



Experience with Modified Makuuchi Incision in the Surgical Treatment of Huge Renal Tumor: A Single Institution's Experience

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Background: Surgical removal of huge renal and retroperitoneal tumors, such as adrenal cortical carcinoma or renal cell carcinoma with inferior vena cava (IVC) invasion, remains a challenge for urologists. **Aim:** Herein, we describe our experience with the modified Makuuchi incision for huge renal and retroperitoneal tumors. **Methods:** We applied the modified Makuuchi incision in 10 patients with a huge renal or retroperitoneal tumor. Another 11 patients with a huge renal or retroperitoneal tumor using different surgical incisions other than modified Makuuchi incision were collected for comparison. The modified Makuuchi incision of the abdomen is initiated in the cephalad to the xiphoid, extended 1 cm above the umbilicus, and then extended laterally to the lateral flank. Through the incision, we mobilized the colon, and when the renal space was seen, the tumor was removed. If an invasion of a nearby organ occurred, a general or cardiovascular surgery specialist was consulted for combined surgery. The patients' age ranged from 43 to 82 years (three men and seven women). **Results:** The modified Makuuchi incision provided good and rapid exposure. No unexpected organ injuries occurred during surgery. There were no wound-related complications, such as dehiscence or incisional hernia, after 3 months of follow-up. Partial hepatectomy, splenectomy, distal pancreatectomy, and thrombectomy of the IVC thrombus were performed through the same incision. **Conclusion:** Our experience demonstrated that the modified Makuuchi incision is a good choice for patients with huge renal and retroperitoneal tumors, even those with nearby organ invasion.

Key words: Renal tumor, retroperitoneal tumor, surgical incision

INTRODUCTION

Surgical *en bloc* excisions of huge renal and retroperitoneal tumors, such as sarcoma, adrenal cortical carcinoma, or renal cell carcinoma with inferior vena cava (IVC) invasion, are challenging but yield benefits to patients. Incision methods, such as subcostal, flank, midline abdomen, or thoracoabdominal incisions, have been widely used. Incision choice might be influenced by the location and size of the tumor, adjacent organ involved, and surgeon's experience or preference.¹

In 1993, the Makuuchi incision was introduced by Dr. Masatoshi Makuuchi for hepatectomy.² Chang *et al.* have modified the Makuuchi incision, extending the midline

incision to the umbilicus and the lateral incision to the tip of the 12th rib and applied it to foregut surgery.³ The modified Makuuchi incisions have been recently applied in urological surgery, including adrenalectomy and nephrectomy.^{4,5}

MATERIALS AND METHODS

This was a single-center retrospective chart review study. We analyzed 10 patients who underwent the modified Makuuchi incision for complex upper abdominal urological tumors. Another 11 patients with complex upper abdominal urological tumors using different surgical incision other than

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modified Makuuchi incision were collected for comparison. Computed tomography or magnetic resonance imaging was performed preoperatively to evaluate the tumor location, size, adjacent organ, or great vessel invasion, if present. Surgeons from different sections were consulted for combined surgery as needed.

A modified Makuuchi incision was made from the xiphoid to the umbilicus and lateral to the flank [Figure 1]. The right-side incision looks like symbol reverse “L,” which is also called the reverse L incision, and the left-side incision is called the L incision [Figure 2]. Kent retractors were applied during the surgery to maintain the surgical field [Figure 3]. After incision, the deviation of the ascending or descending colon was easily taken down to the cecum or sigmoid colon. The ureters, gonadal vessels, and great vessels were clearly identified. The ureter was looped with a Penrose drain. Tumor adhesion and invasion to the surrounding organs were resected with other sections of the surgeon. The patients with different surgical incisions other than modified Makuuchi incision, mostly received subcostal incision (Seven patients), followed by midline incision (three patients), and then Hockey stick incision (one patient). After operation, Jackson-Pratt drainage tube was placed for further postoperative monitoring and care. A subcutaneous Penrose drain was placed for obesity or a complex surgical wound (involving the gastrointestinal tract). This research protocol was approved by the Institutional Reviewer Board of Tri-Service General Hospital (approval number: 2-107-05-167). The patient consent was waived by the IRB.

RESULTS

From 2017 to 2021, 10 patients underwent tumor excision with a modified Makuuchi incision [Table 1]. Three patients were men, and seven were women. Tumors affected the right side in three patients and the left side in seven patients. The mean age was 64.4 years (43–82). The mean operation time was 336.3 (212–515) min. The mean hospital stay was 17.4 (7–32) days.

