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Sonographic Evaluation for Membranous Obstruction of Inferior Vena Cava

—Correlative Study with Venacavography—

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= Abstract =Membranous obstruction of upper cava is one of the frequent causes of inferior vena caval obstruction in this country. Since it can be cured by transcardiac membranotomy or other interventions, accurate diagnosis of the disease is important. Sonographic findings in 6 cases of membranous obstruction of inferior vena cava were analysed and correlated with the findings of the inferior venacavography. At the obstructed site, the membrane was detected as a high echogenic focal or segmental obliteration of the lumen sonographically. The lumen of vena cava below the obstruction was easily delineated without normal respiratory changes. Venacavography was superior in demonstrating all collateral channels except transhepatic collaterals which were depicted well in sonography.

Key Words: ***Membranous obstruction, Inferior vena cava, Sonography, Venacavography, Transhepatic collaterals***

INTRODUCTION

There are many different causes of inferior vena caval (IVC) obstruction such as phlebothrombosis, membrane and thrombotic invasion of various malignancies according to the level of obstruction (Missal et al. 1965; Yamamoto et al. 1968; Kimura et al. 1972; Siqueira-Filho et al. 1976).

Among the causes of IVC obstruction, it is well known that membranous obsturction of upper cava can be cured by transcardiac membranotomy and other surgical intervention or transluminal angioplasty (Kimura et al. 1972; Espana et al. 1980; Jeans et al. 1983; Yamada et al. 1983).

Sonography is known to be not only a simple and safe method but also an accurate alternative of venography for the evaluation of various IVC abnormalities. Sonographic detection of IVC invasion of renal and hepatic tumors has been reported and a few case reports for the sonographic findings of intrinsic IVC obstruction have appeared in literature. However, a sonographic and angiographic correlative study for the membranous obstruction of IVC has not been reported (Goldstein et al. 1978; Sonnenfeld and Finberg 1980; Slovis et al. 1981; Huberman and Gomes 1982; Subramanyam et al. 1984).

Sonographic findings in 6 cases of membranous obstruction of IVC were analysed and correlated with the findings of the inferior venacavography.

MATERIALS AND METHODS

Real-time sonography was performed on 6 patients with membranous obstruction of IVC at department of Radiology, Seoul National Unviersity Hospital for recent 3 years.

An Aloka sector scan SSD-710 and occasionally a Picker 80L-DI digital gray scale unit were used. Either a 3.5 or 5.0 MHz transducer of appropriate focal length was utilized in all instances.

In the patient with clinical impression of membranous obstruction of IVC, ultrasonographic examination was done prior to the cavography which followed for correlative and confirmative study. In the

Table 1. Clinical manifestations in 6 cases of membranous obstruction of IVC

No.	Patient		Clinical Findings	Operation or Biopsy
1	Kim SI	M/50	HM SC As VB H MV	Hepatic artery
2	Min DS	F/35	HM SC As HC	Transcardiac membranotomy
3	Hwang CJ	F/43	HM	Transcardiac membranotomy
4	Han DK	M/57	HM SC As PE	
5	Lee HM	M/31	HM SC PE	Bypass Teflon graft
6	Lee SY	M/47	HM SC As PE	

HM: Hepatomegaly As: Ascites VB: Varix bleeding MV: Mediastinal varix
SC: Superficial collateral PE: titting edema H : Hepatoma HC: Hepatic coma

supine position patients were examined with multiple right parasagittal, transverse and right translateral scan.

Clincal manifestations of 6 cases were summarized in Talbe 1. Among the 6 cases, membrane was demonstrated in venacavography of 5 cases and 4 of them were confirmed at surgical operation. Associated hepatoma was diagnosed with both sonography and hepatic arteriography and confirmed with wedge biopsy at operation in case 1 (Fig. 1). In case 6, the diagnosis was made on the ground of sonographic and clinical findings. In all cases, hepatomegaly was identified. Superifcal collaterals were noted on abdominal wall in 5 cases and ascites were present in 4 cases. Mediastinal varix was detected in chest P-A of 2 cases.

As a surgical procedure for curative purpose, transcardiac membranotomy was performed in 2 cases. Side to side bypass Teflon graft was made in 1 case. In case 1 palliative surgery for the associated hepatoma was done with hepatic artery ligation.

RESULTS

Sonography: At the obstructed site, the membrane was detected sonographically as a high echogenic focal or segmental obliteration of the lumen in all cases(Fig. 2,3).

