THE SURGERY OF INFANTILE OBSTRUCTIVE JAUNDICE*

BY

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Various diseases are responsible for infantile obstructive jaundice. But congenital biliary atresia is considered one of the most interesting diseases from the point of view of surgical treatment. There are many unsolved problems in its embryology, diagnosis, and therapy.

We collected 169 cases of infantile obstructive jaundice from clinics and hospitals in the area as well as from our own hospital. In 39 of them (23%), extrahepatic ducts were clearly visualized. In the remaining 130 (77%), no extrahepatic ducts were found.

For the cases in which extrahepatic ducts were visualized, the following operations were performed: choledocoduodenostomy, choledocojejunostomy, cholecystoduodeno- or jejunostomy, hepaticogastro-, duodeno-, or -jejunostomy, external fistula of hepatic ducts. The results were not good, however, because of complications such as infection, pulmonary complication, or liver failure. The post-operative mortality rate was 62%. There are few surviving cases.

On the other hand, for the cases in which no extrahepatic ducts were found, probe laparotomies were performed in the majority, and also anastomosis between porta hepatis and duodenum or jejunum, anastomosis between liver and stomach, duodenum or jejunum, external biliary fistula by partial hepatectomy, Sterling external fistula and Sterling internal fistula etc. were tried. The majority of the cases died after operation. The results of surgical treatment for this disease are unsatisfactory at present, not only in our country but in paediatric hospitals in other countries too.

Relation between Hepatic Biliary Duct System and Lymphatic System

In searching for a solution to this difficult problem, we have, since 1962, studied the relation between the

hepatic biliary duct system and the lymphatic system from a slightly different view-point. Johnson and Mann (1950) proved histologically the existence of a close relation between the intrahepatic biliary duct and the lymphatic duct. Bollman (1950) also stated that the lymphatic system took bile that was diffused from the biliary duct. Azuma (1963) pointed out the close relationship of the two systems in his experimental study on 'Excretion and absorption of ascites in ascitic dog'. He stated that the measured pressures of the intrahepatic lymphatic duct and the biliary duct were nearly identical in the same dog. Nishimaru and Yata (1956) also reported the existence of close communication between the two duct systems. Dumont and Mulholland (1962) stated that the excess bilirubin in blood regurgitated into the thoracic duct through the intrahepatic lymphatic system. Alican and Hardy (1962) created experimentally an obstruction in the common bile-duct of a dog and studied the bilirubin level of the thoracic duct lymph and of serum: they came to the conclusion that an intrahepatic lymphatic system was an important exit for bile regurgitation. According to the results of our own experiments on an icteric dog (Table 1) following a ligation of the common bile-duct, the bilirubin levels of the thoracic duct lymph and of the serum were much higher than normal. Also, when the thoracic duct lymph was conducted outside the body, the raised serum bilirubin level tended to fall (Fig. 1).

Operative Method

From the results of our experiments, we thought some way of conducting the thoracic duct lymph into the upper alimentary tract might be applicable to the cases in which so-called probe laparotomies only were usually performed. The operative method is as follows. An incision is made along the anterior border of the sternocleidomastoid muscle. The latter is divided near the sternal and the clavicular insertion. The clavicle is then divided close to the sternoclavicular joint. The next step is to recognize the thoracic duct. We think that the thoracic duct itself

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TABLE 1
BILIRUBIN LEVELS OF SERUM AND LYMPH IN DOGS AFTER LIGATION OF COMMON BILE-DUCT

Dog No.	Weight (kg.)	Serum and Lymph	Time Interval After Ligation (days)	Bilirubin (mg./100 ml.)	Flow Rate (ml./min.)
1	12.0	S	15	1.6	0.5
		L	15	2.0	
2	13.0	S	14	2.8	0.7
		L	14	1.08	
3	1.0	S	8	2.58	0.3
		L	8	1.15	
4	12.0	S	6	5.5	0.25
		L	6	2.7	
5	11.5	S	6	2.2	0.28
		L	6	1.68	
6	9.5	S	5	4.4	0.28
		L	5	3.6	
7	8.0	S	5	5.0	
		L	5	7.6	
8	11.0	S	5	10.3	
		L	5	3.7	
Normal Control		S		0.2	
		L		0.2	