Combined surgery with other surgeons was performed with IVC thrombectomy, thrombectomy, T-colon colectomy, distal pancreatectomy, and splenectomy. No additional incision was made using the modified Makuuchi incision. IVC thrombectomy was performed in three patients. Distal pancreatectomy was performed in two patients, and postoperative pancreatitis was noted in one patient. The patient was treated with antibiotics and received adequate hydration. No other incision-related complications were noted.

During the same study period, we collected another 11 patients who underwent tumor excision with nonmodified Makuuchi incision [Table 2]. Five patients were men, and six were women. Tumors affected the right side in seven patients and the left side in four patients. The mean age was 62.27 years

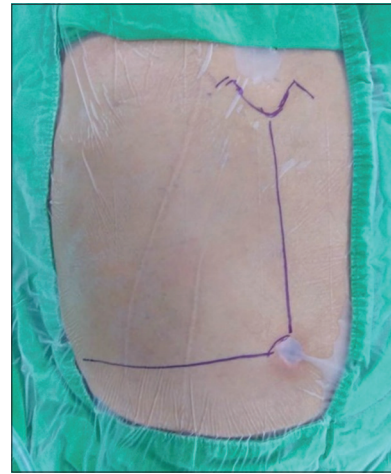


Figure 1: Modified Makuuchi incision for right side tumor

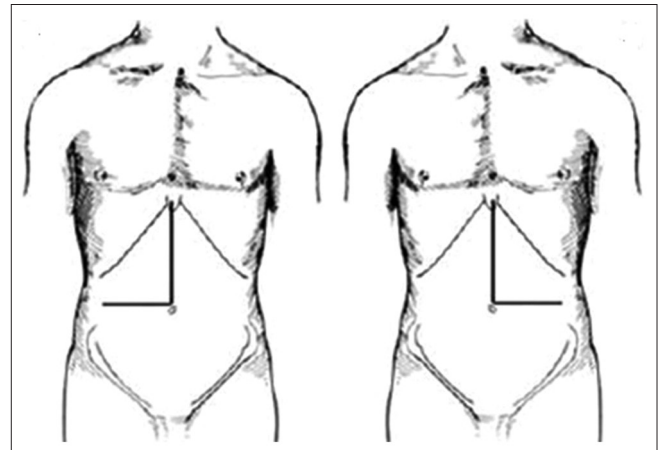


Figure 2: Right-side wound looks like symbol reverse “L” which also called reverse L incision and left side call L incision

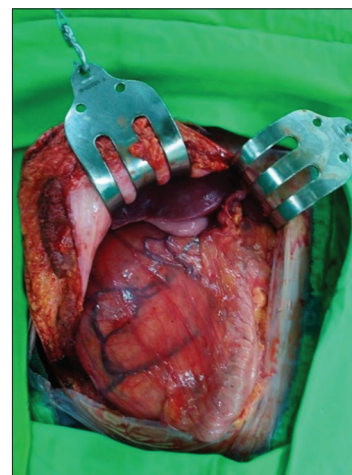


Figure 3: Kent retractors

(54–71). The mean operation time was 354.7 (218–525) min. The mean hospital stay was 17.63 (12–24) days.

Table 1: Characteristics of the 10 patients with modified Makuuchi incision

Serial number	Age	Location/tumor size (cm)	Surgery performed	Pathology	Blood loss (mL)	Combine surgery	Hospital stays	Operation time (min)	CDC scores
1	54/female	Left kidney/17.0×11.2×8.7	RN	Renal abscess	1000	X	18	261	Nil
2	76/female	Left RP + spleen + pancreas/18.0×13.3×11.5	RN + splenectomy + distal pancreatectomy	Leiomyosarcoma	200	GS	20	420	Nil
3	72/female	Left RP/17.4×13.8×13.0	RN	Myelolipoma	400	X	9	213	Nil
4	63/female	Right kidney/17.0×14.2×10.5	PN	Angiomyolipoma	600	X	7	349	Nil
5	43/male	Right kidney + IVC/20.0×18.0×16.3	RN+IVCT	Ewing sarcoma	750	CVS	26	342	Nil
6	54/male	Right kidney + IVC/16.8×10.5×8.5	RN+IVCT	RCC	320	CVS	10	325	Nil
7	60/female	Left kidney spleen + pancreas/18.3×13.5×11.7	RN + splenectomy + distal pancreatectomy	Liposarcoma	900	GS	32	515	I
8	67/female	Left kidney/30.0×26.0×17.0	RN + T-colon colectomy	UC	600	CRS	20	504	Nil
9	82/female	Right RP/52.0×36.0×27.0	RN + IVCT	Liposarcoma	1000	CVS	11	222	Nil
10	73/male	Left kidney/24.0×14.0×8.0	RN	RCC	470	X	21	212	Nil
Mean	64.4 (43–82)	23.0 (16.8–52)			624 (200–1000)	X	17.4 (7–32)	336.3 (212–515)	Nil

