The Use of Argon Laser in Medical Treatment

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It's been a while now since Argon lasers are used for coagulation in the surgery of parenchymal organs. The special properties of lasers with rare gases, especialy the one with argon, have recommended them for hepatic, biliary and ophtalmologic surgery. Hydatidosis is a parasitic disease widely spread in Romania, which has a specific symptomatology and raises major therapeutic problems because of possible postoperative complications. The main problem in surgical cure is the management of hepatic hydatid cyst biliary fistulas. The purpose of this study is to draw attention to the benefits of using argon laser coagulant in closing biliary microfistulas and management of the hepatic hemostasis. We monitored the subjects on whom we have applied this techinque and we have noticed the shortening of hospitalization duration, the positive postoperatove evolution and the reduction to a minimum the postoperative biliary fistulas incidence.

Keywords: argon laser, hydatidosis, biliary fistula, thermal effect

An ion laser is a gas laser, which uses the ionized gas distribution medium (1). The mechanism of operation of these lasers needs a sealed unit that contains the laser and a number of mirrors that form a Fabry-Perot resonator. Because of the high energy requirements to use the ions, such lasers have water cooling system. Ion lasers produce a large number of wavelengths, ranging from ultraviolet (UV) to infrared (IR) in the spectrum. Most of the ion lasers used today are based on argon or krypton, which can emit continuous waves.

Argon is a noble gas (Ar), with atomic number 18, the third most common gas in the Earth's atmosphere, most of it being obtained by decomposition of potassium 40 in the crust . The name, derived from Greek (gr. Άργος meaning "inert"), suggests the inability of this element to undergo chemical reactions. Its resistance is due to the dense layer of 8 electrons. It is an odorless, colorless, non-toxic and inert gas (although it can form compounds such as HArF) (2).

Argon lasers produce the highest levels of power visible, extending substantially through the blue and green portions of the visual spectrum. Usually argon lasers have wavelengths between 514.5 nm and 457.9 nm, the most used lengths being 514.5 nm and 488.0 nm. The above mentioned system of mirrors can influence the radiation by changing their wavelength, thus reaching 1090 nm. UV waves can be achieved only by very strong models, requiring more energy to be developed (3).

An exciplex laser is a form of ultraviolet laser, made of rare gases (Ar, Kr or Xe) and a reactive gas (flourine or chlorine), creating, in certain electrical and pression conditions, a pseudo-molecule that can exist only in active electric state and can generate light in the ultraviolet spectrum (4). The wavelength of the Ar laser with 193 nm ArF is developed at an output of 60 mW (5).

The excimer lasers' ultraviolet light is easily resorbed by biological material and organic compounds, where it develops enough energy to unlink the molecular bindings of the superficial tissue. This tissue disintegrates in a controlled manner through ablation without burning, and this allows the excimer laser to remove thin layers, leaving completely intact the surface without burning or heating of remaining tissue. These features recommend this type of laser for precission and delicate surgery; initially being used in ophthalmology and microsurgical dermatology, nowadays this type of laser is widely employed in vascular surgery (6).

Experimental part

Material and methods

The present study is a longitudinal, retrospective one, in which we have observed the perioperative evolution of a group of 5 subjects who had intraoperative argon laser used for closing biliary fistulas.

Hydatid cysts larger than 6 cm have definite surgical indication. The treatment options are of radical or partial intent. In radical interventions we can choose between total/ideal pericystectomy, atipical or controled hepatectomy. The use of the laser in this case has a great value in the hepatic hemostasis stage, preventing liver bleeding. The partially conservative techniques at choice are drainage, Lagrot pericystectomy, internal drainage by pericysto-digestive anastomosis, omentum filling, transligamentar transomphalic drainage of the cavity after partial pericystectomy, tunneling cavity and marsupialisation (perichistotomy- suture with or without drainage) (10).

Because of the hydatid cyst's structure and the connections which it sets while growing within the hepatic parenchima, we can *a priori* consider as certain the existance of a biliary fistula. The presence of biliary fistulae modifies the dinamics of the bile and of the hydatid liquid. Between the cysts content and the biliary tree there is a permanent connection, which is pressure sensitive.

The surgical technique involves removing the germinative membrane after inactivation of the cyst, pericystectomy, subsequently daining the part of the pericyst witch remains in situ and it is intimately attached to the liver parenchyma. The drainage tubes from the residual cavity may remain active (draining the bile from

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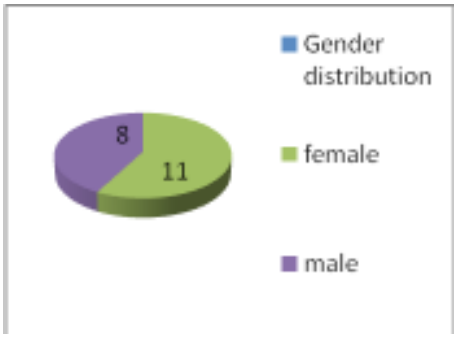

