

Research Article

Electrocoagulation with greased lidocaine gel 2% as hemostatic maneuver after minimally invasive partial nephrectomy: Experimental and preliminary clinical results

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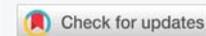
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Abstract

Methods: Experimental phase: Performed a partial nephrectomy off clamp in pig model followed by cauterization of lidocaine gel 2% with different power (control, 30W, 50W and 100W) in the kidney resection bed to evaluate efficacy and deep injury extension.

Clinical phase: 20 patients submitted to laparoscopic or partial nephrectomy for low risk RENAL score were utilized greased lidocaine gel 2% with 50W in cautery scalpel to hemostasis of renal parenchima to validate efficacy and safety.

Results: Experimental study shows that this technique is effective and promote better hemostasis with 50W and 100W, with deep injury of less than 3 mm.

Clinical study confirm efficacy, good control of hemorrhage, few complications and no transfusion. Minimal changes in hematocrit, haemoglobin and creatinine were observed.

Conclusion: In this preliminary experience the use of this new alternative to hemostasis for low risk partial nephrectomy was satisfactory and with good intra and postoperative results.

The best advantages were safety in terms of the depth thermal injury, low cost and absence of artifacts over the resection area observed at CT scan postoperatively.

Introduction

The standard treatment for patients with localized renal mass is surgical excision. In the last 2 decades, nephron sparing surgery emerge as equivalent alternative to radical nephrectomy in most cases of renal cell carcinoma [1]. More recently, technologies such as thermal ablation, laparoscopy or robotic assisted approach extended the therapeutic arsenal [2].

In the absence of level I evidence, treatment settings are subject to changes that may be proportional to the standard of training, comfort and level of individual experience [3].

RENAL score is an interesting instrument to classify kidney tumors into 3 groups of complexity (low, intermediate and high) using the CT scan to reproduce the tumor anatomy. The criteria utilized were size, exophytic/endophytic, nearness to collecting system sinus (mm), anterior/posterior, location

relative to polar lines and if the mass is hilar. Some research show that these score allow to predict intra and postoperative risks of surgical complications [4,5].

Among surgical complications of partial nephrectomy, hemorrhage is the most common. Renal hemorrhage after accidental trauma or during operative procedures can be severe and difficult to control [6]. The surgeon is responsible for adequate control of the renal hilum during resections of lesions and or bleeding control of traumatic renal parenchyma injury, to prevent complications and even death [7]. Clamping the vascular pedicle is a standard technique used to prevent massive hemorrhage. If patient have a good basal renal function the ideal time of warm ischaemia is not exceeding 30 minutes. We know that clamping time longer than recommended can be harmful to the remaining renal parenchyma [8]. The volume of blood lost and warm ischemia time are decisive in the postoperative prognosis of renal function [9].

During conventional renal resection, despite the control of the renal hilum for partial resection, bleeding still occurs. Several surgeons use total or selective vascular clamping maneuvers in attempt to decrease blood loss [10]. However, this maneuver is accompanied by temporary organ ischemia, which can be deleterious when longer than 30 minutes [8].

Although the morbidity and mortality of these procedures has decreased, Advancement of imaging methods promote diagnosis of smaller asymptomatic lesions suitable for nephron-preserving surgery like enucleation or partial resection [11,12]. In some cases with minor renal parenchyma injury, we can opt for resection without pedicle clamping, application of hemostatic agents and sometimes no suture of kidney parenchyma.

Despite advances in surgical techniques for hemostasis after partial nephrectomy, one limiting factor is the cost of synthetic hemostatics, which limits us to their use in the public hospitals and some times in the private one.

The aim of this report were to offer experimental and preliminary clinical data about a new hemostatic low cost technique for hemostasis after minimally invasive partial nephrectomy.

Methods

This paper is composed by 2 phases. Initially we test the potency of cautery and extension of the tissue lesion in pigs. After technical standardization suggested by experimental study and evaluation of amount of smoke to have good visualization we initiate our experience in humans.

Experimental phase

This pilot study was performed in a laparoscopy training laboratory, previously approved by the animal ethics committee of the minimally invasive surgery laboratory at IRCAD Latin America –Barretos-Brazil.

We performed a partial nephrectomy off clamp in pig models followed by cauterization of lidocaine gel 2% in the bleeding resection bed to evaluate the safety and efficacy of the procedure in renal parenchyma.

