HEPATIC PHLEBOGRAPHY IN LIVER AILMENTS*

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Rappaport[1] was the first, in 1951, to suggest catheterization and angiography of suprahepatic veins under block for radiological exploration of the liver in dogs. There is no record, however, that this method has ever been extended to the human clinical field. There are two reasons, in point of fact, which on first sight would appear to rule out the use of this method in human pathology: a haemodynamic reason, based upon the fact that obstructing the suprahepatic veins would of necessity entail the stasis of such individual hepatic districts as are dependent on them; and an interpretive reason, grounded on the consideration that the angiographic pictures so obtained might give an incorrect account of the circulatory situation. As the results that were obtained from angiographic investigations of suprahepatic veins when plain catheterization was employed,[2-5] in addition to being unsatisfactory, did not exclude the recourse to counter-flow injection, it was decided to attempt suprahepatic vein catheterization and angiography under block in the clinical field.

The favourable results obtained over the last 15 years with over 500 liver patients in the Milan University's General Surgery Clinic have conclusively proved the merits of this method while enabling us to determine its indications (Table I). The interpretation of angiographic

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TABLE I. DETAILS OF PERSONAL CASE REPORTS

Diagnosis	*Clinical cases*	*Surgical checks*	*Biopsies of the liver*	*Post-mortem examination*	*Post-mortem liver injection*
Normal	52	25	5	—	10
Primary and metastatic malignancies	123	53	53	3	—
Parasitic cysts	42	38	10	—	—
Cirrhosis	195	129	95	15	35
Biliary cirrhosis	5	4	4	1	—
Biliary stagnation	94	72	35	20	32
Degenerative liver ailments	65	20	18	—	—
Portal thrombosis	28	22	20	—	—
Hepatic stagnation	7	1	—	1	1
Others	4	1	—	—	—
Totals	615	365	240	40	79

