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Experimental study of chemical cholecystectomy through abdominoscopic technology

Shu-Ming Sun, Jian-Heng Xu, Shu-Qing Sun, Tao Ma, Ming-Yao Wu, Li-Biao Wu, Kui Chen, Wan-Xiu Liu

Shu-Ming Sun, Jian-Heng Xu, Tao Ma, Li-Biao Wu, Wan-Xiu Liu, Department of General Surgery, the First Affiliated Hospital, Medical College of Shantou University, Shantou 515041, Guangdong Province, China

Shu-Qing Sun, Guangdong Provincial Medical Information Institute, Guangzhou 510180, Guangdong Province, China

Ming-Yao Wu, Department of Pathology, College of Shantou University, Shantou 515041, Guangdong Province, China

Kui Chen, Department of Surgery, Medical College of Shantou University, Shantou 515041, Guangdong Province, China

Dr. Shu-Ming Sun, male, born in 1967-05-27 in Jieyang City of Guangdong Province, Han nationality, graduated from Shantou Medical College University in 1992, associate surgeon-in-charge of general surgery, visiting surgeon, having 9 papers and 1 book published.

Author contributions: All authors contributed equally to the work.

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Correspondence to: Dr. Shu-Ming Sun, Associate Surgeon-in-charge of general surgery, Visiting Surgeon, Department of General Surgery, the First Affiliated Hospital, Medical College of Shantou University, Shantou 515041, Guangdong Province, China
Telephone: +86-754-8258290-3256

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Abstract

AIM: To verify through animal experiment the validity of chemical cholecytectomy.

METHODS: Experimental animals used were healthy juvenile pigs. A 3cm incision was made at the right costal margin for passing the cold lig ht source and some laparoscopic instruments into the abdominal cavity. The cystic duct was clamped with a siver clip and the gallbladder perfused with anhydrous alcohol (the sclerosing agent used). Gross observations and microscopic studies of the gallbladder, cystic duct, duodenum and adjoining liver specimens were made at the end of 2, 4, 6, 8, and 10 wk.

RESULTS: Coagulative necrosis and inflammatory reaction of the gallbladder and cystic duct appeared early, followed by extensive fibrosis and scar formation by the 8th week, and at the end of 10 wk complete fibrosis of the whole gallbladder occurred.

CONCLUSION: Chemical cholecystectomy is a safe, reliable, simple and practical minor surgical technique.

Key words: Cholecytectomy, chemical; Gallbladder/pathology; Laparoscopy; Disease models, animal

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INTRODUCTION

Salomonowitz in 1984 introduced chemical cholecystectomy, in which the gallbladder mucosa was destroyed by a sderosing agent. Thus, a cholecystectomy was substituted by postsclerosing fibrosis of the gallbladder, achieving the purpose of preventing the relapse of gallstones. The aim of this experiment was to prove the validity of chemical cholecystectomy as a practical, safe, reliable, simple, minor surgical technique for the treatment and prevention of gallstone in the gallbladder.

MATERIALS AND METHODS

Sclerosing agent: Anhydrous alcohol (≥ 99.5%) was prepared by the Guangzhou Chemical Reagent Factory. The silver clips were produced by Shanghai Surgical Instrument Factory. Cold light source (XSL-1) was the product of the Shanghai Medical Optical Instrument Factory No.1 Branch.

Animal: 5 healthy, juvenile and hybrid pigs, each weighing 9-16 kg, provided by the animal experimental center, Medical College of Shantou University.

Methods

3% Pentobarbital was (30 mg/kg) injected into abdomen for general anesthesia, and a 3 cm oblique incision was made at the right lower costal margin for the introduction of the cold light source and laparoscopic instruments into the abdominal cavity. Then, underdirect view, we found out the cystic duct, damped it with a silver clip, punctured the bottom of the gallbladder to aspirate out the bile, installed a small catheter in it, rinsed the gallbladder with normal sal ine and finally measured the volume of the gallbladder. Now through the catheter we perfused into the empty gallbladder the anhydrous alcohol gently in a volume of about 1 mL less than the measured volume of the gallbladder. The sclerosing agent was left there for 4-5 min, before it was completely aspirated out, and then the gallbladder was rinsed with equal volume of normal saline;

Table 1 Histopathological changes

	Gallbladder mucosa	Proximal end of cystic duct	Distant end of cystic duct	Duodenum	Neighbouring liver tissues
No.1 (2 wk)	Coagulative necrosis, focal chronic inflammatory reaction, a great deal of inflammatory granulation tissues	Mucosal necrosis, chronic inflammatory reaction	Mucosa present, chronic inflammatory reaction	No change	No change
No.2 (4 wk)	Complete necrosis, chronic inflammatory reaction, granulation tissue and scar formation	Mucosal necrosis, chronic inflammation	Slight chronic inflammatory reaction	No change	No change
No.3 (6 wk)	Complete necrosis, replaced by inflammatory granulation tissue and scar formation	Mucosal destruction, granulation tissues	Chronic inflammatory reation	No change	No change
No.4 (8 wk)	Mucosal coagulative necrosis, inflammatory granulation tissue and scar formation	Mucosal destruction, fibrous connective tissue	Inflamm atory reaction	No change	No change
No.5 (10 wk)	Mucosa completely destroyed, dropping out, scar formation	Mucosal destruction, fibrous connective tissue	No pathologic change	No change	No change

we re peated the above procedure twice in a total duration of 20 min. The catheter was with drawn, the abdomen was closed, and the animal was sent back to the an imal room for observation.

