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Transgastric Endoscopic Cholecystectomy in a Dog : Natural Orifice Transluminal Endoscopic Surgery

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Abstract : Transgastric endoscopic cholecystectomy was successfully accomplished in a 1-year-old, 15 kg, female, mongrel dog. Single-working channel flexible gastric endoscope was used with the aid of one abdominal laparoscopic port. Gastrotomy was performed using endoscopic needle knife at the ventral antral region. Through the gastric incision endoscope was advanced and retroflexed for the visualization of gallbladder. For the better exposure of surgical field, gentle traction was applied at the fundus of the gallbladder using laparoscopic grasping forceps. Cystic duct and artery was ligated using endoclips. After transecting the duct and artery, gallbladder was dissected using endoscopic coagulating grasping forceps and needle knife. Resected gallbladder was retrieved through the mouth and gastric incision site was sutured using endoclips. There was no evidence of bile leakage or stomach leakage on postoperative day (POD) 3. On POD 16, gastric endoscopy and laparoscopy was performed. Gastric endoscopy revealed complete adhesion of incision site. The content of the peritoneum appeared healthy, with no sign of infection, bile staining, or organ injury. The omentum was adhered over resected gallbladder fossa and the serosal surface of gastrotomy site. This is the first report of NOTES cholecystectomy in the dog and provides new concept of cholecystectomy of the dog.

Key words **:** cholecystectomy, transgastric, dog, NOTES.

Introduction

Cholecystectomy may be indicated for cholelithiasis, non-responsive cholecystitis, primary neoplasia or rupture of gallbladder (5). Cholecystectomy was first reported in 1709 in dogs and in 1882 in human (8). The evolutionary changes in gallbladder surgery was conversion from laparotomy to laparoscopy (8,14). The first laparoscopic cholecystectomy was reported in 1985 (8). The great success in laparoscopic cholecystectomy became trendsetter for minimally invasive surgery and influenced on all fields of surgery (14).

In 2004, Kalloo et al. described a new port to the peritoneal cavity through a transgastric approach in a pig model (7). This seems to be the third-generation surgery: natural orifice transluminal endoscopic surgery (NOTES) (14). In pigs the third-generation, NOTES, cholecystectomy was performed experimentally usually via transgastric (11) or transcolonic (8).

This study was performed to assess the feasibility of the transgastric cholecystectomy in a dog by using standard flexible gastric endoscope with minimal assistance of laparoscopy.

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Materials and Methods

This study was approved by Chungnam National University Animal Care and Use Committee. A 1-year-old, intact female, 15 Kg, mongrel dog was used for the procedure. The dog was fasted for 24 hours before surgery. During this period Hartmann solution (Techflex®, Choongwae Pharm Co, Korea) was administered as a maintenance dose and cefazolin (Cefazolin®, Chong Kun Dang Pharm, Korea) was administered intravenously at a dose of 20 mg/kg, bid. As preanesthetic medication atropine sulfate (0.04 mg/kg, SC, Atropine sulfate®, Je-Il Pharm Co, Korea) and meloxicam HCl (0.2 mg/kg, IV, Metacam®, Boehringer Ingelheim Korea, Korea) were administered. General anesthesia was induced with thiopental sodium (15 mg/kg, IV, Thionil®, Dai Han Pharm Co, Korea) and maintained with 1.5MAC isoflurane (Forane®, Choongwae Pharm Co, Korea) under pure oxygen after tracheal intubation. The dog was positioned dorsal recumbency and the abdomen was prepared aseptically.

Single-working channel gastroscope (Scope : EG-300FP, Processor : EPX-304, Fujinon™, Fuji Photo Optical Co LTD, Japan) was cleansed by using chemical disinfection in 1% dipotassium peroxodisulphate (Virkon®, Antec™ International-A DuPont Co, England) and air-dried before procedure. The gastroscope was introduced through the mouth. By using endoscope the stomach was lavaged with sterile water until

Fig 1. Intraoperative photographs of transgastric endoscopic cholecystectomy in a dog. Gastrotomy is performed by endoscopic needle knife (A). Endoscope is seen at the gastrotomy site (B). Liver and gallbladder is seen after retroflexion of endoscope (C). Gentle traction is applied at the fundus of gallbladder using curved laparoscopic grasping forceps to expose surgical field (D). Cystic duct and artery is ligated using endoclips (E). After ligation and transection of cystic duct and artery, gallbladder is dissected using coagulating grasping forceps (F) and endoscopic needle knife (G). Resected gallbladder is grasped using three prong grasping forceps and retrieved through the mouth (H). The gastrotomy is closed from the inside the gastric lumen with endoclips (I).