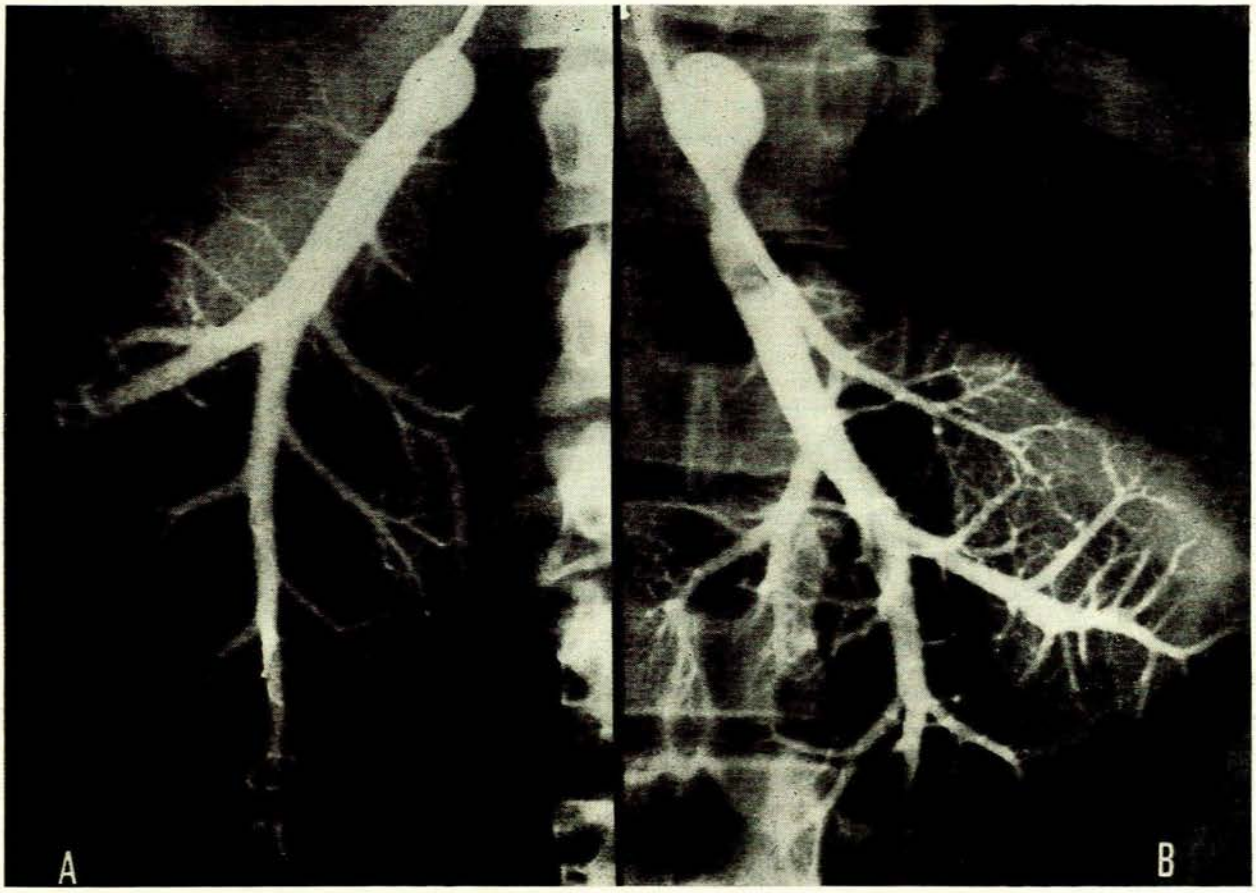

Fig. 1. A: Angiogram of right hepatic vein under block, showing modal arrangement of hepatic veins. B: Angiogram of the left hepatic vein system. The catheter has just entered the paramedian vein's inlet, the block being effected at the height of the outlet of the left suprahepatic vein proper. Note contrast medium progressing into the left paramedian vein system.

pictures was based not on a mere comparison between normal findings and those which are associated with the various liver ailments considered, but also on a comparison with surgical, biopsy and postmortem findings which were occasionally supplemented by injections of contrast media or PVC into the venous system.

METHODS

The test is easily performed and requires no anaesthesia. A catheter is introduced into a vein in the arm and guided under fluoroscopic control to the inlet of the suprahepatic vein selected. We use either a USCI, No. 8.1/2, Dotter-Lukas or a No. 10 Rush twin-lumen catheter and a balloon. Once the balloon has been inflated and the vessel obstructed, 15 - 20 ml. of a 50% water-soluble iodate contrast medium are injected, whereupon two radiographs can be obtained in sequence, i.e. an initial one, taken when only a comparatively small amount of contrast medium has been introduced, providing visualization of the larger suprahepatic veins down to division branches of the 2nd and 3rd orders (Fig. 1A), and a subsequent radiograph, taken when the contrast medium has worked its way to the finest venous ramifications, providing a parenchymatographic picture of the area (Fig. 1B). The tests were consistently well tolerated by our patients, and no ill-effects worth reporting were ever noticed.

RESULTS

Normal Angiographic Patterns

Some mention should be made of such normal pictures of suprahepatic vein patterns as were obtained by this method which, since every suprahepatic vein is individually catheterized, can offer a selective outline of both the right and left systems. As blocks can be effected at various levels, obstruction of the outlet of some of the larger suprahepatic veins (e.g. of the median vein when the left suprahepatic vein is catheterized) may ensue. The pattern of suprahepatic veins *in vivo* is a faithful reflection of the well-known anatomical description of the district as well as the modal arrangement we were able to observe in postmortem liver examinations, even though in about 10% of our cases we found these veins to have abnormal outlets, this being particularly true of right hepatic veins, which may occasionally feature one or more separate outlets into the vena cava inferior.

Pathological Angiographic Patterns

When talking about phlebographic findings associated with suprahepatic vein pathology, we feel that some distinction should be made between those concerning the larger suprahepatic veins and those relating to the finer vein ramifications.

Among the former, those in which all suprahepatic veins appear dilated are particularly significant, as can be seen in the liver where stagnation had been the result of impaired venous return.

Whenever such an obstruction occurs either at the level of a suprahepatic outlet into the cava or inside the cava itself, then catheterization of these venous vessels will be impossible, and their lumina will appear to have remained impervious to the contrast medium—a condition which we found associated with Budd-Chiari's syndrome, malignant obstructions, and extrinsic compressions caused by benign or malignant outgrowths (Fig. 2).

