

# CONSTRUCTION OF RADIOFREQUENCY COLD BIPOLAR NEEDLES AND ITS FUNCTIONAL ASPECTS TO REDUCE THE BLEEDING IN HEPATIC RESECTIONS

*Características construtivas e funcionais das agulhas de radiofrequência bipolares resfriadas para reduzir o sangramento nas ressecções hepáticas*

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**ABSTRACT - Background** - To reduce bleeding in liver resection various technological options have been disclosed, among them the radiofrequency. The intent of the various methods is to avoid vascular clamping, less liver dissection and minimize bleeding. **Aim** - To present a new technique of parallel bipolar radiofrequency needles developed by the authors and the technical details. **Methods** - The needle system has two parallel electrodes (18 gauge each) of 25 cm in length, separated by a distance of 1.5 cm, and only distal 4 cm dissipate energy generated by a bipolar electrocautery. These needles are cooled by an internal cooling system for continuous flow of cold sterile distilled water at 0°C, whose temperature is maintained through the presence of sterile distilled water ice. The operation is performed under general anesthesia and is not used central venous catheters during or after the procedure. The incisions may be right subcostal and median supra-umbilical. **Results** - The initial use in liver resection showed an average 87 minutes operation time, average size of abdominal incision of 14 cm and 58 ml of blood loss during surgery. No patient in the initial group received transfusion of blood or blood products. **Conclusion** - The bipolar radiofrequency cooled needles are viable and reduce bleeding in liver resection.

**HEADINGS** - Bipolar radiofrequency. Hepatectomy. Bleeding.

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**DESCRITORES** - Radiofrequência bipolar. Hepatectomia. Sangramento.

**RESUMO - Racional** - Para diminuir o sangramento em ressecções hepáticas diversas opções tecnológicas têm sido divulgadas, dentre elas a radiofrequência. A intenção dos vários métodos é evitar o clameamento vascular, fazer menor dissecação hepática e obter menor sangramento. **Objetivo** - Apresentar uma nova técnica de agulhas paralelas de radiofrequência bipolar desenvolvidas pelos próprios autores e os detalhes técnicos de seu uso. **Métodos** - O sistema de agulhas apresenta dois eletrodos paralelos (18 gauge cada) de 25 cm de comprimento, separados entre si por uma distância de 1,5 cm, onde apenas os 4 cm distais dissipam energia gerada por um eletrobisturi bipolar. Estas agulhas são refrigeradas através de um sistema de resfriamento interno por fluxo contínuo de água destilada gelada estéril a 0oC, cuja temperatura é mantida através da presença de gelo, formado também por água destilada estéril. A operação é realizada sob anestesia geral, não sendo utilizados cateteres venosos centrais durante ou após o procedimento. As incisões realizadas podem ser subcostal direita e mediana supra-umbilical. **Resultados** - A experiência inicial de sua utilização nas ressecções hepáticas mostraram média de 87 minutos, tamanho médio da incisão abdominal de 14 cm e sangramento médio de 58 ml. Nenhum paciente do grupo inicial recebeu transfusão de sangue ou derivados. **Conclusão** - As agulhas de radiofrequência bipolares resfriadas são viáveis e reduzem o sangramento nas ressecções hepáticas.

## INTRODUCTION

To reduce bleeding in liver resection various technological options have been disclosed, among them the radiofrequency<sup>1,3,4,5</sup>. The intent of the various methods is to avoid vascular clamping, less dissection to obtain liver and less bleeding. The authors aim at presenting a new technique of parallel bipolar radiofrequency needles developed by the authors and the technical details of its use.

## METHOD

### Technique: radiofrequency needles

The needle system mounted by the authors presents two parallel electrodes (18 gauge each) of 25 cm in length, separated by a distance of 1.5 cm, where only 4 cm distal to dissipate energy generated by a bipolar electrocautery (Figure 1). These needles are cooled by an internal cooling system for continuous flow of cold sterile distilled water at 0°C, whose temperature is maintained through the presence of ice also formed by sterile distilled water.