cannot be anastomosed directly to the alimentary tract owing to its smallness and the friability of the duct. Both the subclavian vein which is distal, and the brachiocephalic vein which is proximal to the venous angle where the thoracic duct joins, are ligated. The internal jugular vein is dissected and divided near the distal end so that it can be used for anastomoses. Therefore, only the thoracic duct lymph flows into the venous angle. In performing this procedure the following points should be noted: in cases where the cirrhosis has progressed to a certain degree, the lymphatic system around the venous angle is abnormally distended. One should avoid injuring the lymphatic system. Secondly, when the brachiocephalic vein is ligated, the dissection should be carried out carefully in order not to injure the thin pleura. Thirdly, there are tributary veins near the thoracic duct, which flow into the brachiocephalic vein. It is important to ligate these tributary veins so that only the thoracic duct lymph flows into the venous angle.

The first method we tried in 1962 was to conduct the thoracic duct lymph to the oesophagus, utilizing the venous angle and the internal jugular vein. In the majority of patients where this method was applied, it was past the optimum operative time and their general condition was unfavourable: 2 out of 3 had an anastomotic insufficiency and the other had pneumothorax and a

complication that was probably due to anaesthesia. There were no long-term survivors. The survival periods were short and no fall in the bilirubin level was seen. MacKneally, Carey, Rogers, and Absolon (1963) also reported anastomotic insufficiency, thrombosis at the anastomotic site, and inflammatory stenosis as the complications.

We next tried experimentally and clinically the following method. First, the external fistula of the thoracic duct was created and then the fistula was anastomosed to the oesophagus using polyethylene tubing or natural rubber tubing.

Since 1962 we have used a method by which the thoracic duct lymph is conducted to the subglossal portion of the oral cavity, utilizing the venous angle and the internal jugular vein (Suruga-Yamazaki procedure) (Figs. 2 and 3). The details of the operative procedure are almost the same as in our original operation, but in order to utilize a long internal jugular vein, it was dissected well above the facial vein and divided (Fig. 3). However, if the internal jugular vein is divided too distally, the diameter of the stump may be too small for the subglossal opening. Before the anastomosis is made, the internal jugular vein is sutured to the adjacent tissue utilizing the previous tributary veins and thus the anastomosis is performed without tension. Usually, it is done by 6 to 8 simple sutures. The fewer the sutures used for anastomosis, the better the lymph flow to be expected. In this method, though there is no real danger of anastomotic insufficiency, prevention of post-operative infection becomes important. Even slight infection of the operative wound affects lymph flow. Therefore we finished the neck portion first and then operated in the mouth. After operation, we use a drain in order to avoid accumulation of lymph or blood.

Results

Operations were carried out on 14 patients (Table 2). In 4, anastomosis between the thoracic duct and the oesophagus was performed: 3 in one stage, and 1

FIG. 1.—Serum bilirubin levels after diversion of thoracic lymph flow in dogs by ligation of common bile-duct.

FIG. 2.—Suruga-Yamazaki procedure 1.

TABLE 2
DIVERSION OF THORACIC LYMPH FLOW FOR
TREATMENT OF CONGENITAL BILIARY ATRESIA

Method	No.
1: Oesophago-thoracic duct anastomosis	3
2: Oesophago-thoracic duct anastomosis (two-stage procedure)	1
3: Suruga-Yamazaki method	10
Total	14

in two stages. In the remaining 10 cases the thoracic duct lymph was conducted to the subglossal areas using the internal jugular vein (Suruga-Yamazaki's

FIG. 3.—Suruga-Yamazaki procedure 2.

method). The results of 4 thoracic duct oesophagus anastomoses have already been mentioned. The results of a further 10 cases in which Suruga-Yamazaki's method was used are as follows: one was 2 months old, 5 were between 2 and 3 months, and 4 were older than 4 months when the operation was performed. 8 cases were followed up after operation for a limited period and a fall in serum bilirubin level was seen in all. The direct bilirubin level was particularly lowered (Table 3). Kolmen (1961) experimentally revealed that a fall in the serum protein occurred when the thoracic duct lymph was led outside the body. In our cases, no fall in serum protein value was found.

