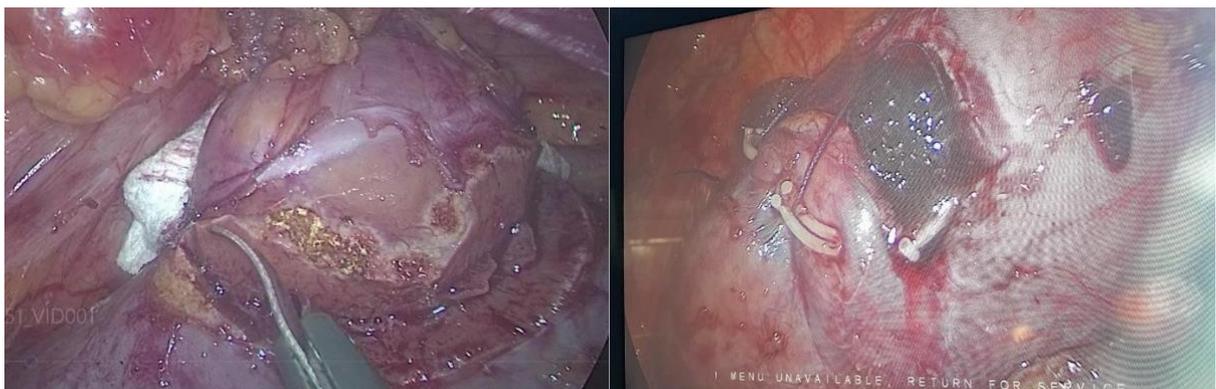
165 Surgeons clamp renal artery to interrupt the blood flow to kidney during
166 surgery, which helps the surgeon to work on the open area with less bleeding.
167 There are two opinions about this action. Some authors say that blood flow
168 interruption can be a reason of an ischemic damage, while others think that kidney
169 can support it. Anyway, modern studies show its harmful effect on the kidney.

170 The greatest achievement of this method is that there were not
171 postoperative complications in patients. Blood loss depends on some factors, such
172 as tumor size, tumor complexity. These factors also effect operativetime.

173 It is also important to emphasize the direct relationship between Warm –
174 ischemic time (WIT) and tumor size. In our study it was appropriately 30 minutes.

175 In larger tumors this time may be up to 50 minutes. Current studies aimed
176 to differ the impact of parenchymal loss from the WIT effect on the operated
177 kidney.

178 Tumor size and renal function are vital determinants of suitability for PN.
179 The age, sex of patients, tumor location and other factors remain to stay important
180 in postoperative outcomes. We believe that with the integration of new methods
181 post-operative hospital stays would decrease.
182



183 **Figure 1.** Kidney tumor is resected by cold scissors and the kidney is sutured to recover
184

185 **DISCUSSION**

186 **Specify**

187
188 PN in the treatment of kidney tumors has been carried out over the past two
189 decades, with the same cancerous treatment results as radical nephrectomy,
190 especially in the long term. The kidney will save and preserve the functional
191 kidney unit. LPN is a minimally invasive procedure and may yield results that are
192 not different from that of OPN. Therefore, LN is gradually being accepted and
193 preferred for treatment of benign kidney tumors and pT1 or less stage kidney
194 cancer (Guillonneau et al., 2009; Rendon et al., 2014).

195 Laparoscopic surgery approaches to the kidney during LPN presently
196 include transperitoneal, retroperitoneal, hand-assisted, robotic, laparoendoscopic
197 single-site surgery (LESS), and natural orifice transluminal endoscopic surgery
198 (NOTES). With each approach, a pneumoperitoneum is created to increase the
199 intra-abdominal working space.

200 Nowadays, a large amount of studies found out that patients undergoing
201 LPN had decreased rate of surgical complications, length of stay, need for blood
202 transfusion etc. With recognition of this fact this method is getting more and more
203 popular.

204 Laparoscopic renal surgery is far from being perfected. Physician's goals for
205 the future are to improve outcomes, decrease length of recovery while trying to
206 cost effective and as least invasive as possible.

207 Robotic technologies are being developed, which can assist in completing
208 different operations. It includes image guided robots that can help to introduce
209 instrument or needles into the kidney safely to avoid organ injury.

210 Also in robot assisted partial nephrectomy (RAPN) tumor complexity does
211 not affect operative time, while for LPN it does.

212 Under the guidance of the Canadian Cancer Society, for kidney tumors in
213 the pT1a stage (tumor size ≤ 4 cm), it is preferable to choose treatment with: partial
214 renal resection; radiofrequency ablation (RFA) or cryoablation As for kidney
215 tumors in the pT1b stage (tumor size > 4 cm and ≤ 7 cm), you should only choose to
216 have PN or RN. The choice of laparoscopic surgery or open surgery to remove the
217 tumor or kidney depends on the ability of the surgeon and the facilities of the
218 treatment facility (Dominguez-Escrig et al., 2011).