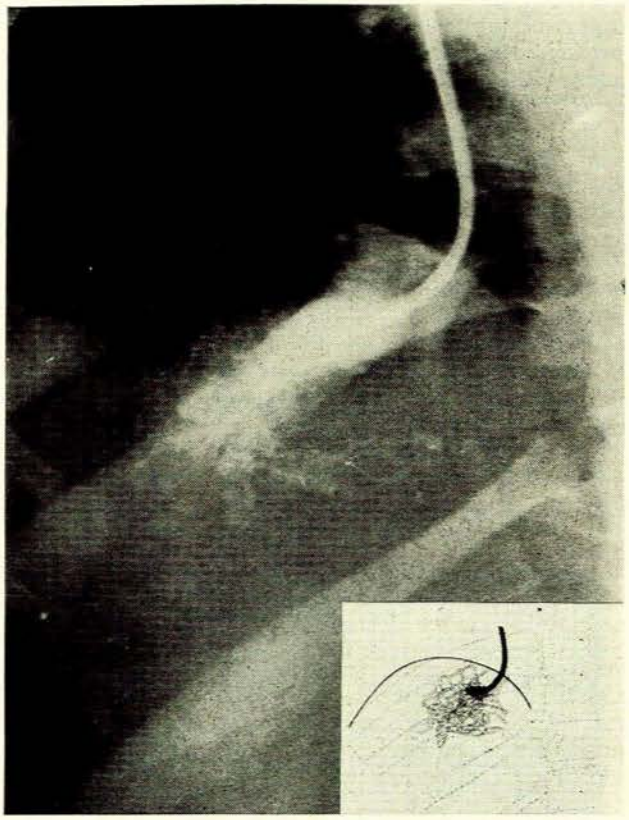

Fig. 2. Right hepatic vein catheterization. The catheter is being detained and the contrast medium diffusion follows an uneven pattern. Right hepatic vein thrombosis. Budd-Chiari's syndrome.

In most cases, phlebographic images provide clues to the pathological conditions by which pattern alterations are determined. An obstructed or irregular vasal outline or an obliterated lumen, for instance, is often the tell-tale mark of a malignancy, while an echinococcal cyst, an amoebic abscess or a similar outgrowth is frequently betrayed by a thinned-down lumen and/or a drastic displacement of the vein (Fig. 3).

Collateral circulatory patterns should be considered whenever phlebographic evidence is evaluated for diagnostic purposes. In point of fact, since any obstruction or compression invariably results in the venous reflux being impaired or prevented, the restriction is bound to be compensated by some collateral circulatory system, whether pre-existing or newly-established, to cope with the situation, the pattern and load being determined both by the manner in which the obstruction was formed and by how fast it was formed. In benign expansive processes, collateral circulation patterns are fairly regular and confluent into suprahepatic veins of other districts, but when a malignant outgrowth is present collateral circulation patterns are bound to be disorderly, irregular and 'aimless'.

