Lymphographic and Venographic Observations after Iliofemoral Venous Obstruction in the Dog

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Iliofemoral ligation, isolation or excision does not cause edema in the hind legs of the dog (4–6). However, lymphatic obstruction secondary to venous thrombosis caused massive edema of the limb (5) and edema also resulting from thrombosis caused by the injection of barium sulphate (1). This study is concerned with the question of whether iliofemoral thrombosis leads to secondary lymphatic obstruction and with the relationship between the extent and level of thrombosis and lymphatic obstruction.

Material and Methods

Nine mongrel dogs, weighing 15–20 kg, were divided into three groups of three dogs each (Fig. 1). In the first group, iliofemoral thrombosis was produced by ligation of all inguinal branches of the deep femoral veins. In the second group, the same procedure was carried out on both iliac venous systems. In the third group, both iliac venous systems, the caval bifurcation and both of the large lumbar veins were ligated.

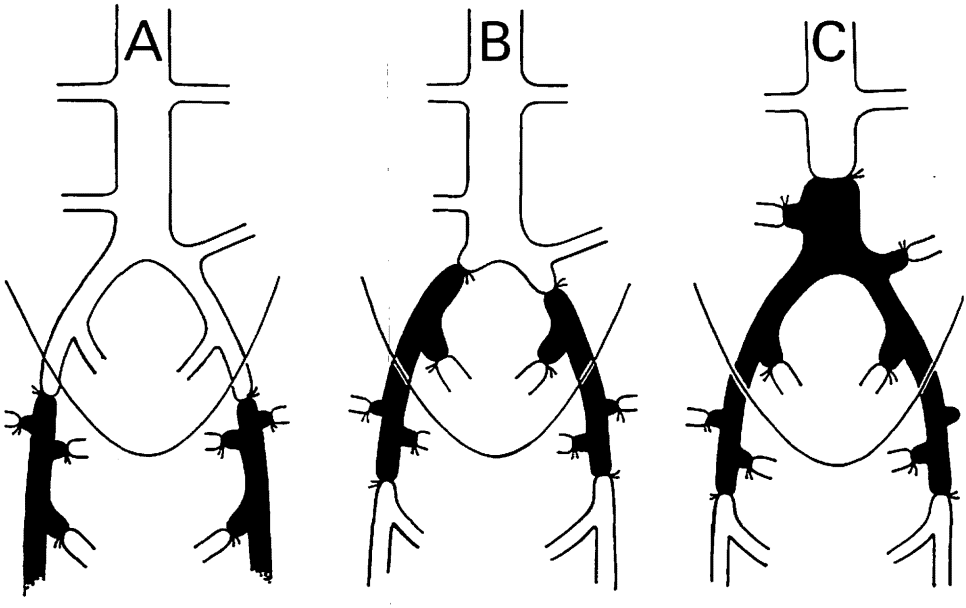

Fig. 1 Extent and location of different types of thrombosis.

Surgical technique: The dogs were anesthetized with intravenous Pentothal®. Inguinal dissection was carried out through an incision parallel to the femoral vessels while the iliac veins and caval bifurcation were dissected through a midline incision under surgical asepsis. In all dissections, tissue trauma was avoided as much as possible.

To produce a thrombus, 4–6 cc of homologous serum and 0.5 cc of 10% Epsilon-Aminocapronsäure® was injected into the ligated venous system. Immediate thrombus formation was observed in all experiments and confirmed by operation two weeks later.

Fourteen days after iliofemoral thrombosis had been induced, lymphography and venography of both hind extremities were carried out.

Lymphographic technique: A popliteal node was subjected to direct intranodal lymphography as described by *Bruun* and *Engeset* (2). The injection was given with a 10 cc syringe through a No. 20 hypodermic needle applying 0.5 kg on the plunger of the syringe according to the method of *Wiljasalo* (7). Lipiodol Ultra Fluid® was used as a contrast medium. Pictures were taken every third minute over a period of 40 minutes with an AOT film changer and single technique. By this method the thoracic duct as a rule could be exposed for depicition within 25–40 minutes. Pictures were also taken the next day.

