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STENTED AUTOLOGUS VEIN GRAFT VERSUS GORE-TEX TUBE GRAFT FOR THE REPAIR OF COMMON BILE DUCT DEFECTS AN EXPERIMENTAL STUDY

By
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This experimental study compared the effectiveness of using a stented autologus vein graft versus Gore-Tex tube graft in the repair of large defects of the common bile duct (CBD) in a canine model. A 3-cm segment of the great saphenous vein and a 2-cm segment of the CBD were removed from ten healthy dogs with normal blood biochemistry levels (Group A). A stent was introduced into the proximal end of the CBD, through the vein segment and into the distal end of the CBD. The venous graft was then sutured to the CBD. A 2-cm segment of the CBD was removed and was replaced with a 2-cm segment of Gore-Tex tube for another ten healthy dogs with normal blood biochemistry levels (Group B). A liver biopsy was taken for histopathological examination during laparotomy and relaparotomy 15 days after graft implantation. Blood samples were obtained for biochemical examinations on postoperative days 5,10 and 15. In Group A, 1 dog died after 5 days with complete disruption in the upper anastomosis and biliary leakage (10%). Complete healing of the anastomosis occurred in 9 dogs (90%). In Group B 3 dogs (30%) died with complete disruption in the upper anastomosis (2 dogs- 20%) and in both anastomoses (1 dog -10%) and biliary leakage. Partial disruption occurred in the upper anastomosis in 3 dogs (30%) and in the lower anastomosis in 2 dogs (20%) with biliary leakage. Complete healing was confirmed in 2 dogs (20%). In the 7 surviving dogs the Gore–Tex graft was surrounded by fibrosis and its lumen was obturated by clots in 2 dogs (20%). No changes in liver biopsies or blood biochemistry were observed in surviving dogs of either group.
We conclude that the use of an autologus vein graft and stent to repair CBD injuries could be a feasible method of treatment and that its use is more effective, safe, economic and practical than Gore-Tex tube graft although it is more difficult and time consuming. We found that the Gore-Tex tube graft is not a god alternative to repair CBD injuries but longer follow up may yield a better outcome.

Keywords: Repair of common bile duct defects - Stented autologus vein graft - Gore-Tex graft

INTRODUCTION

Common bile duct (CBD) injury is one of the most serious complications of open or laparoscopic cholecystectomies. Furthermore, surgery for primary tumors of the CBD and for tumors invading the CBD presents a great challenge in avoiding choledochal injury. CBD injuries can be repaired using various approaches, including primary suturing with T-tube drainage, choledocho - choledochostomy with T- tube drainage, choledocho-duedonostomy, and choledocho-jejunostomy, however, large defects of CBD and cases in which resection of the CBD is needed complicate the treatment. Many artificial and natural tissues have been used as CBD prostheses for reconstruction, usually with little success.[1-6]

In this study, we compared the effectiveness of autologus vein graft and stent application versus Gore-Tex tube graft to repair large defects of the CBD using a canine model.

PATIENTS AND METHODS

This study was carried out in the animal operation room and animal house in Tanta University, faculty of Medicine during the period from March 2001 to January 2003. A total of 20 healthy dogs weighing 8 ± 1 Kg. were used in the study. Blood was taken one day before the operation for biochemical tests. The animals were anaesthetized using 60 mg / Kg Ketamine hydrochloride (i.m.) and 1.2 mg/1 Kg Medazolam (i.m.). The dogs were randomly divided into two equal groups. Dogs that died due to causes irrelevant to the present research were excluded from the study.

Group A included 10 dogs for which a 3-cm segment was removed from the great saphenous vein (Fig.1) and kept in physiological saline. A laparotomy was performed through a midline incision. The CBD was prepared and 2-cm of it was resected. A stent, in the form of an FG 6 feeding tube, was used. One end of this stent was introduced into the proximal end of the CBD, through the vein segment and the other end was introduced into the distal end of the CBD. The venous graft was sutured to the CBD with interrupted 60 prolene sutures (Figs.2, 3).