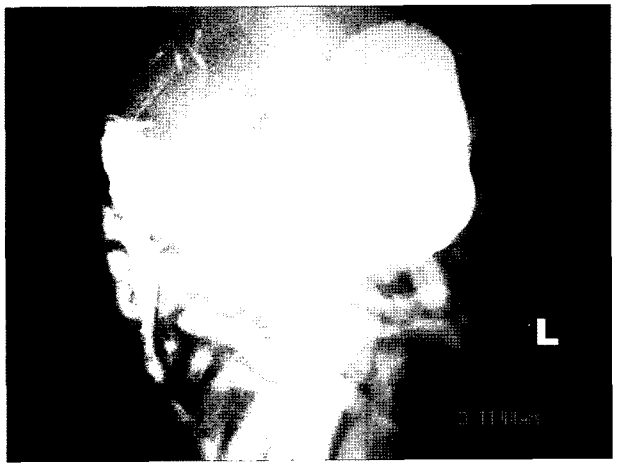

Fig 2. Positive-contrast ventrodorsal abdominal radiograph of the dog on POD 3. There is no evidence of gastric leakage or bile peritonitis.

free of debris. Subsequently cefazolin solution (1 g in 300 ml of normal saline) was instilled into the stomach. This solution was maintained for 10 minutes and removed using endoscopic suction.

By using abdominal indentation and endoscopic illumination, proper incision site was described and marked at the vental antral region of the gastric mucosa using endoscopic needle knife (KD-10Q-1A, Olympus Optical LTD, Japan). Pneumoperitoneum was created by CO_2 insufflation via Veress needle and a 5 mm trocar (B5ST, Ethicon Endo-Surgery Inc, USA) was placed for laparoscope (Fencer, MGB Endoscopy Co LTD, Germany). Intraabdominal pressure was maintained to 6 mmHg. One centimeter length full-thickness gastric wall incision was performed using endoscopic needle knife with combination of 50W coagulation and 60W cut current (Electrosurgical Unit Model UM300, Union Medical Engineering Co, Korea) (Fig 1-A). Through this opening endoscope was advanced into the peritoneal cavity and retroflexed toward the gallbladder (Fig 1-B, C). Curved laparoscopic grasping forceps was introduced through the 5 mm trocar. For the better exposure of surgical field, gentle traction was applied at the fundus of the gallbladder using the grasping forceps (Fig 1-D). This simple procedure provides good visualization of cystic

Fig 3. Postoperative endoscopy and laparoscopy of the dog on POD 16. Gastric endoscopy shows complete adhesion of incision site (A). On laparoscopic findings, omentum is adhered over the resected gallbladder fossa (B). The serosal surface of gastrotomy site is not well observed due to omental adhesion (C).

duct and artery. Cystic duct and artery were triple ligated with 135 endoclips (HX-600-135°, Olympus Optical LTD, Japan) and clip fixing device (HX-5lR-1, Olympus Optical LTD, Japan) through the working channel of endoscope (Fig 1-E). Cystic duct and artery was transected by using coagulating grasping forceps (FD-410LR, Olympus Optical LTD, Japan). Subsequently the gallbladder was dissected from the liver using coagulating grasping forceps or needle knife (Fig 1-F, G). Resected gallbladder was grasped using three prong grasping forceps (FG45L-1, Olympus Optical LTD, Japan) and retrieved by withdrawing the endoscope through the mouth (Fig 1-H). The gastrotomy was closed from the inside the gastric lumen with endoclips (Fig 1-I). Laparoscopic port was withdrawn and a penrose drain was placed.

Results

Food was withheld for three days after procedure and Hartmann-dextrose solution was administered at a maintenance dose. Antibiotics were treated same as preoperatively for 7 days. On postoperative day (POD) 3, positive contrast abdominal radiography revealed no leakage from the stomach (Fig 2). Serum biochemical profiles of POD 3 revealed no bile leakage (total bilirubin : < 0.1 mg/dl). On complete blood count, elevation of WBC was observed for 5 days. From the POD 4, food was allowed and the dog showed normal appetite without any postoperative complications.

On POD 16, the dog was anesthetized as a same manner. Gastric endoscopy revealed complete adhesion of incision site (Fig 3-A). Following endoscopy, laparoscopy was performed for the inspection of abdominal cavity. The content of the peritoneum appeared healthy, with no sign of infection, bile staining, or organ injury. Omentum was adhered over the resected gallbladder fossa (Fig 3-B). The serosal surface of gastrotomy site could not be well observed due to omental adhesion (Fig 3-C).

Discussion

The transluminal endoscopic route for surgery has the potential to eliminate complications associated with traditional surgery (e.g. postoperative abdominal wall pain, hernias, and wound infection) and offer scarless surgery (14). Investigators reported the feasibility and potential advantages of NOTES procedures inside the peritoneal cavity in comparison to traditional open surgery or laparoscopy (2,4,7,8,10,12,13). Various groups around the world are now actively researching the use of this novel surgical procedure (14). For the clinical use of NOTES, safety and benefits must be demonstrated (14). Stomach, colon, vagina and urinary bladder were examined to access the peritoneal cavity (1,3,6,8,14). On the present study, stomach was used as access site for cholecystectomy. Transgastric endoscopic view of cranial abdominal organs such as liver and gallbladder are limited, and retroflexion is required. Straight-shot of gallbladder is achieved by transvaginal or transcolonic access. However, more studies might be needed due to the narrow pelvic cavity of the dog.