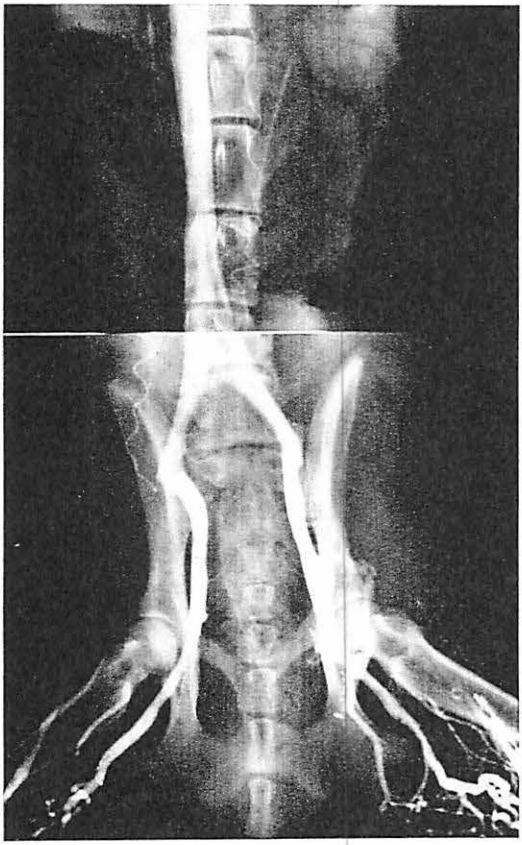

Fig. 2 In group A, proximal extension of secondary thrombosis occluded the entire external iliac vein as far as the internal iliac vein, which remained patent and served as a sizeable collateral pathway.

Venographic technique: Both popliteal veins were surgically exposed and manually injected with Angiografin®, a water-soluble contrast medium. Pictures were taken with an AOT film changer at a speed of three pictures per second.

Results

Good thrombus formation in the ligated vein was observed in all instances. In addition, distal and/or proximal extension of a secondary thrombus was always present. Edema did not develop after iliofemoral thrombosis and ligation in any of the dogs during an observation period of four months.

Venographic observations: An extensive collateral network rapidly developed in all three groups (Fig. 2–4).

In group A, proximal extension of secondary thrombosis occluded the entire external iliac vein as far as the internal iliac vein, which remained patent and served as a sizable collateral pathway (Fig. 2). In group B, a much more extensive and complicated network was formed with the main collateral channels through the large lumbar veins and the spermatic or ovarian veins (Fig. 3). In group C, the ascending lumbar veins were the main collaterals, supplied chiefly by the internal iliac veins. In addition, the spermatic-ovarian and the thoraco-epigastric veins showed considerable dilatation (Fig. 4).

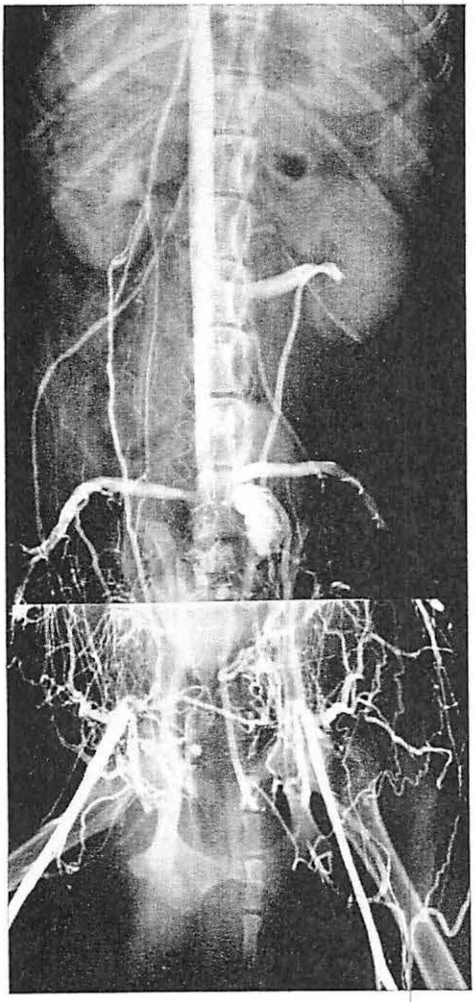

Fig. 3

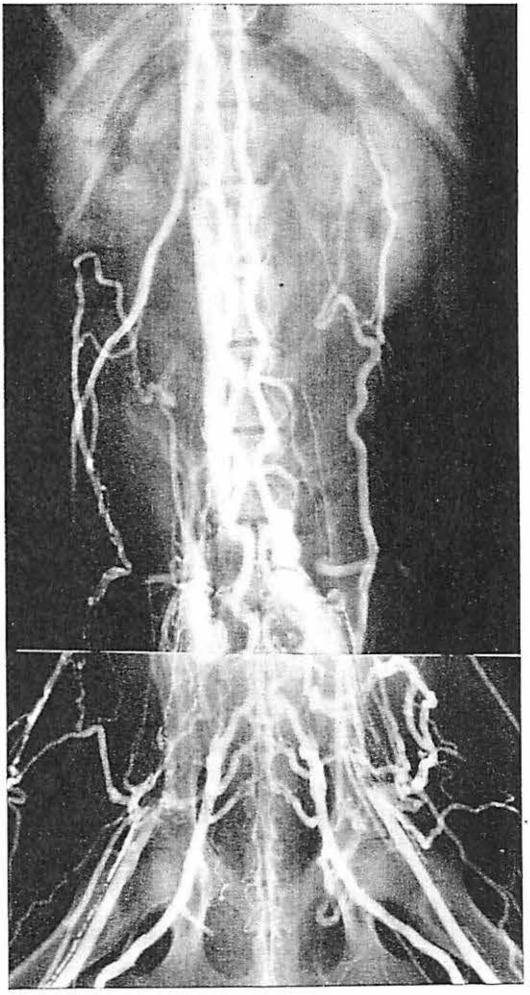

Fig. 4

Fig. 3 In group B, a much more extensive and complicated network was formed with the main collateral channels through the large lumbar veins and the spermatic or ovarian veins.