Group B included 10 dogs for which a laparotomy was performed through a midline incision. A 2-cm segment of the CBD was removed and was replaced with a 2-cm segment of Gore-Tex graft ® (W. L. Gore & Associates, Inc. Flagstaff, Arizona, USA). The graft was sutured to the CBD with interrupted 60 prolene sutures (Figs. 4,5). A liver biopsy was taken for histopathological examination.

The animals were kept on intravenous fluids for two to three days postoperatively. Blood biochemistry was screened by taking blood samples on postoperative days (PODs) 5,10 and 15.

On POD15, a relaparotomy was performed through the previous incision site. The replaced autologus vein graft and stent, including both ends of the anastomosis (Group A) and the Gore-Tex tube and the adjacent parts of the CBD (Group B) were removed and a liver biopsy was taken again for histopathological examination. The biopsy materials taken for histopathological examination during laparotomy and relaparotomy were fixed in 10% formalin prior to routine processing through paraffin- embedded blocks. Sections 4 um thick were cut and stained by Hematoxylin- Eosin and examined under light microscopy.

RESULTS

Group A

One animal died after 5 days. Autopsy revealed complete disruption in the upper anastomosis with biliary leakage in this dog (10%). Relaparotomy on POD15 confirmed complete healing of the anastomosis and absence of biliary leakage in 9 dogs (90%) (Table 1). In surviving dogs no changes in liver biopsies were observed.

Table 2 shows the results of blood biochemistry taken preoperatively and on PODs 5,10 and 15. Histopathological examination revealed the extension of single layer columnar cells into the subepithelial region, beneath which was loose connective tissue and smooth muscle cells. There were no columnar cells at the junction with the vessel, and the intimal and medial layers lay in continuity with the vessel (Fig. 6). No changes in liver biopsies were observed.

Group B

Three animals died after 2- 6 days (30%). Autopsy revealed complete disruption in the upper anastomosis in 2 dogs (20%) and in both anastomoses in 1 dog (10%) with biliary leakage in these three dogs (30%). Relaparotomy on POD 15 revealed partial disruption in the upper anastomosis between the CBD and the graft in 3 dogs (30%), partial disruption in the lower anastomosis between the graft and the CBD in 2 dogs (20%), with biliary leakage in these 5 dogs (50%). Complete healing was confirmed of the anastomosis and absence of biliary leakage in 2 dogs (20%) (Table 1).

In the 7 surviving dogs the Gore–Tex graft was surrounded by variable degrees of fibrosis (Fig.7) and its lumen was obturated by clots in 2 dogs (20%) in which partial disruption occurred in the upper anastomosis. No changes in liver biopsies were observed.

Table 3 shows the results of blood biochemistry taken preoperatively and on PODs 5,10 and 15.

Table (1): ***Summary of the end results of Group A and B dogs*****.**

Event	*Group A*		*Group B*	
	Number of dogs	*%*	*Number of dogs*	*%*
Early postoperative death with:	1 dog	10%	3 dogs	30%
Complete disruption in the upper anastomosis	1 dog	10%	2 dogs	20%
Complete disruption in both anastomoses			1 dog	10%
Partial disruption in the anastomosis			5 dogs	50%
Partial disruption in the upper anastomosis			3 dogs	30%
Partial disruption in the lower anastomosis			2 dogs	20%
Complete healing of the anastomoses	9 dogs	90%	2 dogs	20%

Table (2): ***Liver function tests taken preoperatively and on PODs 5,10 and 15for Group a surviving dogs.***

Mean N=9	*SGOT (U/L) Mean ± SD*	*SGPT (U/L) Mean ± SD*	*Alkaline phosphatase (U/L) Mean ± SD*	*Total bilirubin (mg/dL) Mean ± SD*
Normal value	0-40	40-66	0-88	0.1- 0.6
Preoperative value	32 ±7.6	35.22±15.3	45.32±24.1	0.33 ± 0.15
POD 5	34 ±5.8	37.11 ±17.9	50.22 ±20.3	0.40 ± 0.14
POD 10	32 ±4.8	33.22 ±16.2	48.77 ±23.5	0.26 ± 0.16
POD 15	33±6.3	35.33 ±15.9	48.00 ±19.7	0.32 ± 0.16

SGOT: Serum glutamic oxalacetic transaminase. SGPT: Serum glutamic pyruvic transaminase.
POD: Postoperative day.