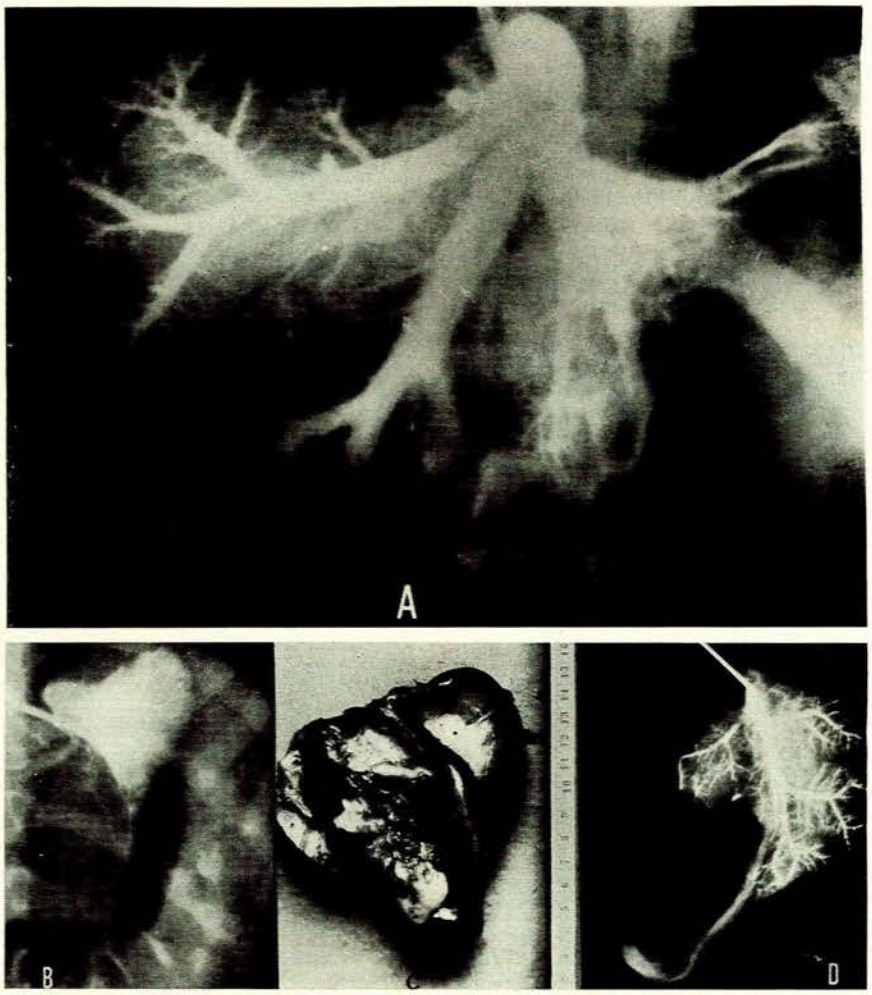

Fig. 3. Echinccoccal cyst of the left hepatic lobe. A: Angiogram of caval confluents of hepatic veins under block. Note good visualization of right and median systems. Contrast medium is stopped at the root of the left hepatic vein. B: As the catheter is inserted into the left hepatic vein, further visualization is provided of a liver portion surrounding an expanded intraparenchymal area. C: Portion of left hepatic lobe removed. D: Radiogram after barium has been injected into the left hepatic vein—a mirror duplicate of the angiogram.

Nor should we fail to note in this respect that collateral circulation was a persistent angiographic feature in cases of enlargement of the liver when this condition was the result of a compensatory process induced by a restricted outflow, an altered inflow or a biliary obstruction (Fig. 4).

Whenever parenchymal atrophy is present instead, the angiogram contains no evidence of collateral circulation. Quite valuable, from the diagnostic standpoint, are also such alterations of the finer vein ramifications as are detectable in the parenchymatographic stage because of the tell-tale significance of the vascular patterns with which they are associated. When the normal aciniform design is drastically upset and becomes mottled, fuzzy and interspersed with vascular gaps, an altered parenchyma may be assumed. When these images take the appearance of patterned vascular gaps surrounded by an irregular vascular design, they may well indicate a metastatic process. We could consistently identify them whenever metastases over $\frac{3}{4}$ inch in diameter were present (Fig. 5).

This stage of the phlebographic investigation is also important in diagnosing cirrhosis of the liver or precirrhotic conditions. Actually, the results that may be obtained in these cases are highly significant inasmuch as they may indicate not only the existence of the condition but even its stage of evolution, which may be gauged by the magnitude of the alterations and by the presence or absence of a collateral circulation pattern as previously mentioned. Whenever an enlarged liver is associated with biliary stagnation or a precirrhotic condition, the angiogram is bound to show only minor structural changes but a conspicuous collateral circulation.

Conversely, an atrophied parenchyma such as may be found in biliary cirrhosis originating from long-standing stagnation, or in cholangiolithic, alcoholic or postnecrotic

cirrhosis will be reflected in an angiogram featuring a mottled appearance, a zonal distribution and no collateral circulation, which will faithfully duplicate the macroscopic aspects of macro- and micro-nodular cirrhosis (Fig. 6).

