

## Usefulness of the ultrasonically activated scalpel in laparoscopic cholecystectomy: our experience and review of literature

V. MINUTOLO<sup>1,2</sup>, G. GAGLIANO<sup>2</sup>, C. RINZIVILLO<sup>1</sup>, G. LI DESTRI<sup>1</sup>, M. CARNAZZA<sup>2</sup>, O. MINUTOLO<sup>2</sup>

**SUMMARY: Usefulness of the ultrasonically activated scalpel in laparoscopic cholecystectomy: our experience and review of literature.**

V. MINUTOLO, G. GAGLIANO, C. RINZIVILLO, G. LI DESTRI, M. CARNAZZA, O. MINUTOLO

*Laparoscopic cholecystectomy (LC) actually represents the most used and proper treatment for gallbladder lithiasis, because its many and known advantages in comparison with 'open' abdominal surgery. But there are some problems during and after LC due to the use of the electric scalpel and these have brought to the search of an alternative system of dissection and coagulation.*

*The ultrasonically activated scalpel (Harmonic Scalpel, HS) allows to perform dissection and coagulation with a minimal thermal side effect for surrounding tissues, unlike the electrocoagulation. Furthermore, the use of the HS brings a series of advantages in comparison to the other electromagnetic forms of energy (electroscalpel, laser). HS cuts and coagulates with the same effectiveness of the electroscalpel but, unlike this, it doesn't introduce risks of wandering currents. Moreover, HS contributes to have a more clean and clear (smokes-free) field of operation and it reduces the operative time, the bleeding and the costs of the operation without an increase of the complications and of the percentages of 'open' conversion, and perhaps leads to a less negative influence on the postoperative systemic immune response.*

*The Authors report their experience that confirm these observations, according also with results reported in a brief review of the recent scientific literature, and support wider diffusion and technical development of this ultrasonically-operating surgical team.*

**RIASSUNTO: Utilità del bisturi ad ultrasuoni nella colecistectomia laparoscopica: nostra esperienza e breve revisione della letteratura.**

V. MINUTOLO, G. GAGLIANO, C. RINZIVILLO, G. LI DESTRI, M. CARNAZZA, O. MINUTOLO

*La colecistectomia laparoscopica (LC) attualmente costituisce il più usato e appropriato trattamento in caso di colelitiasi per i molti e noti vantaggi rispetto chirurgia "Open,.. Tuttavia alcuni problemi attribuibili all'impiego dell'elettrobisturi hanno spinto alla ricerca di sistemi alternativi di dissezione e coagulazione.*

*Il bisturi armonico (HS), ad ultrasuoni consente di ottenere dissezione e coagulazione con un minimo effetto termico sui tessuti vicini, diversamente dalla elettrocoagulazione. Inoltre, l'uso dell'HS apporta una serie di vantaggi rispetto ad altre forme di energia elettromagnetica (elettrobisturi, laser). HS taglia e coagula con la stessa efficacia dell'elettrobisturi ma, diversamente da questo, non ha i rischi di correnti vaganti; inoltre, contribuisce ad avere un campo operatorio più pulito e visibile (privo di fumo), a ridurre la durata dell'intervento, il sanguinamento e i costi dell'intervento stesso, senza aumentarne complicità e percentuali di conversione e potrebbe avere effetti negativi sul sistema immunitario del paziente.*

*Gli Autori riportano la loro esperienza che conferma live tali osservazioni, in accordo anche con quanto riportato in una breve rassegna della letteratura scientifica recente. Tutte queste considerazioni spingono ad una più vasta diffusione e a un perfezionamento tecnico di tale strumentazione chirurgica operante ad ultrasuoni.*

KEY WORDS: Lithiasis of the gallbladder - Laparoscopic cholecystectomy - Harmonic scalpel.  
Litiasi della colecisti - Colecistectomia laparoscopica - Bisturi ad ultrasuoni.