The intact portion below the obstruction was easily delineated due to constant dilatation of the lumen without normal respiratory change in most cases of complete membranous obstruction. In case 6, the lumen of IVC below the obstruction was not identified (Fig. 4). However, the hepatic segment revealed high echogenic tract along the course of IVC, suggesting segmental membranous obstruction as underlying cause of thrombotic occlusion of whole length.

There were some additional sonographic findings. In 4 cases, hepatic veins were dilated and connected each other, forming transhepatic collaterals (Fig. 2,3). In some cases, the communication between hepatic vein and IVC of the above and below the obstruction was demonstrated with real-time scan. The patency of intact segment of IVC and draining branches such as hepatic veins and both renal veins could be identified. Additional thrombotic involvement of renal and hepatic veins was also detected.

Sonographic-angiographic Correlation: At the obstruction site, angigoraphy showed abrupt flat or dome-shaped obstruction of the lumen while sonography disclosed high echogenic membrane or segmental obliterative area (Fig. 1,2,3). In case 6, venacavography showed ill-defined termination of contrast column without demonstration of higher segments of its branches (Fig. 4).

In order to determine the accurate extent of the lesion with venacavograhpy, double injections with two catheters from the above and the below obstruction were tried in 3 cases. Otherwise it is difficult to determine the upper extent of the lesion with ascending venography alone, unless the distal portion is opacified with contrast flow from nearby collaterals.

Angiography revealed various collateral pathways in all cases. There were transhepatic pericardiophrenic collaterals, central collaterals such as vertebral plexus, ascending lumbar to hemiazygos or azygos vein, superficial collaterals such as presacral plexus and deep circumflex iliac to intercostal vein. All these collaterals could not be detected sonographically except transhepatic collaterals.

The above sonographic-angiographic correlative findings of the 6 cases were summarized at Table 2.

Table 2. Correlative findings of sonography and venography in 6 cases of membranous obstruction of IVC

Patient		Sonography				Venography		
No.	Sex/Age	Level	Lesion	Below	Collaterals & Others	Level	Lesion	Collaterals & Others
1	M/50	U	HEM	NR, ND	Hm	U	M	C,S
2	F/35	U	HES	NR, ND	TH	U	SO	TH, C
3	F/43	U	HEM	NR, D	TH	U	M	TH
4	M/57	U	HES	NR, D	TH	U	SO	TH, C
5	M/31	U	HES	NR, D	TH	U	SO	TH, C
6	M/47	IMU	HES	NI	HVT	I	IDo	C

U: Upper cava
IMU: Infrarenal, mid and upper cava
HEM(S): High echogenic membrane (segment)
(N)R: (No) respiratory change
(N)D: (Not) dilated
NI: Not identifiable
Hm: Hepatic mass
HVT: Hepatic vein thromobosis
M: Membrane
SO: Segmental obliteration
IDO: Ill-defined obstruction
TH,C,S: Transhepatic, central, superficial collateral

DISCUSSION

Inferior vena cava is an important vascular landmark in abdominal sonography. In dynamic sonographic display, one can easily find the respiratory cycle of this echoless tubular sturcture. The lumen of IVC is dilated in end expiration and suspended respiration after maximum inspiration (Taylor 1975; Grant et al. 1980).

Though venacavography is known to be a procedure of choice for the evaluation of abnormality of IVC, a few reports have insisted that real-time sonography is the preferred modality. There have been case reports for the sonographic findings of incomplete thrombosis, membranous obstruction, interruption with azygos continuation and malignant tumoral invasions in the IVC (Garris et al. 1980; Slovis et al. 1981; Huberman, and Gomes 1982).

Obstruction of IVC is a relatively rare disease but induced by a great deal of conditions including intrinsic and extrinsic causes. Examples of intrinsic causes would be thrombosis, neoplasm of IVC, tumor thrombus and membranous obstruction (Missal et al. 1965; Yamamoto et al. 1968; Kimura et al. 1972; Siqueira-Filho et al. 1976). Among the causes, hypernephroma was known to be the most frequent cause.