Sample collection

Samples of the gallbladder wall, the proximal and distant end of the clamped cys tic duct, common bile duct and the neighbouring liver tissues around the gallbladder bed (5 pieces from different sites) were collected in the 2nd, 4th, 6th, 8th and 10th week after the procedure, when the animals were sacrificed one after the another.

Goss Observation

We observed the skin and sclera for the presence of jaundice, the contour and size of the gallbladder, the gross appearance of the liver, duodenum and common bile duct of the animals.

Pathological examination

Specimens of the gallbladder, the proximal and distant ends of the cystic duct, common bile duct and the neighbouring liver tissues were routinely fixed, embedded, made into sections, stained with H-E and optical well studied under light microscope.

RESULTS

Gross observation

On the skin or sclera of each experimental pig, no jaundice were found. Their liver, common bile duct, and duodenum were all normal, but the gallbladder adhere d to the omentum majus. Two wk after the procedure, an obvious atrophy of the gallbladder occurred; no scar or hydrops could be seen. At the end of 4 wk, the gallbladder was markedly atrophied with no scar or hydrops. Six wk after, the gallbladder atrophy became nearly complete and scar tissue could be seen, but there was still no hydrops. By the 8th week, gallbladder atrophy was complete and basically substituted by the scar. At the end of 10 wk, the scar replace d the whole gallbladder. The results of microscopic study of the sections were shown in Table 1.

DISCUSSION

The processes of histopathologic changes

The sclerosing agent was absorbed through the mucosal epithelial cells of the gallbladder, causing coagulation of cellular protein, cells necrosis, inflammatory reaction, and reparative fibrous scar tissues. Eventually the gallbladder became totally fibrotic ("self amputation")[1]. The whole course of events needed some time for their completion. In a series of observation, we found that destruction and necrosis of all the mucosa of the gallbladder, inflammatory re action accompained by the formation of granulation tissue occurred in the first two wk. Chronic inflammatory reaction with a great deal of granulation tissue and scar formation occurred in the 4th-8th week. At the 10th week later, the inflammatory reaction reduced and scar tissue formation of the gallbladder became nearly complete. The mucosal changes of the proximal end of the clamped cystic duct was basically consistent with that of the gallbladder. In the 2nd-8th week the changes of the distant end of the cystic duct showed a chronic imflammatory reaction which disappeared completely at the end of 10 wk. No pathological change of the duodenum and neighboring liver tissue could be found. The whole course of such pathological changes provided a pathological evidence for the clinical application of chemical cholecystectomy.

Occlusion of cystic duct

The complete occlusion of the cystic duct is not only the premise of the sclerosing agent perfusion but also can prevent from its injury to the common bile duct and intestine. Moreover, such a complete occlusion may check the extension of common bile duct mucosa into gallbladder cavity and lead to epithelial regeneration. The destruction of the cystic mucosa and the occlusion of the cystic duct are therefore crucial for a successful chemical cholecystectomy[2]. There were many methods, which were used to occlude the cystic duct one after another since Salomonowitz first reported to use aminopropylenic acid and collodion as an embolus to occlude the cystic duct[3], such as gelatin embolus and adhesives *etc*, but the disadvantage of these emboli were easy to drop out into common bile duct, and could not prevent the cystic mucosa from regenerating into the gallbladder. In 1985, Gertajdman used silk thread to ligate the cystic duct, an d this can might avoid such shortcoming. Some-one used microwave thermo-coagulation to occlude the cystic duct through a percutaneous chole-cystscope; themicrowave thermo-coagulation can result in occlusion of the cystic duct immediately[4,5], but this method needs special instruments and a minor operation. In China, Guan Hong Geng used metal clip to clamp the cystic duct without any complication[1]. In our experiment we also used metal clips to block the cystic duct only, with no injury to the common bile duct and intestine, and the destruction of the proximal end of cystic duct mucosa was basically similar to that of the gallbladder mucosa. We believe that in this experiment the use of the metal clip to block the cystic duct is a reliable, simple and practical method, during chemical cholecystectomy.

Selection of the sclerosing agent

Selection of the sclerosing agent directly influences the result of chemical cholecystectomy, and the duration of perfusing is also a decisive factor. In 1985, Getrajdman proved that alcohol, tetracycline, metacrylic acid ester and trifluoroacetic acid could make rabbits gallbladder to be fibrosed, but thermo-contrast medium and normal saline were ineffective[6]. From a review of the literature from abroad and home, many sclerosing agents can be chosen. Of them, the more commonly used are as follows: 95% alcohol or anhyrous alcohol, 5% tetracycline solution, 2 mol/L trifluroacetic acid benzoic acid composita, *etc*. In this experiment we used anhydrous alcohol (≥ 99.5%) only, and the perfusing time was only 20 min. The whole gallbladder mucosa could be destroyed completely. We belie ve that the anhydrous alcohol is a simple, easily available, effective and safe sclerosing agent.

Chemical cholecystectomy has many advantages, and may achieve the same efficacy of surgical cholecystectomy. This method needs only a 3 cm incision for passing a light source and some simple laparorscopic instruments under direct view. There is no need to make a preumoperitoneum and to make use of a laparsscope. Moreover, it is a simple, relatively easy, less expensive, minor surgical procedure, and results in little postoperative visceral adhesion or other complications. Thus, it is our conviction that chemical cholecystectomy is a novel, simple and very effctive technique for treating cholelithiasis even in not very well equipped

basic medical units.

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