RP=Retroperitoneum; RN=Radical nephrectomy; PN=Partial nephrectomy; IVC=Inferior vena cava; IVCT=IVC thrombectomy; RCC=Renal cell carcinoma; UC=Urothelial carcinoma; GS=General surgery; CVS=Cardiovascular surgery; CRS=Colon and rectal surgery; CDC score=Clavien–Dindo complications score;

Combined surgery with other surgeons was performed with IVC thrombectomy, segmental resection of ileum, and ascending colon with ileocolostomy. Additional incision was made in one patient for bladder cuff excision. IVC thrombectomy was performed in three patients. There was one patient who suffered from severe sepsis with acute kidney injury after a simple nephrectomy for a renal abscess. The patient recovered after broad-spectrum antibiotics and adequate fluid management. One patient suffered from an unexpected duodenal injury, and primary repair was performed by a general surgery specialist without delay digestive complication occurrence. One patient suffered from mesenteric injury during dissecting retroperitoneal tumor, causing ischemic change of ileum, and ascending colon. Surgical wound extension was made and segmental resection of ileum and ascending colon with ileocolostomy was conducted by a general surgery specialist. Delayed enteral nutrition occurred and lengthened the hospital stay. Fortunately, there was no prolonged nutrition absorption problem during follow-up.

DISCUSSION

The surgical management of huge renal and complex retroperitoneal tumors is a critical issue for urologists. Invasion of surrounding organs, including the great vessels, liver, spleen, and colon, is common. Sometimes, creating a new incision for combined surgery due to inapplicability or

familiarity with the subcostal, flank, or thoracoabdominal incisions is unavoidable. The mass effect causes difficulty in the dissection of adhesion tissue, which may increase the risk of organ damage or major vessel injury.

A modified Makuuchi incision also called L or reversed L incision, was first described by a general surgeon for liver resection.² The modified Makuuchi incision also showed great exposure to right hemicolectomy combined with liver resection.⁶ In the treatment of huge renal tumors, the operator mostly prefers flank or abdominal midline incision. The subcostal, Chevron, or thoracic abdominal incisions are also preferred in patients with previous flank incisions or huge renal tumors. However, a modified Makuuchi incision has not been well applied by urologists.

Polat *et al.* first described using this incision in the surgical treatment of renal tumors.⁷ There were 26 radical nephrectomies and 3 partial nephrectomies. The tumor size ranged from 5 cm to 16 cm. Venous thrombi were observed in 11 patients. No incision site-related complications were noted, and no incisional hernias were observed. Ruffolo *et al.* collected experiences of Makuuchi incision for adrenalectomy in 41 patients.⁴ The mean tumor diameter was 8 cm; 17 patients had a history of abdominal surgery, and 2 with postoperative pneumonia with prolonged intubation were reported. The author also reported that incision achieves not only excellent exposure to both the upper abdominal quadrants and retroperitoneum, optimizing access, and dissection potential for adrenalectomy but also