Alterations of the suprahepatic vein system proved comparable, and occasionally identical, with those found in operative biopsies and in postmortem material injected with China ink. Less significant from a diagnostic standpoint were the angiographic aspects of such degenerative liver ailments as fatty degeneration of the liver and haemochromatosis. Even with these conditions, however,

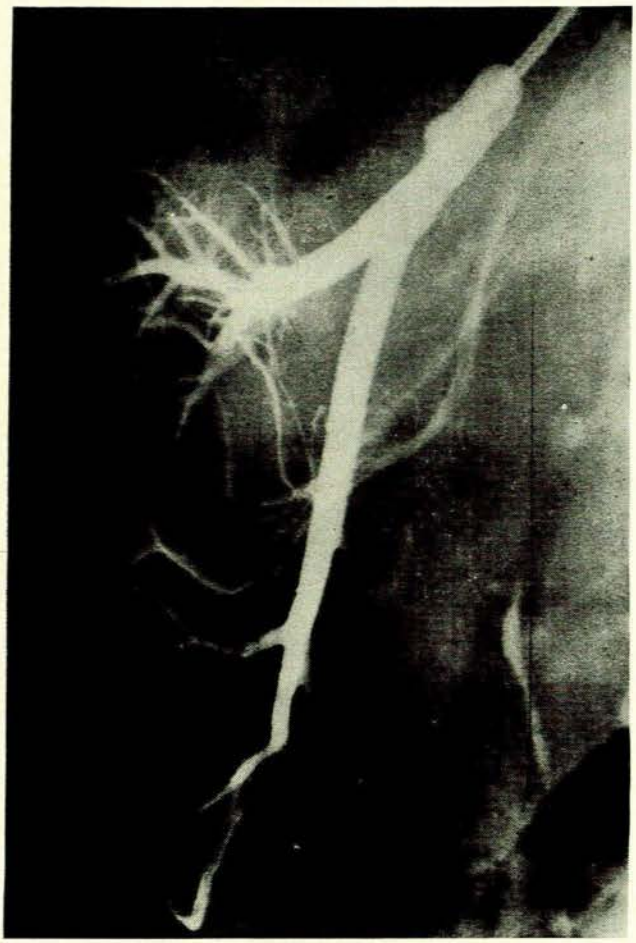

Fig. 4. Angiogram of the right hepatic vein system in a patient with enlarged liver caused by occlusive icterus. Note irregular pattern and intralobal type of collateral circulation.

parenchymal, non-specific, damage was proved by phlebography, as the wide-mesh, regular vascular patterns that were associated with these diseases were typical enough to be at least distinguishable from those observed in precirrhotic conditions or in such forms as tend to evolve in a cirrhotic direction.

CONCLUSIONS

Experience and the results of our research project would seem to provide enough ground for drawing some conclusions as to what indications our method may have. It will prove irreplaceable in identifying benign or malignant outgrowths, whether primary or secondary, within the liver parenchyma. It will also be found invaluable in the

Fig. 5. Angiogram of the left hepatic vein system in a metastasized malignancy of the liver (surgical control). Note irregular venous pattern, intraparenchymal gaps.

diagnosis of cirrhosis by the early indication it can provide of such vascular damage as is associated with this condition. Nor should the fact be overlooked that angiography is but one stage of the examination, the findings of which are invariably supplemented by such haemodynamic and haemochemical determinations as are the routine diagnostic procedures whenever a liver ailment is suspected. If all other methods of vascular exploration of the liver are likewise considered, the obvious deduction may be drawn that each of them plays a specific role in the detection of such damage as is typical of the particular system for which the method has been adopted. Experience, however, appears to warrant the contention that suprahepatic vein catheterization and angiography under block are easier to perform, entail no risk for the patient and provide pictures that are both more complete and more significant.

SUMMARY

The results of a new method of catheterization and phlebography under blockade of suprahepatic veins are discussed. The method was used on over 600 patients suffering from a variety of liver ailments, most of which were of surgical interest. Tolerance was invariably good, and the following results were obtained:

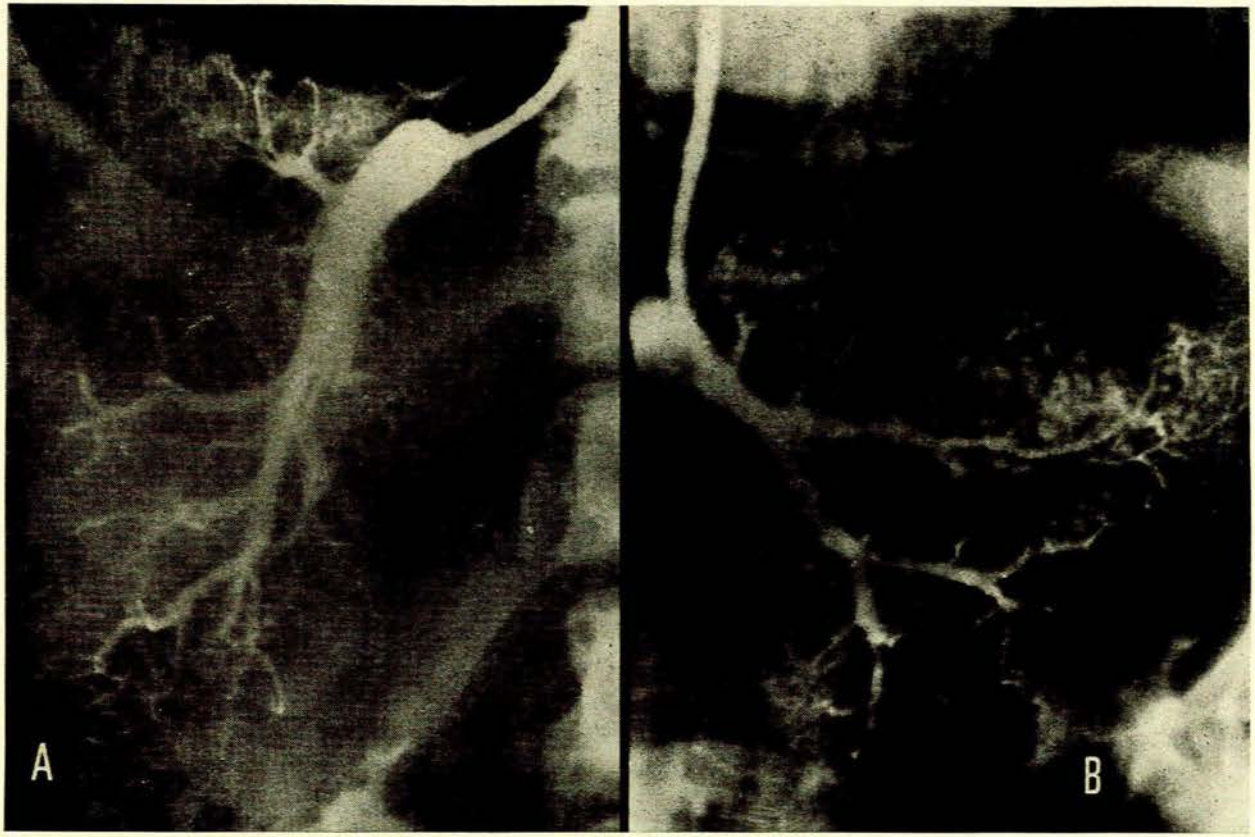

Fig. 6. Angiograms in alcoholic cirrhosis. A: In the part-filling stage, vascularization (right) appears depleted and amputated even at the level of the first divisional branches. B: In the complete filling stage, left, the pattern becomes fuzzy and mottled.

The modal and altered patterns of the liver's efferent venous system were identified. The phlebographic aspects of the hindered return blood stream caused by caval and/or suprahepatic-caval obstacles (Budd-Chiari's syndrome, 'stagnant liver') were investigated. Such morphological alterations of the blood-vessels as originated in or developed through compression of the larger suprahepatic veins were investigated, together with the mechanics whereby functional compensation occurs through collateral circulation (echinococcus cysts, amoebic abscesses, tumours of the liver).

The subtlest changes in vascular structure patterns were evidenced in the parenchymatographic stage of phlebography (cirrhosis of the liver, Hanot's disease). The vascular picture was obtained under such liver-ailment conditions as are associated with either a reduced inflow (prehepatic obstructions) or a hindered outflow (bile duct obstructions). Blood-vessel morphology in degenerative ailments of the liver was delineated.

The method is indicated as a fundamental procedure for the correct assessment of both malignant and non-malignant liver-expansion processes; as a valuable tool for the early detection of cirrhotic-type liver ailments and for evaluating their stage of development; and as a source of basic anatomical and surgical data on the condition of the suprahepatic peduncle. The method described is both easy to perform and capable of yielding hepatographic pictures of great completeness and significance.

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