Fig. 1. Gender distribution in the chosen group

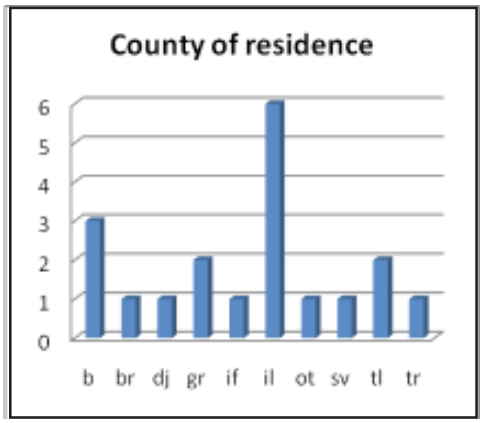

Fig. 2. County of residence for subjects; district abbreviations are listed. We can notice that almost all the patients in this group were from Muntenia region, from plain areas, where agriculture and sheperding are more encounterd activities. We must however take into consideration the adresability of the capital medical center

more or less obvious fistulas) up to several months, in severe cases. To decrease the drainage flow rate there can be used a postoperative Endoscopic retrograde cholangio-pancreatography (ERCP), with its innerent risks, or, intraoperative the visible fistulas can be sutured with „x" stitches.

Results and discussions

We chose a group of 19 subjects who underwent operations (17 classical and 2 laparoscopical intervention) within the past 12 months, and in which billiary fistulas were noticed. In this group the average age was 41.10 years, with a 40.7/42.3 years female/male age ratio (fig. 1).

The home county of the subjects has a great significance, due to the known association between the parasites lifecycle and the traditional occupation in some parts of the country (fig. 2).

A cystectomy/pericystectomy was performed during all the procedures, after the inactivation of the cysts content with hypertonic saline (fig. 3). Except for two procedures, with ideal cystectomy and atypical resection of the liver, all the subjects had their remaining cavity drained. This drainage is very important for the follow up of the patient as there might be microscopic billiary fistulas which will start producing bile after the operation.

The colecistectomy is routinely performed as the gallbladder is a continous reservoir of the parasite.

Although the digestive anastomosis with the cyst was a well recognised method of treatment, now it is used only occasionaly, in selected cases, due to the great risk of infection it poses.

The surgical technique used influences the hospitalisation duration, the costs of the recovery period

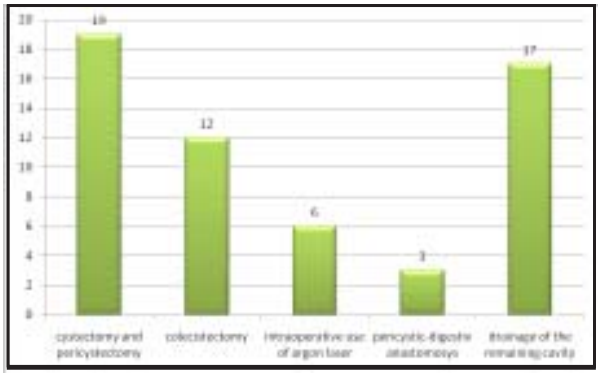

Fig. 3. Case distribution considering the chosen procedure

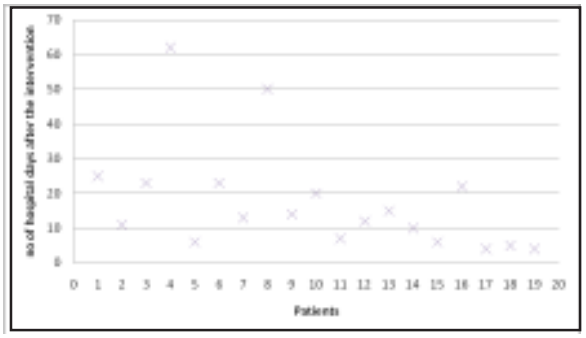

Fig. 4. Hospitalisation duration for each subject, after the operation was performed (number of days). The two subjects with longest hospital stay had postoperative complications, one of them with remaining cavity infection and the other with an associated thyreotoxic crisis

and not at last, the quality of life for the patient. The duration of the hospitalisation is figured in figure 4.

The use of the argon laser reduces to half the recovery period (fig. 5), the costs and the social reintegration time. The digestive anastomosis is the most time consuming technique.

After surgery, the main concern is the billiary drainage from the remaining cavity. Sometimes waiting for the fistula to close, spontaneously or with the aid of ERCP technique, may take up to months. It is not uncommon for the subject to leave the hospital with the drainage tube *in situ*, which increases the risk of infection and complications of the wound, decreases the mobility of the subject, and alters his/her social life (fig. 6).

The group with argon use has the lowest number of subjects discharged with the drainage tube. The only case that left the hospital with drainage tube in situ is discused in the next paragraph.

Because of the great risk of haemorrhage, the hepatic surgery is a very difficult one . The surgery of echinococosis employs a difficult management of the remaining cavity, of the cystic tumor and of the biliary fistulas. The association of these two elements brings us to a very controversial surgery, with no clear boundaries or protocols.