Table (3): ***Liver function tests taken preoperatively and on PODs 5,10 and 15for Group B surviving dogs.***

Mean N=7	*SGOT (U/L) Mean ± SD*	*SGPT (U/L) Mean ± SD*	*Alkaline phosphatase (U/L) Mean ± SD*	*Total bilirubin (mg/dL) Mean ± SD*
Normal value	0-40	40-66	0-88	0.1- 0.6
Preoperative value	32 ±7.6	31.85 ±15.8	43.28±25.4	0.30 ± 0.16
POD 5	34 ±5.8	35.00 ±20.6	46.42±19.5	0.40 ± 0.11
POD 10	32 ±4.8	27.05 ±11.7	45.85 ±23.9	0.45 ± 0.11
POD 15	33±6.3	31.14±13.1	43.42 ±19.5	0.52 ± 0.17

SGOT: Serum glutamic oxalacetic transaminase. SGPT: Serum glutamic pyruvic transaminase.
POD: Postoperative day.

Fig. (1): Removal of a 3-cm segment from the great saphenous vein

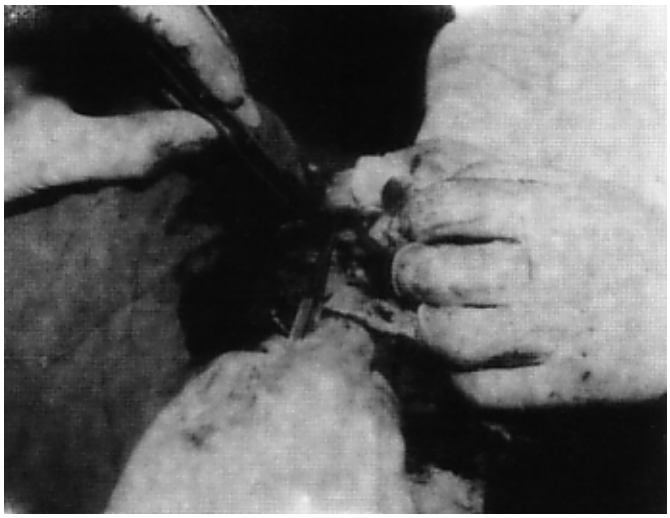

Fig. (2): The venous graft was sutured to the CBD

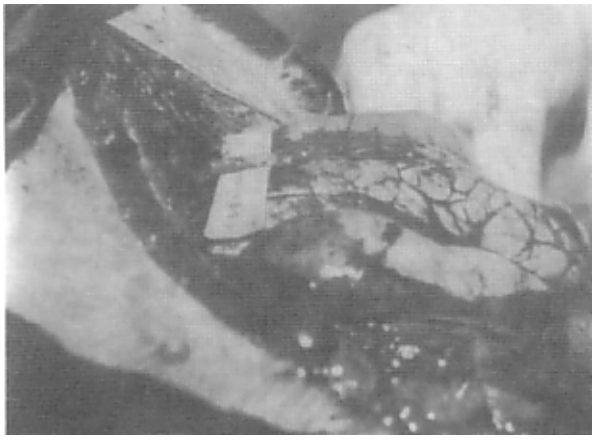

Fig. (3): The anastomosis between the venous graft and the CBD.