Control: Cauterization of the renal bleeding of the renal parenchyma without use lidocaine gel 2%

Lesion: Circular wedges

Radius: 1.0 a 1.8 cm

Deep: 0.3 a 0.9 cm

Power:

30W of potency with Spray (no lesion)

30W of potency with Spray and with Lesion

50W of potency with Spray and with Lesion

100W of potency with Spray and with Lesion

Intervention: Cauterization of the renal bleeding of the renal parenchyma with use lidocaine gel 2%

Lesion: Circular wedges

Radius: 1.0 a 1.8 cm

Deep: 0.3 a 0.9 cm

Power:

30W of potency with Spray (no lesion)

30W of potency with Spray and with Lesion

50W of potency with Spray and with Lesion

100W of potency with Spray and with Lesion

Clinical phase

After assigned inform consent for procedure we select patients with small renal mass and RENAL score of low complexity candidates to perform off clamp laparoscopic or robotic partial nephrectomy between January 2018 to January 2020. Patients with severe comorbidity (ASA II ou IV) were excluded. Antiaggregant drugs were suspended 10 days before surgical procedure.

After tumor resection it was injected lidocaine gel 2% through a plastic catheter over the resected surface. Cautery was calibrated to 50W (chose after 4 first cases because produce less amount of surgical smoke than 100W) and triggered to burn gel until a firm clust emerged to complete hemostasis of kidney surface. After that no hemostatic parenchymal suture was planned except if hemostasis could not achieved. If possible Gerota's fascia was sutured to cover the defect and reconstitution of anatomy.

Patients had sample of blood to measure hematocrit/haemoglobin and creatinine 12 hours after surgery to evaluate blood loss and renal function.

All patients receive low molecular weight heparin for thromboembolism prevention for 4 weeks starting 12h after procedure if no significant bleeding occurred.

Results

Experimental results

Macroscopically, it is clear that the cauterization of the bloody bed of the lesion with a lidocaine gel 2% interface injured less the healthy parenchyma in depth when compared to the same potency without the use of lidocaine (Figures 1-3 and Tables 1,2).

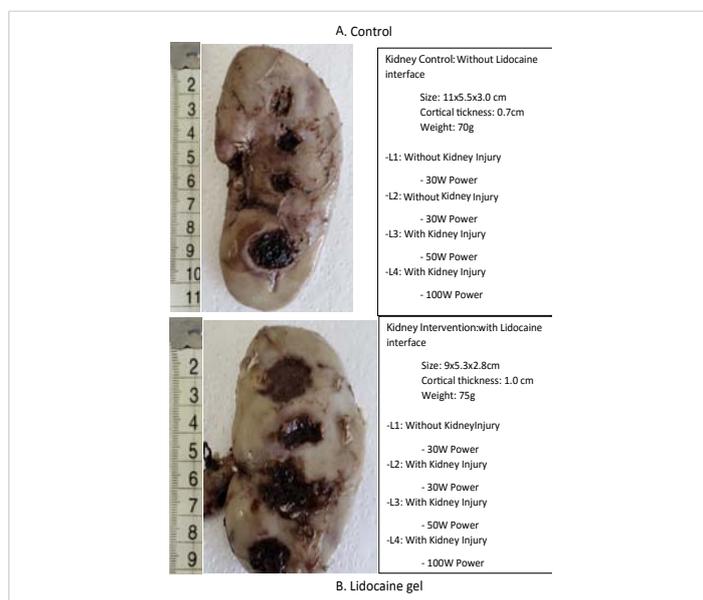


Figure 1: Macroscopic view of control kidney submitted to different power of electrocautery. A. control of burned kidney injury without lidocaine gel; B. lidocaine injury burned with lidocaine gel.

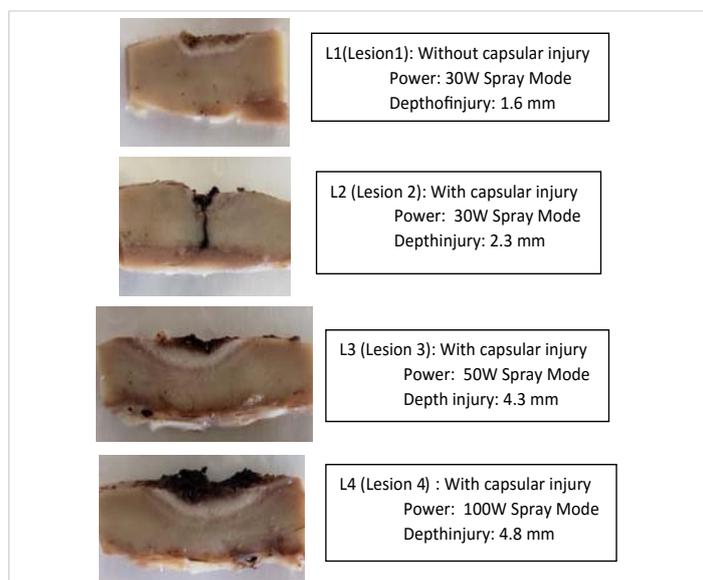


Figure 2: Cortical macroscopic view: Kidney control (without lidocaine interface).