219 Recently, many authors have added to the tumor complexity scoring system
220 (usually calculated by the RENAL system of Kutikov and Uzzo in 2009) to predict
221 the difficulty of the PN process, especially is to PN by laparoscopic surgery, this
222 system is based on 5 criteria to calculate points, each of the criteria has from 1 to 3
223 points, of which 2 criteria are the most noticeable, that is: size tumor size and the
224 closest distance from the tumor to the renal pelvis system (nearness to the
225 collecting system). For PN by laparoscopic surgery, patients with low-grade
226 kidney tumors (4-6 points) and average (7-9 points) should be selected (Kutikov
227 and Uzzo, 2009; Rendon et al., 2014).

228 The patients in our study group were assigned a PN with an average tumor

229 size of 3.5 cm, in which the proportion of tumors was accidentally discovered by
230 ultrasonic examination is relatively high (8/10 patients), the tumor complexity
231 score calculated by the RENAL system from 4a to 8x, successful surgery results in
232 9/10 patients. About 1 in 10 patients has to change the method to radical
233 nephrectomy by laparoscopic surgery, this is the case of a kidney tumor with a size
234 of 5 cm, located at the position crossing the polar lines and lying deep into renal
235 parenchyma (endophytic). According to Kapoor, it is recommended that for new
236 surgeons to perform LPN who should be selected patients with renal tumor in pT1a
237 stage, tumors that are protruding out of the kidneys (exophytic) and not near the
238 renal hilar (nonhilar) are needed, he also said that when the surgeon passes the first
239 10-20 cases, he should extend the appointment of LPN for larger and more
240 complicated kidney tumors (Kapoor, 2009). According to Nadu et al.(2007), 140
241 cases of LPN showed
242 that:forthe first30cases,althoughonlyselectedtumorswithanaveragesizeof
243 2.6 cm but the rate of transferring surgery method is up to 10%; While with the
244 next110cases,withanaveragetumorsizeof3.9cm,therateoftransferring
245 surgery method was only 2.7%.

246 **The surgical process**

247 **Access and trocars**

249 Choosing the way to enter the retroperitoneal or abdominal cavity to perform
250 LPN is very important. According to the instructions in Laparoscopic Techniques
251 in Uro-Oncology, it is recommended to use the abdominal route for cases of
252 anterior, anterior-lateral side tumors or large kidney tumors that require at least
253 30% of the kidneys. If the tumor is on the back or the posterior side, the
254 retroperitoneal route should be used (Guillonneau et al., 2009). Recently, many
255 authors have considered the choice of the route of entry for LPN, which often
256 follows the habits of the surgeon and the views of the treatment facility. In this
257 study, we performed all cases of LPN through the retroperitoneal line, which has the
258 advantage of direct access to the renal artery to control. The cavity must be made
259 to the maximum extent to facilitate the surgery process. The patients in our study
260 had 5 cases of anterior tumor, 4 cases of tumor on the back and 1 case of tumor in
261 the medial (lateral) position, all cases were performed by retroperitoneal LPN that
262 favored by 3-4 working trocar.

263 **Controlling kidney blood vessels and the time of hot anemia**

264 In LPN, the control of the blood vessels of the kidney will make the cutting
265 process as well as the recovery suture of the kidneys less blood loss, the surgical
266 field and the tumor area are clearer, but it is this control that makes the kidneys
267 suffer from anemia during the procedure. The maximum time the kidney has a
268 warm-ischaemic time (WIT) depends on the author, but it can be up to 30 minutes,
269 which will limit the time it takes for the kidneys to be cut and restored, especially
270 for large and complex kidney tumors (Guillonneau et al., 2009; Shikanov et al.,
271
272

273 2010). Some authors believe that for kidney tumors that require a lot of time for
274 cutting and recovery, they should lower the temperature of the kidneys before
275 controlling blood vessels, at which time the kidneys will be cold anemia with the
276 time of cold anemia (cold ischemic time - CIT) may last longer (Wolf, 2010).
277 Recently, there have been authors reporting successful cases of super-selective
278 control of tumor-specific arteries during renal laparoscopic surgery (Dominguez-
279 Escrig et al., 2011). According to Wolf (2010) the viewpoint in LPN is: for kidney
280 tumors with deep penetration into renal parenchyma (tumor depth) > 5mm, it is
281 recommended to perform clamping pedicle of kidney; When \leq 5mm, there is no
282 need to clamp pedicle of kidney.