In all of transluminal surgery, appropriate closure of incision site and preparation of contaminated access field are the most crucial part to prevent postoperative leakage and/or peritonitis. Our team used endoclips for the gastrotomy closure. There were some difficulties in closing the gastrotomy site, because endoclips are primarily designed for hemostasis. However, approximation and sealing of gastric mucosa was achieved, with additional three-days of postoperative fasting. To aid the closure of incision site for the NOTES, various devices are being developed. These include a novel endoscopic incision and closure device (The Springer Device, LSI Solutions, USA), a three-channel device based on ShapeLock® technology (USGI Medical INC, USA), EndoCinch (Bard, USA), a needle, tag-thread and locking method, and Eagle Claw (Olympus America, INC, USA) (2).

Endoscopic devices currently used are designed to intraluminal use. These are not intended to be used for organ resection, tissue retraction, suturing or other surgical procedure (14). For the better transluminal peritoneal procedure, newly designed endoscopic devices are in developing, such as multiple working-channel endoscope or multidirectional bending endoscope (1,2,3,11). Our team used single-working channel gastroscope for transgastric cholecystectomy. There were little difficulties in gastric incision and closure. But, other procedures including exposure of surgical field, ligation, transecting, dissection and retrieval were carried out with the aid of additional single abdominal port and a laparoscopic grasping forceps. With

this novel surgical procedure, cholecystectomy was successfully accomplished in a dog.

In dogs, cholecystectomy is usually done by the traditional laparotomy with big abdominal incision, because of surgical anatomy of gallbladder. Usually multiple abdominal ports (4~5 ports) are used in human patients for the laparoscopic cholecystectomy. Therefore, laparoscopic cholecystectomy might be the limited procedures in dogs, because of small peritoneal cavity for such a many laparoscopic instruments. On the present study, NOTES cholecystectomy procedure required the space only for the endoscope and single laparoscopic port.

This is the first report of NOTES cholecystectomy in the dog and provides new concept of cholecystectomy of the dog. However, for the clinical use of NOTES in small animal surgery more studies might be needed. More kinds of NOTES procedures should be investigated in more experimental animals, in more animal species, and in more breeds. Microbiologic, histopathologic and immunologic studies are also needed. Furthermore, developing specifically designed endoscopic devices will enhance the clinical use of NOTES and match up with ultimate purpose of NOTES, no-scar surgery.

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개에서 내시경을 이용한 경위장관 담낭절제술 1예 : 자연개구부 내시경수술

정성목[1] · 김영일* · 이재연 · 지현철 · 박지영 · 박종헌 · 김지연** · 이상일** · 김명철 · 신상태 · 이영원**

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요 약 : 1년령, 암컷, 15 kg의 잡종견에서 위내시경을 이용한 경위장관 담낭절제술을 최소한의 복강경 도움아래에서 성공적으로 수행하였다. 내시경용 바늘 절개도를 이용하여 배쪽 유문부에서 위절개를 실시하였다. 위절개부를 통하여 내시경을 복강내로 진입한 다음 뒤쪽으로 돌려서 담낭쪽 시야를 확보하였다. 술야의 확보를 위해 복강경용 겸자를 이용하여 담낭의 바닥부위를 부드럽게 들어올렸다. 담낭관과 동맥을 내시경용 endoclip을 이용하여 3중 결찰하였다. 담낭관과 동맥을 절단한 후 내시경용 소작겸자와 바늘 절개도를 이용하여 담낭을 간으로부터 분리하였다. 분리된 담낭은 내시경을 이용해 입을 통하여 제거하고, 위절개부위는 내시경용 endoclip을 이용하여 봉합하였다. 술후 3일째 방사선검사 및 혈청화학검사를 통해 위봉합부위의 천공이 없음과 담즙의 누출이 없음을 확인하였다. 술후 16일째 위내시경과 복강경 검사를 실시하였다. 위내시경검사 결과 봉합부위가 완전히 유합 되었음을 확인하였고 복강경 검사를 통해 담낭절제부위와 위절개부의 장막에 대망막이 유착되어있음을 확인하였다. 본 연구는 개에서 자연개구부 내시경수술(NOTES)을 이용한 담낭절제술의 최초 보고로써 새로운 방법에 의한 담낭절제술에 대한 가능성을 제시한다.

주요어 : 담낭절제술, 경위장관, 개, 자연개구부 내시경수술