Lymphatic Network of the Common Bile Duct

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Abstract

The fine lymphatic network of the hepatic pedicle and of the common bile duct, as proved by immunohistochemical techniques, plays an important role in many clinical syndromes. Common bile duct is supported by absorbing and collector lymphatics inducing a possible regulation of the flowing fluid besides that purely mechanical of conduction. The absence of valves in lymphatics allows an inversion of direction of lymph flow towards the liver, especially when the main abdominal lymphatic trunks are involved by cancer disease.

Introduction

The anatomy of the common bile duct, arising from the junction of cystic and hepatic ducts (Illustration 1) has been carefully elucidated in its arterial and venous components (1-6). However, its lymphatic component has been concerned mainly with the location of the lymphnodes and the main lymphatic channels but not with the thinner lymphatic vessels or their interconnections. This has been the purpose of our research with special regard to the knowledge of lymphatic supply according to the classification suggested by Azzali in absorbing and collectors lymphatic vessels (7).

Methods

Our research was devoted to the study of the lymphatic structures of the hepatic pedicle and common bile duct. In order to differentiate the small lymphatic vessels, belonging to Apparatus Lymphaticus Periphericus Absorbens (ALPA, Azzali 2003), from other similar venous or arterial structures, our findings were supported by immunohistochemistry, due to the lack of specific histological markers for differentiate vascular endothelial cells from endothelial lymphatic cells. For this, we could not use autopic material, often inadequate to the immunohistochemical techniques, but six large specimens of duodeno-cephalo-pancreatic resection performed for pancreatic head cancer and paraffin-embedded. Hepatic pedicle and common bile duct were dissected and fixed in neutral 4% formalin for more than 24 hours. Serial sections were made at four different levels: intrapancreatic and sovrapancreatic tracts of the choledochus, confluence with the cystic duct, common hepatic duct. At first, the histological sections, 3 ?m thick, were stained with haematoxylin-eosin. The subsequent immunohistochemical study was performed following the ABC (avidin-biotin complex) method, and using the murine monoclonal antibody D2-40 (podoplanin), directed towards a sialoglycoprotein O-linked of 40 kDa weight, which is present in the lymphatic endothelium and absent in the vascular endothelial cells (8-9). A parallel study was carried out by using both the same monoclonal antibody D2-40 (Dako) and the murine polyclonal antibody CD31 (Ventana), reactive towards lymphatic and vascular endothelium, with two different chromogens: DAB (3-3 diaminobenzidine tetrahydrochloride) and new fuchsin, respectively. Moreover, a third antibody CIV22 (Ventana) was employed. It is specific for collagen IV, which is a main component of the basal membrane. So we were able to differentiate collector lymphatics supplied by basal membrane from absorbing lymphatics often lacking in basal membrane.

Results

The common bile duct, running down from the hepatic pedicle is provided with a complex of arterial and venous structures together with lymphatic vessels identifiable as:

- absorbing: immunoreactive for D2-40 and negative for CIV22 and CD31 (performed after D2-40);
- collector: immunoreactive for D2-40 and CIV22 and negative for CD31 (performed after D2-40).

Absorbing lymphatic vessels flowing into collectors are present in both sovrapancreatic and intrapancreatic common bile duct (Illustrations 2-5). The former devoted to the absorption of extracellular fluid are located in the inner submucosal layer of the choledocal wall, the latter concerned with a function of lymph conduction are mainly located in the outer subserosal layer. The absorbing lymphatics run from the choledocal lumen towards outside mainly obliquely or perpendicularly assuming a radial shape. The collector lymphatics run parallel to the choledocal lumen in a cranio-caudal direction with a flange-like shape. Their size increases up to maximum in the pericholedocal adipose tissue (Illustrations 6-8).
A parallel well developed system of venous and arterial vessels of small calibre was seen in the hepatic pedicle all around the common bile duct. We have not observed a distinct true connective sheath around the hepatic pedicle, but only a serous membrane, corresponding to the peritoneal covering.