Coagulation through argon ion lasers is a method highly used in surgical hemostasis, with great care towards the risk of gas embolism in the venous system. (7) The argon is inert, noncombusting, a perfect medium of transmition for electricity, which can easily ionize this gas' particles, making it a better conductor than air. It can create a bridge between the tissue and the electrode, repaces oxigen and nitrogen. The use of srgon devices (excimer lasers) leads to: decrese of blood loss, minimal tissue damage, lack of intimate contact with cell structures (8).

The curent produced by the argon laser formes an ionized bridge in a gas flow , created between the tissue and the

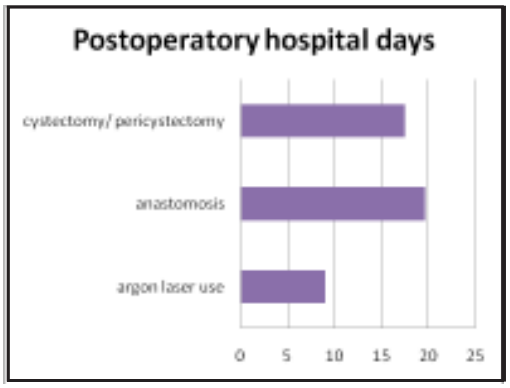

Fig. 5. The three main techniques used in this group and the postoperative recovery days

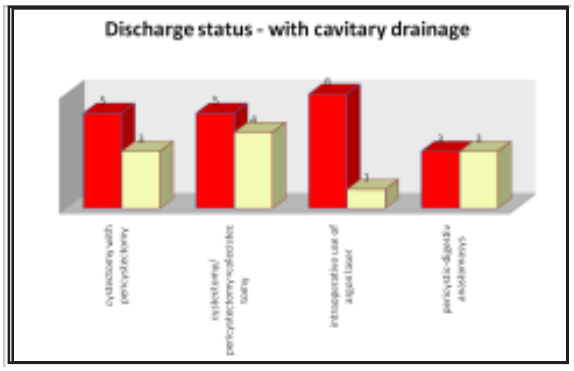

Fig. 6..11/19 subjects in the group left the hospital with an intracavitary drainage in situ; 2 of the subjects with no cavity drain tube had an ideal cystectomy with atypical hepatic resection.

electrode. It results in a soft spray of electric curent which coagulates evenly the tissue surface. The peril of venous gas embolism of this technique increases with the associated risk factors: laparoscopy, lessions of the hepatic parenchyma, hepatic vascular damage, the close contact of the hepatic tissue with the tip of the electrode's probe (most of the studies nominate this as a technical error and the main cause of venous embolism) (9).

The device of argon laser we use In our clinic is System 7550 (ConMEd), which allows a rapid hemostasis, puls cutting, programable modules. The device may be used at 110 V by 60 Hz or 230 V by 50/60 Hz (fig. 7) (12).

Case presentation. One of the female subjects first presented with jaundice and had 3 giant hydatid cysts in the liver. The tumors occupied almost entirely the hepatic parenchyma. (fig. 8).

The surgical protocole contained: median incision or right side Kocher incision, dissection of the wall and peritoneum layers, identification of the cystic tumors , injecting H_2O_2 for inactivation of the content, aspiration of the cysts content, pericystectomy, removal of the germinative layer, use of argon laser to seal the visible and microscopic biliary fistulas with regard to the vascular safety limits, drainage of the remaining cavity. There has been no intraoperative incident, no bleeding or rupture of the cysts that could not be controlled using the argon laser.

Postoperative evolution of the subject was favorable. In the case we are presenting, the drainage of the central cyst remained *in situ* for 35 days, with an average flow of 75 mL bile/day, the other two being suppressed in the 3rd and 7th day postoperatively; the subject was discharged on the 10th postoperative day.

Conclusions

The use of argon laser eases the operatory technique for the cure of hepatic hydatid cysts, grants more confort and safety in the process of hepatic hemostasis, reduces the period of hospitalization, decreases the number of hepatic and biliary complications perioperatory, can be used sucessfully in any circumstance, and also decreases the learning curve for the management of this particular pathology.

Fig. 7. The device of argon laser used: System 7550 (ConMEd), 110 V by 60 Hz or 230 V by 50/60 Hz

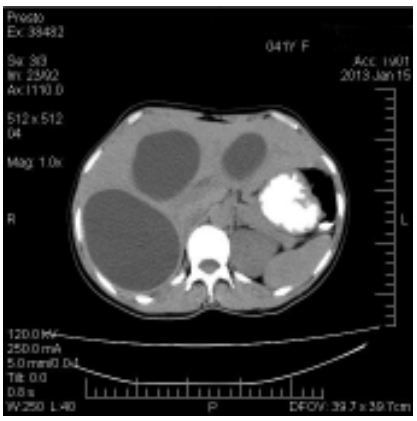

Fig. 8. Computer tomograph (CT) scan section, showing 3 hydatid cysts

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