## Introduction

Laparoscopic cholecystectomy (LC) actually represents the most used and proper treatment for the Gallbladder Lithiasis (GL), because its many and known advantages compared with 'open' abdominal surgery. In the last years biliary complications due to LC decreased thanks to the improved ability of the surgeons learning curve), nevertheless they weight in greater

Università degli Studi di Catania, Italy  
<sup>1</sup>Dipartimento di Scienze Chirurgiche,  
Trapianti d'organo e Tecnologie Avanzate  
(Direttore: Prof. A. Licata)  
Ospedale "Vittoria" (Ragusa), Italy  
<sup>2</sup>Divisione Clinica Chirurgia Generale  
(Direttore: Prof. V. Minutolo)

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measure in comparison with the traditional surgery. In fact the clips used to close cystic duct and artery (usually in titanium) can slip and detach themselves because of retraction of the sectioned tissues, while during the dissection of the gallbladder the scissors or the hook connected to the electrocoagulator can cause the perforation of the gallbladder (thermic side effect) with leakage of bile and/or gallstones and sometimes cause abdominal abscesses.

Therefore, these problems due to the use of the electric scalpel brought to the search of alternative systems of dissection and coagulation and towards a clips cholecystectomy (1). In fact, the ultrasonically activated scalpel (Harmonic Scalpel, HS) allows to perform dissection and coagulation (2, 4) with a minimal thermal side effect unlike the electrocoagulation. Moreover, the HS scalpel can be used in patients with permanent pacemaker or similar devices (5). In fact, electrocoagulator produces the clot overheating the tissues up to denature the proteins, while with the ultrasounds scissors the denaturation of the proteins happens, transferring to the tissues enough mechanical energy, to break only the tertiary structure (bonds of hydrogen) and favouring the generation of internal heat due to the resultant cellular friction by means of the low frequency vibration in the tissue. The heat produced by the ultrasounds dissector is lower than 80°C but generates the same effectiveness of haemostasis and dissection respect to the electric scalpel.

The aim of our study is to compare the two methods for the binding and for the section of the cystic duct and the cystic artery during the dissection of the gallbladder from the liver bed, to evaluate average duration of the operative time, the intra-operative and post-operative complications, bleeding and percentage of conversion in open cholecystectomy.

## **Patients and methods**

In the last two years we treated 152 patients with GL. Twelve cases were traditionally operated, while 140 patients were underwent to laparoscopic procedure: in 50 of these patients the laparoscopic cholecystectomy has been performed with the use of the HS both for the closing of the cystic duct and the cystic artery and for the dissection of the gallbladder from the liver bed. In 90 patients the binding and section both of the cystic duct and of the cystic artery has been performed with use of clips and without use of HS.

In both groups we collected the following data: mean operative time, incidence of injuries of the main biliary tract (MBT), bleeding of the liver bed during the dissection, leakage of bile from the gallbladder due to perforation, loss of bile from the drainage or due to injury of a accessory duct or displacement of the clips from the cystic duct, rate of conversion in open cholecystectomy. We used both Ethicon Ultracision® and Tyco/USSC Autosonix® without substantial differences between these two kinds of harmonic scalpels.

## **Results**

Only 5 (3.5%) of 140 patients laparoscopically operated underwent conversion in open cholecystectomy; 2 patients (1,4%) showed loss of bile by the drainage, in the first case due to missed sealing of the clips on the cystic duct and in the second one to injury of a biliary accessory small duct (complication solved in both cases by endoscopic papillosphincterotomy). We have not reported any case of injuries of the MBT.

The average time for isolation and section of the elements of the pedicle shank and dissection of the gallbladder from the liver bed has been respectively 23 minutes with use of clips and 14 minutes with use of the ultrasonically-activated dissector.

The bleeding during LC occurred in 11 patients (7,8%): only 2 cases (1,4% in the patients treated with HS dissector, in 9 patients (6,4%) of the group treated with electric tools (control group).

The perforation of the gallbladder with leakage of bile during the dissection from the liver bed happened only in patients of the control group (13 patients, 9,2%).

## **Discussion**

LC was performed for the first time in France (Lyon) by Philip Mouret in 1987 and it's a surgical technique that in the last decade has quickly spread in the whole world and actually it represents the treatment of choice of the GL.

Sometimes it's necessary to convert the laparoscopic operation in traditional approach (open surgery). In several series the percentage of global conversion both for acute and chronic cholecystitis is ranging from 2% up to 15%, with an average of 5% (6-9).