Fig. 4 In group C, the ascending lumbar veins were the main collaterals, supplied chiefly by the internal iliac veins.

Fig. 5 Lymphography in all cases revealed no signs of delayed emptying, collateral vessels or retrograde flow and dermal back flow.

Lymphographic findings: Bilateral lymphography one nine dogs revealed no signs of delayed emptying, collateral vessels or retrograde flow and dermal backflow (Fig. 5) (3). In three cases, lymph cysts and local lymph vessel breaks were observed (Fig. 6). In all these cases the lesions developed precisely in the operation area and seemed to be caused by surgical trauma. It should be noted that these lesions were slighter than those resulting from irradiation (8).

Comments

Regardless of the extent of the bilateral venous ligation and thrombosis, edema and secondary lymphatic obstruction of the hind extremities did not develop in our experimental series. Collateral venous channels promptly developed and rapidly seemed to become adequate for the prevention of venous stasis. When venous ligation and thrombosis were carried further cephalad, occluding important collaterals such as the large lumbar veins, other venous networks were immediatly able to take over the function of the latter. Except in three cases, in all types of iliofemorally induced venous thrombosis lymphangiography showed absence of delayed emptying, collateral vessels or retrograde flow and dermal back flow. In three cases in question, occlusion of the lymphatics or extravasation was due to direct surgical trauma to the lymph channels during the initial vein dissection. The lesions were not caused by the inflammatory process associated with the Haller thrombus, as supposed by (5).

The close anatomic or topical relationship between veins and lymphatics was clearly demonstrated in our study, as was also the vulnerability of the lymphatics during any kind of iliofemoral vein dissection.

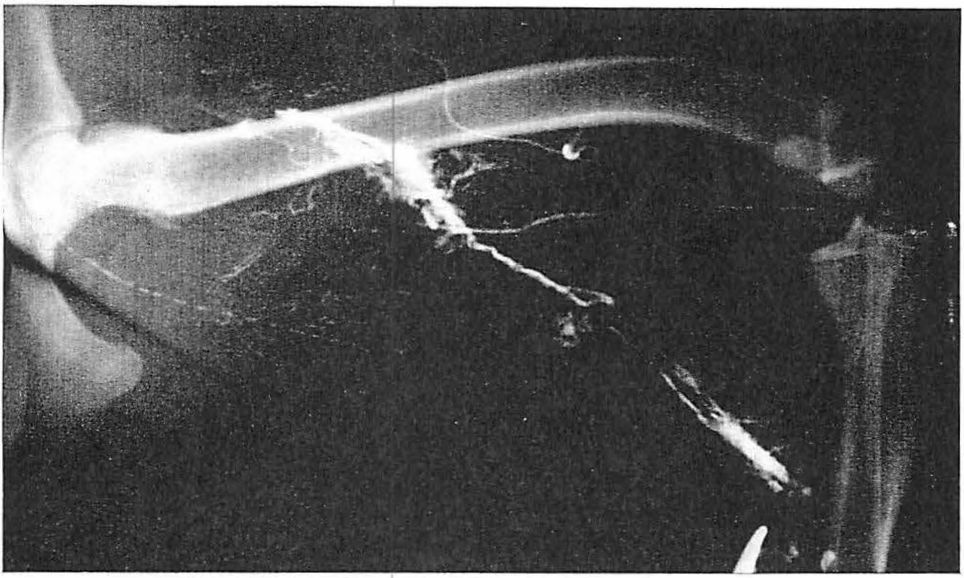

Fig. 6 In three cases, edema developed precisely in the operative area and seemed to be due solely to surgical trauma.

Summary

The purpose of this investigation was to study the occurence of secondary lymphatic obstruction in connection with iliofemoral venous thrombosis.

Iliofemoral thrombosis was produced in nine mongrel dogs at three different levels. In the first group, bilateral femoral thrombosis developed after ligation of all inguinal branches of the deep femoral veins. In the second group, both iliac veins were thrombosed. In the third group, bilateral iliac and caval bifurcation thrombosis developed. The formation of a thrombus was confirmed immediately and 14 days later when lymphographic and venographic studies of both hind extremities were also made. Good thrombus formation was observed in all instances. Regardless of the extent of the bilateral thrombosis, edema did not occur and lymphography revealed no signs of delayed emptying, collateral vessels or retrograde flow and dermal backflow. In three cases, lymph cysts and local lymph vessel breaks observed precisely in the operative area seemed to be due to surgical trauma. Secondary lymphatic obstruction was not observed in any of the dogs.

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