Post-operative complications included 3 wound

TABLE 3
DIVERSION OF THORACIC LYMPH FLOW (SURUGA-YAMAZAKI METHOD)

Case No.	Age (mth.)	Serum Protein (g./100 ml.)	Bilirubin (mg./100 ml.)			Result
			Direct	Indirect	Total	
1	Op. → 2	6.7	1.73	0.5	2.23	Alive
	3	6.5	0.8	0.03	0.84	
	10		0.6	1.7	2.3	
	10		0.8	0.4	1.2	
2	Op. → 3	6.4	10.5	1.0	11.5	Dead
	4	5.4	10.0	2.0	12.0	
	5	5.0	9.5	0.9	10.4	
	6		3.6	1.0	4.6	
3	Op. → 2	6.8	3.6	0.21	3.81	Alive
	3	7.1	6.7	0.4	7.1	
	4	8.1	5.5	1.5	7.0	
	5	6.0	1.66	0.47	2.13	
4	Op. → 2	6.0	6.5	0.6	7.1	Alive
	3	5.4	6.6	0.5	7.1	
	4		4.2	0.3	4.5	
	5	7.0	2.5	0.82	3.32	
5	Op. → 2	6.6	5.35	7.63	13.0	Dead
	3	7.5	2.54	1.76	4.3	
	4	6.7	3.1	2.4	5.5	
	5	6.9	9.4	5.1	14.5	
6	Op. → 9		4.7	4.3	9.0	Dead
	2	7.1	11.1	0.4	11.5	
	3	5.9	12.7	3.8	16.5	
	4	7.3	11.1	2.4	12.5	
7	Op. → 3	6.0	7.0	1.6	8.6	Alive
	4	6.6	4.4	1.1	5.6	

infections, and one air-way obstruction due to an excessive amount of thoracic duct lymph flowing into the oral cavity. In this case the operation was performed at a late stage, and cirrhosis was advanced. One pulmonary complication was seen. It is important to avoid infection of the operative wound when this method is performed. Also in order to avoid an excessive amount of lymph flowing into the oral cavity, the patient should be in a prone position in the immediate post-operative period. In 2 out of the 5 cases that died, liver cirrhosis was identified macroscopically at operation and serum bilirubin level fell, but death was finally caused by hepatic coma. One was operated on at 4 months and the other at 9 months. Other causes of death were as follows: one died within 24 hours due to air-way obstruction, one died from pulmonary complications and one from complications unrelated to operation.

Post-operative liver function tests and histological findings were studied. The post-operative liver function is gauged by serum cholinesterase levels, which can be measured with 0.05 ml. serum, correlated with B.S.P. test. The serum cholinesterase was raised in all. In general, a raised level of serum cholinesterase did not fall in cases older than 2 months.

Histologically, the biopsy from the right liver lobe was studied for cell infiltration, cell necrosis, fibrosis, giant cell transformation, hepatic duct hyperplasia, and bile stagnation.

Histological findings varied in individual cases. Prognosis seemed unfavourable in 4 cases in which marked fibrosis, cell necrosis, and hyperplasia of the hepatic duct were seen. This finding corroborates the results of previous liver function tests. On the other hand, in cases less than 2 months old, although marked bile congestion may be seen, other pathologic

findings tend to be slight and the prognosis is consequently better.

In congenital biliary duct atresia, according to our results, if the optimum operative time is missed, prognosis is unfavourable even if the thoracic duct lymph is led into the alimentary tract. MacKneally *et al.* (1963) produced experimentally in this way a decrease in ascites in a case with advanced cirrhosis. In one of our congenital biliary duct atresia cases, we produced the same decrease in ascites after this procedure.

Conclusion

The results of Suruga-Yamazaki's procedure in congenital biliary duct atresia are reported. We have not found post-operative anorexia, diarrhoea, or oedema due to circulatory disturbance in the upper extremity after this operation.

The operation is technically difficult. Post-operative fat, protein, and electrolyte metabolism is a problem. In order to obtain better results this disease should be differentiated at an early period.

A long-term follow-up and continued study of this problem is required.

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