Table 2: Characteristics of the 11 patients with other type incision

Serial number	Age	Location/tumor size (cm)	Surgery performed/surgical wound	Pathology	Blood loss (mL)	Combine surgery	Hospital stays	Operation time (min)	CDC scores
1	65/female	Right kidney/16.5×10.1×8.3	RN/subcostal	RCC	1100	X	19	289	Nil
2	56/male	Right kidney + IVC/15×8.1×7.8	RN + IVCT/subcostal	RCC	1300	CVS	22	415	Nil
3	61/female	Right kidney/20×13×8.1	RN/midline incision	Polycystic kidney with hemorrhagic cysts	850	x	14	423	Nil
4	62/male	Left kidney/17×10×7.2	Simple nephrectomy/subcostal	Renal abscess with complete staghorn stone	480	x	24	318	I
5	70/female	Left kidney /16.4×14.6×15.0	Nephroureterectomy + bladder cuff excision/subcostal + gibson	Urothelial carcinoma of renal pelvis	600	X	13	302	Nil
6	57/male	Right RP/14.0×10.2×9.2	Adrenalectomy/subcostal	Adrenal cortical carcinoma	850	x	12	218	Nil
7	70/female	Right kidney /16.2×9.2×6.8	RN + IVCT/midline incision	RCC	1600	CVS	20	475	Nil
8	53/male		Retroperitoneal tumor excision + segmental resection of ileum and ascending colon + ileocolostomy/hockey stick incision	Desmoid fibromatosis	1450	GS CVS	23	525	IIIb
9	54/female	Left RP/23.0×17.5×12.3	RN/midline	Angiomyolipoma and the nonfunctioning kidney	920	Nil	12	257	Nil
10	71/male	Right RP/14.5×16.1×9.7	Adrenalectomy + IVCT/subcostal	Adrenal cortical carcinoma	1100	CVS	16	386	Nil
11	66/female	Right kidney /26.0×24.0×15.0	RN + primary repair of duodenum/subcostal	UC	450	GS	19	294	IIIb
Mean	62.27 (54–71)	17.55 (16.8–52)			972 (450–1600)	X	17.63 (12–24)	354.7 (218–525)	Nil

RP=Retroperitoneum; RN=Radical nephrectomy; IVC=Inferior vena cava; IVCT=IVC thrombectomy; RCC=Renal cell carcinoma; UC=Urothelial carcinoma; GS=General surgery; CVS=Cardiovascular surgery; CDC score=Clavien–Dindo complications score

offers superb exposure to the most lateral and posterior portions of the triangular ligament of the liver on the right and to the splenic attachments on the left, which are often challenging to reach through a standard midline incision. Bokka *et al.* also described the benefit of the management of complex renal and adrenal lesions.⁵ IVC thrombectomy, resection of the right hemidiaphragm, colectomy, and anastomosis of the jejunum were performed using the same incision. There were four cases of class 1, one of class 3A, and no class 3B or above complications in the study.

In our experience, the benefit of the modified Makuuchi incision is not only the clear surgical field of the retroperitoneum and intra-abdominal space but also its space was open enough that the relationship could be identified between the tumor and the surrounding organs.

Combined surgery with general surgery, a cardiovascular surgery specialist for distal pancreatectomy, splenectomy, and removal of IVC thrombus was performed in some cases, without an additional surgical incision. After removing the

colon, the ureter was easily identified, renal pedicle and ureter dissection were performed, and the vena cava dissection was smooth after excellent exposure to the surgical field with the modified Makuuchi incision. The level of thrombectomy during IVC thrombectomy could be as high as level III.⁵ Some complications for this surgical incision include wound tenderness, dehiscence, and incisional hernia. Postoperative analgesic usage was comparable with that of the traditional subcostal, flank, or thoracoabdominal incision. None of our patients had wound infection or severe postoperative ileus. The subcutaneous Penrose drain was removed after no wound discharge for 2 days if applied.

Our study has some limitations. First, it is subject to the biases that are associated with a retrospective study, such as selection bias, recall bias, and information bias. Second, the incidence of incisional hernia might be underestimated, due to the mean follow-up time was <3 years. Furthermore, some of our case did not receive sectional imaging postoperation and may not reveal an inapparent incisional hernia. Finally, our

comparative group of patients who underwent huge renal or retroperitoneal tumor surgery through nonmodified Makuuchi incisions is not quite similar to our study group due to limited case numbers. However, despite the limitations, our experience with the modified Makuuchi incision indicates that this is a well-tolerated approach with favorable surgical outcomes for complex urological tumors.

CONCLUSION

The modified Makuuchi incision provides an excellent surgical field when the abdominal flap created can be totally lifted superiorly and laterally with the aid of a Kent retractor. The surgical field is then maximized, leading to a clear view of kidney, renal pedicle, ureter, vena cava, and adrenals and good for liver mobilization as necessary.

Furthermore, the MM incision also provides clear exposure for cases with the tumor invades to colon or the mesentery. In our opinion, complex or extremely huge renal or retroperitoneal tumor requires excellent surgical exposure for better tumor resection and reduces the risk of renal vein, IVC or nearby organ injury, such as renal cell carcinoma with IVC thrombus or infiltrating nearby organ, may better benefit from the modified Makuuchi incision.

Data availability statement

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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