Discussion

In both hepatic pedicle and common bile duct there is a well developed system of lymphatic channels, interconnected with lymph nodes, whose anatomic description is well known (10-11); their large calibre correlates with the abundant amount of lymph produced by the liver. Usually the direction of the lymphatic flow is from the liver towards other abdominal lymphatic stations. Nevertheless, considering the absence of valves in all lymphatic channels, an inversion of direction can be easily admitted, i.e. from the abdominal organs such as pancreas and lymph nodes towards the liver, especially when the main abdominal lymphatic trunks or stations are involved by cancer disease (12-14). The rich lymphatic network, present inside the choledocal wall and around it, is suggestive to admit that the choledochus can play also an active part in the regulation of the flowing fluid besides that purely mechanical of conduction.

Conclusion

Our morphological observations have some clear clinical correlations. At first, we have observed the great development of the lymphatic network in the hepatic pedicle. This finding well agrees with the importance of both lymph and lymphatics in the liver physiology. The absence of valves in the lymphatic main channels of the hepatic pedicle explains the possible double and reversible direction of its flow from and towards the liver, and their secondary involvement from tumours located more distally with a centripetal diffusion. The common embryological origin of both lymphatic and venous structures in the hepatic pedicle explains their definitive neighbourhood, around the common bile duct, and always inside the same peritoneal envelope. The common bile duct has different ways of connection with lymphatic structures, always inside the hepatic pedicle: its submucosal layer and just outside its wall the pre-lymphonodal channels and the lymphatic follicles, the main lymphatic nodes, and finally the post-synusoidal collectors. It is clear that a primary pathology of the lymphatic system can secondarily involve this important biliary structure, with the first consequence of narrowing its lumen by mechanical compression. Besides, in the oncological field, a mechanism of secondary infiltrating lymphangitis can be considered largely possible (15). Similarly, the strict anatomical neighbourhood, all inside the hepatic pedicle, between the venous structures, which belong to the portal system, and the common bile duct, explain the origin of the “porto-biliary” syndrome, which can be easily reported to a compression on the common bile duct by adjacent veins, dilated by the portal hypertension (16-18). The same mechanical factor can be invoked for the absolutely rare syndrome of biliary compression by dilated lymphatic channels, observed after liver transplantation (19). Our histological observations permit two other conclusions. Firstly, in the hepatic pedicle, a fibrous sheath, equivalent to that described for the rectum (20), which could represent a possible surgical landmark, cannot be demonstrated. Secondly, besides the extracellular matrix containing important venous, arterial, nervous and biliary structures, the lymphatic network appears to play an important role for the diffusion of inflammatory or neoplastic diseases at hepatic pedicle level, with possible fibrotic narrowing of the common bile duct (21).

References

Illustrations

Illustration 1

Tract of hepatic pedicle. Coronal section of cystic (CD) and hepatic (HD) ducts. (haematoxylin-eosin, image obtained by direct scanning of the slide).

Illustration 2

Sovrapancreatic common bile duct. The wall is rich in both vascular and lymphatic vessels (haematoxylin-eosin, original magnification x10).
Illustration 3

Detail of fig. 2. The vascular endothelia are red stained by the sequence CD31-new fuchsin, whereas the lymphatic endothelia are brown stained by the sequence D240-DAB. The lymphatic vessels are lacking in red blood cells. AL = absorbing lymphatics (original magnification x40).

Illustration 4

Intrapancreatic common bile duct provided with many intramural vascular spaces. Pancreatic tissue is evident at the left top corner (haematoxylin-eosin, original magnification x10).
Illustration 5

Detail of fig. 4. Vascular endothelia and lymphatic endothelia are red and brown stained, respectively. AL = absorbing lymphatics (original magnification x40).

Illustration 6

Intrapancreatic pericholedocal adipose tissue. Neoplastic obstruction of a main collector lymphatic vessel is present (haematoxylin-eosin, original magnification x4).
Illustration 7

Section near adjacent to fig. 6. The endothelial lining is D2-40 immunoreactive (original magnification x4).

Illustration 8

Intrapancreatic percholedocal adipose tissue. Collector lymphatic vessels are seen irregularly dilated and narrowed close to the neoplastic area (original magnification x40).
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