The incidence of obstruction at hepatic segment is very low. However, in some countries such as Japan, India, South Africa and Korea, the leading cause of obstruction of the upper segment is membrane, which can induce Budd-Chiari syndrome (Yamamoto et al. 1968; Kimura et al. 1972; Espana et al. 1980; Okuda 1982; Simson 1982). Making an accurate diagnosis for this disease is very important because it is a curable condition with some surgical or radiological interventions such as transcardiac membranotomy, bypass Teflon graft, azygocaval anastomosis or percutaneous transluminal angioplasty (Kimura et al. 1972; Espana et al. 1980; Yamada et al. 1983; Jeans et al. 1983). The etiology and pathogenesis of mebranous obstruction is disputed. Evidences for a congenital or an acquired etiology have been reported (Yamamoto et al. 1968; Espana et al. 1980; Huberman and Gomes 1982; Okuda 1982; Simson 1982).

Two basic patterns of membranous obstruction have been described. One is a membrane or a web, the other is a segmental absence of variable length. Occasionally secondary thrombosis can be accompanied by the both patterns of membranous obstruction (Simson 1982).

In order to determine the accurate extent of the obstruction some authors recommend venacavography with two catheters, one above and the other below the obstruction (Kimura et al. 1972; Espana et al. 1980). However, sonography of IVC can easily visualize the obstructions as either a high echogenic membrane or a high echogenic obliteration of the lumen just below the diaphragmatic level of hepatic portion. The inflow to the right atrium can be delineated above the obstruction. Almost constant dilatation of lumen without normal respiratory changes is noted below the obstruction with dynamic real-time scan (Taylor

1975).

Transhepatic collaterals were also well delineated in the liver with sonography. Usually the membrane is located just above the orifice of right hepatic vein and below that of left hepatic vein (Kimura et al. 1972; Espana et al. 1980). Blood in right hepatic vein flows through the collaterals into left hepatic vein that drains into subdiaphragmatic IVC again. Another pathway of collateral flow is extrahepatic continuation through capsular vein toward retroperitoneal, intercostal or phrenic vein which can cause mediastinal varix (Cho et al. 1982). In addition to the various collateral pathways of IVC obstruction such as central, intermediate, portal and superfical routes, transhepatic collateral pathway was described in the cases of membranous obstruction, extrinsic obstruction of hepatic lymphoma, caval thrombosis and hepatic vein occlusion (Garcia and Lewitan 1963; Doppman et al. 1967; Cho et al. 1982; Salomonowitz et al. 1984).

Association of hepatoma with membranous obstruction has been reported by some authors, but the pathogenesis is yet uncertain (Yamamoto et al. 1968; Okuda 1982; Simson 1982). The possible association of hepatoma should be examined in either sonographic or angiographic diagnosis of membranous obstruction.

In the evaluation of thrombotic occlusion of IVC with venacavography, occasionally encountered problems must be considered. One is the inability to demonstrate the exact caudal extent of the occlusion because of the preferential flow into collaterals even with adequate catheter placement. The other problem is that, venacavography with single catheter from femoral route usually cannot delineate the cranial extent of the obstruction. An alternative may be the double catheter technique with an additional one via the brachial route, however, it has disadvantages of possible dislodgement of thrombi (Slovis et al. 1981).

In summary, sonography has some advantages over angiography in evaluation of membranous obstruction of IVC for accurate delineation of craniocaudal extent, nature of obstruction and possible association of hepatoma, in addition to its noninvasiveness and simplicity.