283 In our research patients, all cases were controlled renal pedicle by rubber
284 band but still ensure good hemostasis required for surgery, there is no case of using
285 lowering Kidney temperature or super-selective control of tumor arteries. The
286 average duration of hot anemia of the patients in the study group was 29.4 minutes,
287 in the case of hot anemia was 43 minutes, the tumor was large, deep in the kidney
288 parenchyma, when the stage of kidney recovery was completed, drop control of
289 kidney arteries to see a lot of bleeding, although the stitch has been supplemented
290 but unable to control the bleeding, it is necessary to transfer to laparoscopic radical
291 nephrectomy. The results of our hot anemia time were not significantly different
292 from the other researches of: Tran Ngoc Sinh et al. in 2010 was 10-20 minutes;
293 Brown G.A. in 2007 it was 30 minutes (15 - 55); Nadu A.M. et al. in 2007 it was
294 30 minutes (18- 49) (Brown, 2007; Nadu, 2007; Trần Ngọc Sinh et al., 2010).

296 **Tumor removal and recovery of renal parenchyma**

297
298 Before the tumor is removed during LPN, the peripolar fat should be
299 liberated from the kidney surface (taking care not to lose the renal cortex), but the
300 adipose layer adjoins and adheres to the mass should be left with the purpose of
301 facilitating the removal of the tumor and also to help the process of staging the
302 disease on histopathology later on. The tumor was cut in a enucleation to
303 the healthy kidney (note that the margin area must be negative), in order to do this
304 well, many authors recommend using nondisposable laparoscopic cold scissors, the
305 process of attention is always controlled and controlled. These points break into the
306 calyces system or renal vessels to correct treatment during recovery. Most authors
307 perform a double-layer suture using a bolster with rolled-up surgical pads, but for
308 tumors that are small in size and less invasive into kidney parenchyma, it may not
309 be necessary to use a bolster or even not renal parenchyma repair suture (Wolf,
310 2010).

311 In this study, we stitched 2 layers using bolster in all cases with a success
312 rate of 9/10 patients, 1 in 10 patients bleed immediately after release controlled
313 arteries, in this case, due to the large tumor and deep invasion of the kidney sinus
314 (RENAL score = 8x), when cutting, it has violated large artery branches, causing
315 failure of the process of recovery and hemostasis.

317 **Some surgical results**

319 The result of our average operation time is 125.6 minutes. The average
320 blood loss was 85.2 ml. The draining period and the average hospitalization time
321 were 5 and 6 days, respectively. Histological results: kidney cancer accounts for
322 8/10 cases, benign kidney 2/10 cases. Follow-up after 1 month in 10 patients, after
323 3 months in 6 patients, all patients did not have urine leakage, hernia or infection
324 of trocar, especially no patients showed any signs of metastasize far orlocally.

325 There was one case of bleeding during surgery that required surgical
326 procedure to laparoscopic radical nephrectomy, this case took about 250ml of
327 blood and had the longest surgery time (185 minutes). Although the outcome of the
328 surgery is still goal and safe for the patient (not a blood transfusion), if we have
329 better assessments to change the procedure right from the beginning or when
330 cutting the tumor, the patient does not lost a lot of blood and did not last long.
331 Therefore, it is very important to complete bilan before surgery to evaluate and
332 plan for a LPN, Wolf (2010) recommends thatsurgeons:

333 • Before surgery, should be based on image diagnosis to evaluate: the
334 deep invasion of the tumor into renal parenchyma; the closest distance from the
335 tumor to the calyces system; and the location of thetumor.

336 • During surgery, an endoscopic ultrasound should be used to assessthe
337 association of the tumor with the calyces system, sinuses and bloodvessels.

338 • Must know how to use additional means and techniques to stop
339 bleeding: biological glue; techniques to control blood vessels; and technique of
340 placing stitches orbolster.

341 342 **CONCLUSION**

343
344 LPN for the treatment of kidney tumors is a type of surgery that can be
345 performed at provincial hospitals, with an appropriate initial selection of ≤ 4 cm
346 kidney tumors. However, to perform well this technique, the treatment facilities
347 need to have adequate equipment, surgeons with experience in laparoscopic
348 surgery and intensivetraining.

349 With the help of robotics and technologies, renal surgery is now
350 significantly less invasive, and operative outcomes are more positive. As modern
351 technology develops, will continue to be pushed by urologists with the hope of
352 improvement of patient outcomes and satisfaction.

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358 359 **CONFLICTS OF INTEREST**

360
361 The authors declare no conflict of interest.

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