In the last years are also decreased the biliary complications thanks to the better manual ability of the surgeons, nevertheless the possibility of complications engraves in higher percentage in comparison to the traditional operation. The most frequent complications are represented by: 1) injuries of the MBT; 2) loss of bile from the bed of gallbladder (from a biliary accessory duct or from the cystic duct due to displacement or defective sealing of the metallic clips); 3) bleeding from the gallbladder bed; 4) perforation of the gallbladder during the dissection with spreading of bile and gallstones in the peritoneal cavity that can determine the early or late formation of abdominal abscesses.

The aforesaid complications can be often correlated with the employment of inadequate material of suture as the metallic clips or to the use of the electrocoa-

gulation. The electrocoagulation can produce some side thermal effects for diffusion of the heat determining injury of the surrounding structures (MBT or biliary accessory duct) that is evident in the post-operative period as biliary peritonitis.

The use of the HS both in the laparoscopic surgery and in the open surgery aims to get the prevention of the bleeding and the reduction of the side thermal damages (10-18). Besides, the ultrasonic energy allows to eliminate the electricity transferred to the patient, to improve the process of recovery and to eliminate the possibility of scorches in the site of mass-plate and of electric shake to the operator (19, 20). Huscher and coll. (21) treated 461 patient suffering from GL with the use of the HS and they reached the conclusion that the use of this tool reduces the complications during and after operation (particularly, the lesions of the biliary tract).

In our opinion and experience, the use of the HS allows to section the duct and the cystic artery without further bindings through clips (or endo-loops) and it reduces near to zero the risk of thermal injuries to the adjacent tissues, with smaller consumption of other expensive instruments (scissors, dissectors and clipping tools) generally adopted during laparoscopic surgery. Nevertheless, microscopic examinations of structures near to the terminal extremity of the handpiece have underlined the presence of microlesions of different degree, demonstrating a certain diffusibility of the injurious effect; therefore it is useful to employ the HS with extreme caution, i.e. using low frequencies and always viewing the point of the tool (22).

The use of the HS has allowed us to obtain a smaller incidence of complications both during and after operation but, above all, to reduce notably the bleeding from the liver bed (1,4% versus 6,4%, HS-case vs. controls) and the injury of an anomalous vessel and to improve the vision of the whole operating field, underlining the possible presence of accessory ducts, often responsible of the postoperative bile loss or of the conversion in open surgery.

The perforation of the gallbladder during LC is particularly frequent, especially when the dissection from the liver bed is performed with the normal electric hook or scissors (9,2% in our casuistry) while it is absent (in our experience) or reduced near to zero (in clinical literature) when the ultrasonic scissors are used (23).

The reduction of the operative time (in our experience 23 minutes vs. 14) represents the most mea-

ningful aspect of the employment of the HS in the LC as well as in other surgical operations. Some authors (24, 25) confirmed the usefulness of the HS in the laparoscopic treatment of gastroesophageal reflux (especially for the binding and section of the brief gastric vessels): it reduces the operative time and the costs without increasing the percentages of conversion and the perioperative complications.

It has been observed that some thermal damages to the adjacent tissues are depending from level of use and duration of activation. Emam and coll, in experimental study on the pigs, have confirmed that the optimal level to avoid damages to the adjacent tissues is the third and that the time of activation with level 4 and 5 don't have to overcome 5 seconds.

Other Authors reported their recent experiences about use of HS in other laparoscopic procedures (26, 27), in pediatric surgery also (i.e. laparoscopic splenectomy 28), thyroid surgery (29), liver resection (30).

In the operations performed by HS, the operating field (in comparison with using of electric scalpel) is free of smokes, clean and clear, so the surgeon is able to respect better the plans of cleavage.

The use of the harmonic dissector brings to evident and clear advantages, like the reduction of the average operative time, the bleeding and of the biliary complications, but has no influence on the percentage of the conversions; moreover, perhaps the use of HS leads to a less postoperative negative influence on the immune response (31). For a correct and valid use of the HS kit a proper curve of learning is needed.

## Conclusions

Based upon our experience and literature, we think that the use of the HS brings a series of advantages in comparison to the other electromagnetic forms of energy (electro-scalpel, laser). HS cuts and coagulates with the same effectiveness of the electroscalpel but, unlike this, it doesn't introduce risks of wandering currents (due to the circuit-closing plate to earth); besides it contributes to reduce the operative time, the bleeding and the costs of the operation without an increase of the complications and of the percentages of open conversion.

All these considerations brings to a wider diffusion and development of this ultrasonically-operating surgical equipment (32).

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