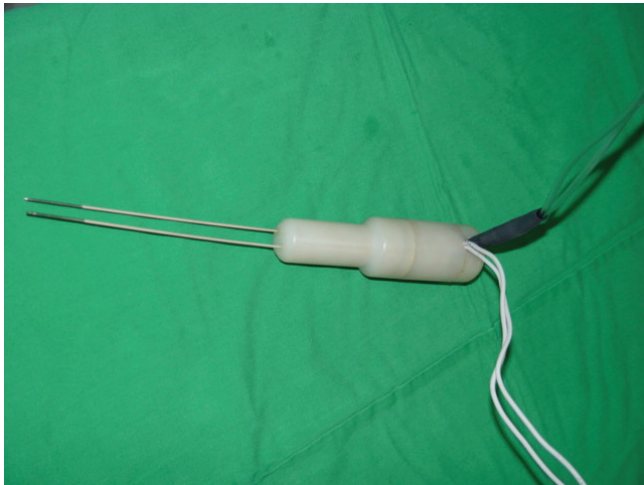


FIGURE 1 - Handle with two cooled RF needles

The electrocautery works as a source of electrical energy that generates the electric current needed to denature the target tissue. In this case, the nominal frequency is 500 kHz modulated by 40 kHz. The available power by the device switches between 4 and 80 watts. This unit is equipped with power control device and monitor the resistance of the tissue between the electrodes; the device goes off when the resistance rises above a safe limit that prevents tissue necrosis.

The goal is to generate tissue area that provides the denatured cutting line, whereby a conventional

scalpel blade can cut the parenchyma without bleeding. The area of necrosis contains 1 cm wide and 1 cm long by 4 cm deep, leaving only 0.5 cm of tissue remaining denatured to the parenchyma, since the conventional section with blade runs along the edge of needles that are in contact with the part to be removed. This area is between the electrodes, in volume that extends about 80% of the active exposed part (Figure 2).

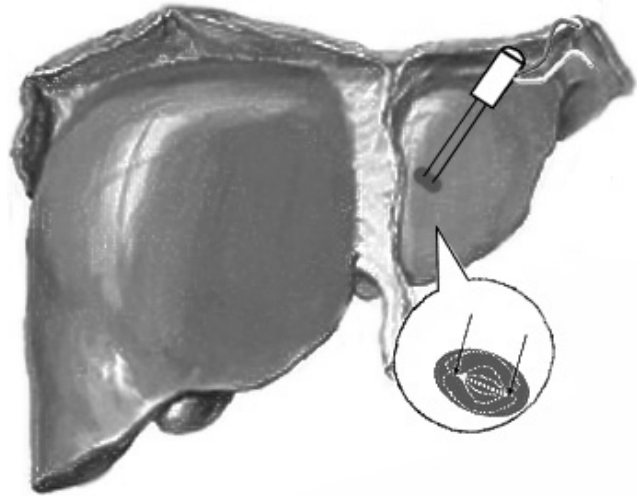


FIGURE 2 - Radiofrequency needle creating an area of necrosis of the liver for subsequent bloodless section with conventional scalpel

The alternating voltage generated by electrocautery is applied through the electrodes, giving density gradient of electric current in the region between them. As the region is composed of cells with certain concentration of ions in aqueous solution - peculiar to the intracellular volume -, the flow of electric current has low resistance early in the process. However, the continued movement of the alternating current causes sudden drop of the resistance, increasing the heat generated by Joule effect. This heating causes tissue to denature, with consequent loss of fluid, causing a gradual increase in tissue resistance between the electrodes. This occurs until they reach levels where there is progressive decrease in the Joule effect. At a time when the resistance reaches levels of security pre-determined, the electrocautery off the power supply. The tissue temperature generated by this effect reaches about 80° C. The electrodes are cooled so the tissues close to it does not become necrotic and adhered to them (which increases, by far, the electrical resistance of tissue), thereby ensuring continuous flow of electric current between them and more gradual denaturing throughout the volume between the active electrodes.

### Surgical technique

The operation is performed under general anesthesia, not using central venous catheters during or after the procedure. The incisions may be right subcostal and median supra-umbilical. Where right subcostal incision is used, the operating table should be lateral at an angle between 15° and 30° to the left.

After opening, liver intraoperative ultrasound with transducer in the form of T with 7 MHz should be performed in all cases to confirm the number and position of the lesions and exclude possible previously undetected nodules in the parenchyma. Need for dissection of the ligaments of the liver is restricted to patients undergoing right or left hepatectomy, aiming the mobilization and exposure of the removed area. The demarcation line with monopolar electrocautery resection defines the area to be removed, allowing to obtain a minimum distance of 1 cm from the tumor.

Always with sonographic control, the introduction of the needles should be initiated by the free edge of the liver toward the surrounding parenchyma. Once positioned the needles, the clotting process is initiated, interrupted when the high impedance tissue is measured. The tissue coagulation is achieved between the needles, as well as by a distance of 0.5 cm around the axis formed between them. The liver parenchyma can then be cut with conventional scalpel blade right in the middle of the line of observed necrosis following both in extent and depth, to complete segmental resection, without the use of any sutures or biological

glue.

After washing the cavity at the end of surgery, silicone drainage tube may be placed depending on local conditions before the closure of the wall.

Preliminary clinical results and experience in a series of patients are published elsewhere<sup>2</sup>.

## CONCLUSION

Cooled bipolar radiofrequency needles are feasible and reduce bleeding in liver resection.

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