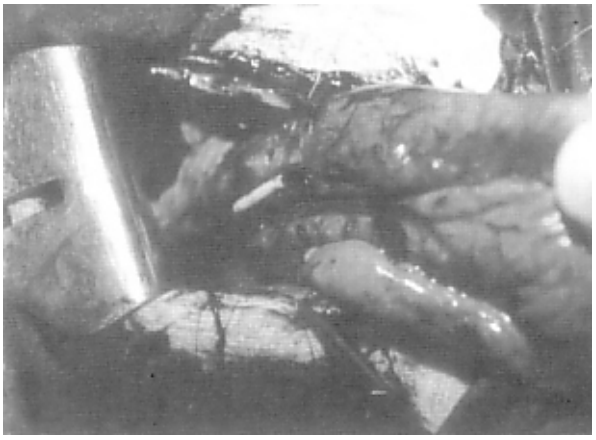

Fig. (4): Forming the lower anastomosis between the Gore-tex graft an the CBD

Fig. (5): The anastomosis between the Gore-Tex graft and the CBD

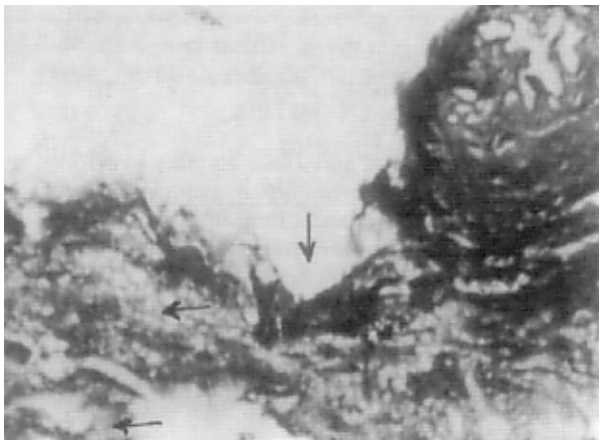

Fig. (6): Arrows point to the junction between CBD and venous wall, intimal layer and medial layers (H&E stain).

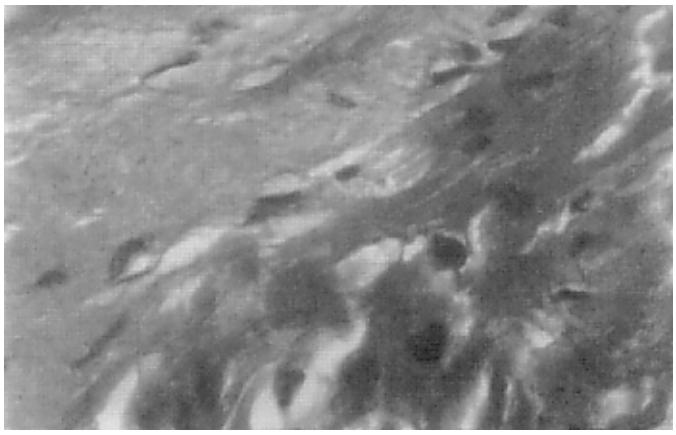

Fig. (7): The Gore–Tex graft was surrounded by fibrosis (H&E stain).

DISCUSSION

. Repair of the CBD after injury presents a great challenge to surgeons. Although a number of diverting operations are currently employed, some alternative treatments have been tried experimentally, such as repairing the defect using pedicled small intestine, an autologus vein graft, the cystic duct, gall bladder and the appendix. [5-9] Synthetic materials such as Dacron have also been tried as CBD prostheses for reconstruction. [10]

In the present study, we compared the effectiveness of autologus vein graft and stent application versus Gore-Tex tube graft to repair large defects of the CBD using a canine model.

A venous graft was prepared, and a stem was passed into the graft so that it would help in forming the anastomosis and prevent cholestasis. The application of a stent facilitated the anastomosis. By using the stent, bile flow through the CBD was achieved without risking anastomotic healing.

Gore-Tex tube repair of the CBD defects, although easier, less time-consuming and not requiring harvesting a graft from a site exterior to the abdominal operative field yielded very poor results in comparison to stented autologus vein graft. The healing between the CBD and Gore-Tex graft was much less than expected. The slow stream of bile in the graft in comparison to the rapid flow and high pressure in the arteries where Gore-Tex is usually grafted sometimes facilitated the formation of intraluminal thrombi from bleeding CBD vessels.

According to some reports in the literature, blood biochemistry changed in the early postoperative period, [5-8] however, in our study the values were normal on PODS 5,10 and 15. This may be attributable to the prevention of cholestasis by the application of the stent in Group A and the bile leak in the abdominal cavity in Group B.

No changes in liver biopsies were observed, in accordance with other studies. [5–7] although cholestasis could be expected in the long term, as often seen following the insertion of biliary drainage catheters, it was not observed during the early follow up period in this study.

CONCLUSION

We conclude that the use of an autologus vein graft and stent to repair CBD injuries could be a feasible method of treatment and that its use is more effective, safe, economic and practical than Gore-Tex tube graft although it is more difficult and time consuming. We found that the Gore-Tex tube graft is not a good alternative to repair CBD injuries but longer follow up may yield a better outcome.

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