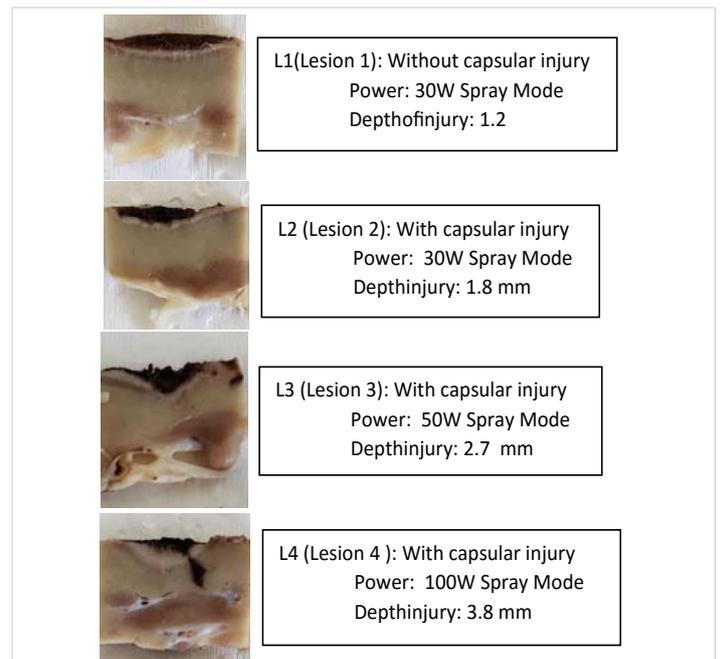


Figure 3: Cortical macroscopic view: Kidney Intervention (with lidocaine interface).

Table 1: Lesion dimensions, power of electro cauterization in "spray" mode and depth of the injury of healthy parenchyma for successful hemostasis, without using lidocaine gel 2% as the conduction interface.

Kidney Control	Size	Depth	Power (Spray Mode)	Depth injury
Lesion 1	1.2x1.0 cm	-	30W	0.16 cm
Lesion 2	1.0x1.0 cm	0.4 cm	30W	0.23 cm
Lesion 3	1.0x1.0 cm	0.4 cm	50W	0.43 cm
Lesion 4	1.5x1.8 cm	0.5 cm	100W	0.48 cm

Table 2: Lesion dimensions, power of electro cauterization in "spray" mode and depth of the injury of healthy parenchyma for successful hemostasis, with using lidocaine gel 2% as the conduction interface.

Kidney Intervention	Size	Depth	Power	Depth Injury
Lesion 1	1.6x2.0 cm	-	30W	0.12 cm
Lesion 2	0.9x1.5 cm	0.3 cm	30W	0.18 cm
Lesion 3	1.6x2.5 cm	0.4 cm	50W	0.26 cm
Lesion4	1.5x1.5 cm	0.4 cm	100W	0.38 cm

The time to obtain hemostasis without lidocaine was longer, as it does not suffer the physical tamponage that occurs when the lidocaine interface is dehydrated when submitted to different power of energy, lidocaine undergoes dehydration, making a more solid crust buffering the bleeding surface. Lidocaine is water-soluble and has electrical conductivity characteristics, in addition to acting as a sealant when the water evaporates, it is believed to act as a protector of energy dissipation for the healthy parenchyma, with a smaller halo of energy dissipation being seen in microscopy using interface of lidocaine.

According to this results we observe that potencies of 50W and 100W over lidocaine gel promote faster coagulation, minimal tissue injury with acceptable deep penetration.

Clinical results

Demographic data

It was included 20 cases of partial nephrectomy in multiple American centers.

Mean age was 55 years (40-65), 12 male and 8 female. Regarding comorbidities 8(40%) had controlled hypertension and 5(25%) had type II diabetes controlled with oral medication.

Thirteen cases underwent pure laparoscopic and 7 underwent robotic transperitoneal technique. In seventeen cases access was transperitoneal and in 3 cases retroperitoneal.

Report of clinical and laboratorial results

Hemostasis with greased lidocaine with no suture were obtained in all cases (Figure 4) Mean blood loss was 350 (150-500) ml. No intraoperative complications occurred. The average drain output in the first 24 hours was less than 100ml of serohematicoid liquid in all patients. No reoperation or readmission due to bleeding or other postoperative complications were observed. 15(75%) cases discharged after 24 h and other 5(15%) cases were discharged until 72 hours after surgery.

Mean variation in hematocrit was 2(0-6), mean variation of haemoglobin as 1ng/ml (0.5-3.0) and mean variation of creatinine was 0.3ng/ml (0-0.5).

All cases revealed renal cell carcinoma without compromised margins. Postoperative CT scan did not present any artifact mimicking tumor or sign of residual cancer.

Discussion

Electrocoagulation using lidocaine gel 2% in the bed bleeding after liver resection was first described by Mattos Filho, et al. in 2009 in rabbits [13] and reproduced by Petroianu in 2011 in humans [14]. Based in this principals we hypothetize that this kind of hemostasis will be suitable after enucleation of small renal tumors.

Cauterization after partial nephrectomy can achieve good hemostasis for vessels with thin caliber. Then, we select only small renal masses, exophytic and distant from collecting system sinus (classified as Low Complexity by RENAL Score) for these preliminary experience.

To the best of our knowledge this is the first description of this technique applied to renal surgery.

The technique was developed on swine model at different levels of power in the electrocautery in order to determine the depth of thermal damage by the process. The preliminary results provide us with security for the use of this as there no unwanted transmission of energy to deep structures on the face of tumor enucleation.

In humans electrocoagulation of 2% lidocaine gel in the bleeding bed after tumor enucleation with potency of 50W in spray mode offer an excellent hemostasis.

The use of this new technique extrapolated from liver surgery [13,14] was satisfactory.

Its reproduction in retroperitoneoscopy showed some limitations due to the large amount of smoke released by the process in small space, what can be more laborious and require more aspiration to achieve better visualization. Therefore, laparoscopic pure or robotic assisted, transperitoneal route is the most indicated if greased lidocaine is used.

The aim of applying this technique is to make feasible enucleation of small and low complexity tumors without clamping the renal hilum and sutures with low cost and safety in its execution.

Conclusion

In this preliminary experience we observe that greased lidocaine gel after surgery for small renal mass promote:

- 1) Good efficacy in hemostasis after partial nephrectomy or enucleation by RENAL Score tumors of low complexity;
- 2) Safety in terms of the depth of thermal injury seen in swine models;
- 3) Low cost;
- 4) Absence of artifacts in CT scan evaluation.

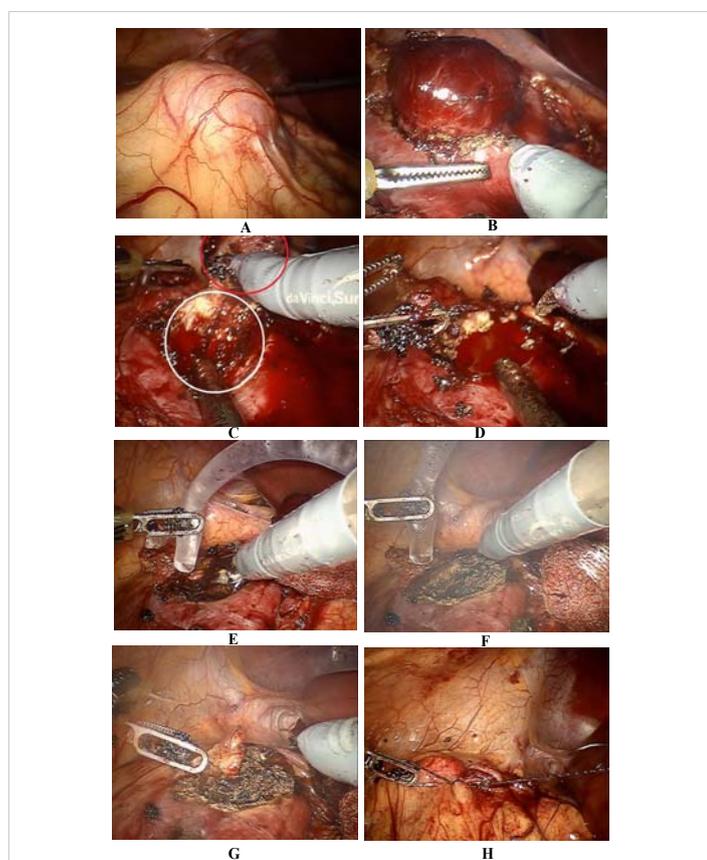


Figure 4: A. Endoscopic view of 3 cm exophytic kidney tumor; B,C,D. robotic minimal margins off clamp robotic partial nephrectomy; E. application of lidocaine gel 2% through plastic catheter over kidney defect in the resection area; F,G. burning lidocaine and formation of crust that cover defect; H: suture of Gerota fascia to cover the defect.



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