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= 국문초록 =

하대정맥 막성폐쇄의 초음파소견

—하대정맥조영술과의 비교를 중심으로—

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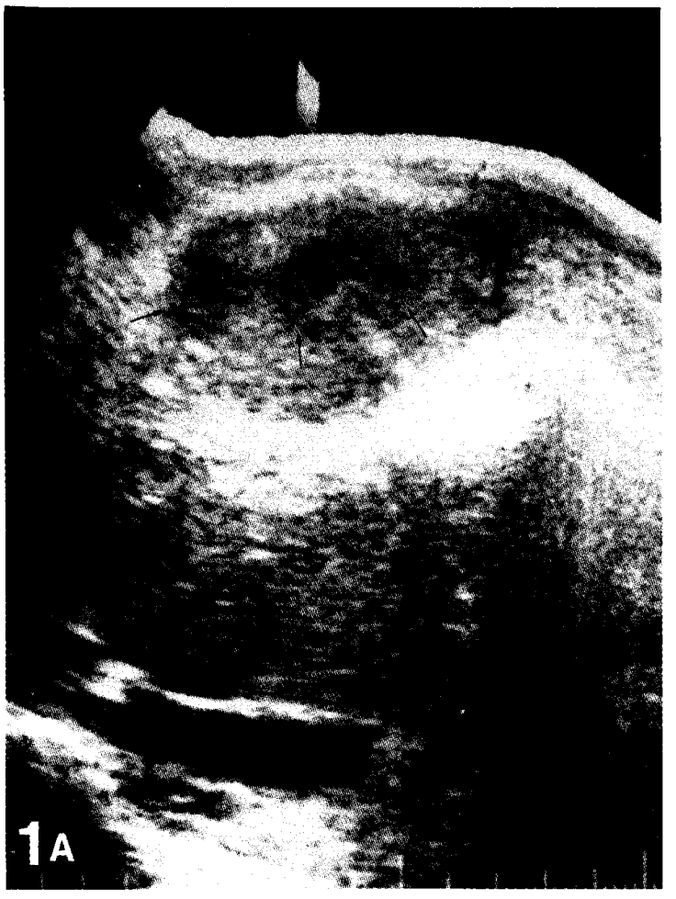
복부초음파소견상 하대정맥은 중요한 해부학적지표가 된다. 하대정맥의 폐쇄중 막성폐쇄는 우리나라에서 중요한 원인중 하나로서 수술적 처치로써 치료가 가능하여 정확한 진단이 특히 중요하다.

저자등은 지난 3년간 서울대학교병원 방사선과에서 하대정맥의 막성폐쇄 6례의 초음파 촬영 및 하대정맥조영술을 실시하고 그 소견을 비교 분석하여 다음의 지견을 얻었다.

초음파상 막성폐쇄는 에코가 고도로 증가된 막 혹은 분절로서 하대 정맥의 횡격막직하 간분절에서 나타나며 실시간(real-time)기법으로 폐쇄하부에서 호흡에 따른 하대정맥의 정상적 내경변화가 소실되었다. 그외 초음파소견을 통하여 경간측부순환을 잘알 수 있었고 1례에서는 막성폐쇄와 동반빈도가 높은 간암을 동시에 진단하였다.

하대정맥조영술과의 비교고찰을 통하여 초음파촬영은 하대정맥 막성폐쇄의 범위와 폐쇄하부의 역동적관찰, 주위장기 관찰등이 가능함으로써 막성폐쇄의 진단에 있어 간편 용이할 뿐 아니라 정확한 진단방법임을 알 수 있었다.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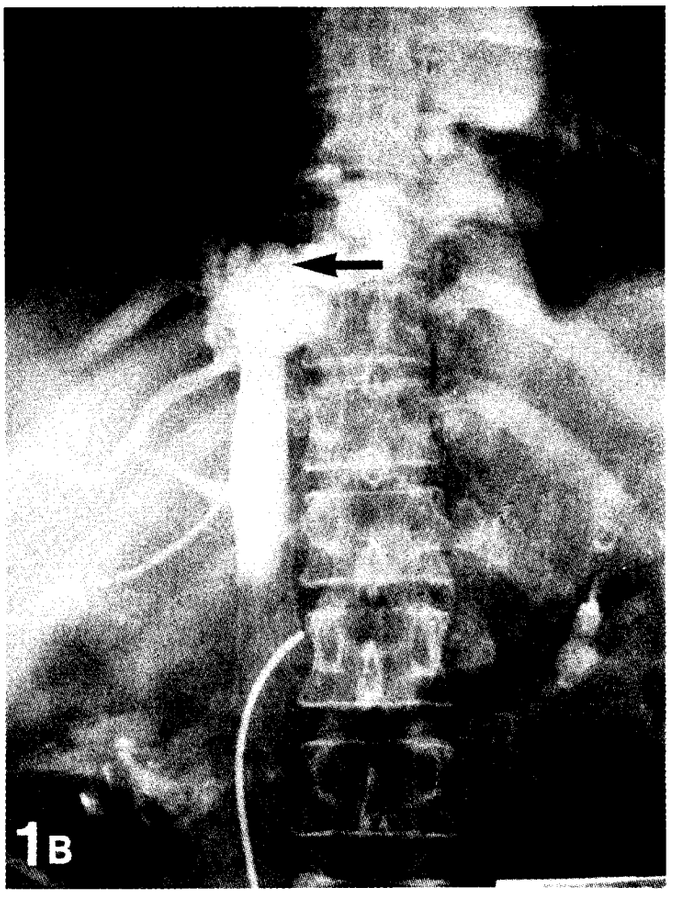
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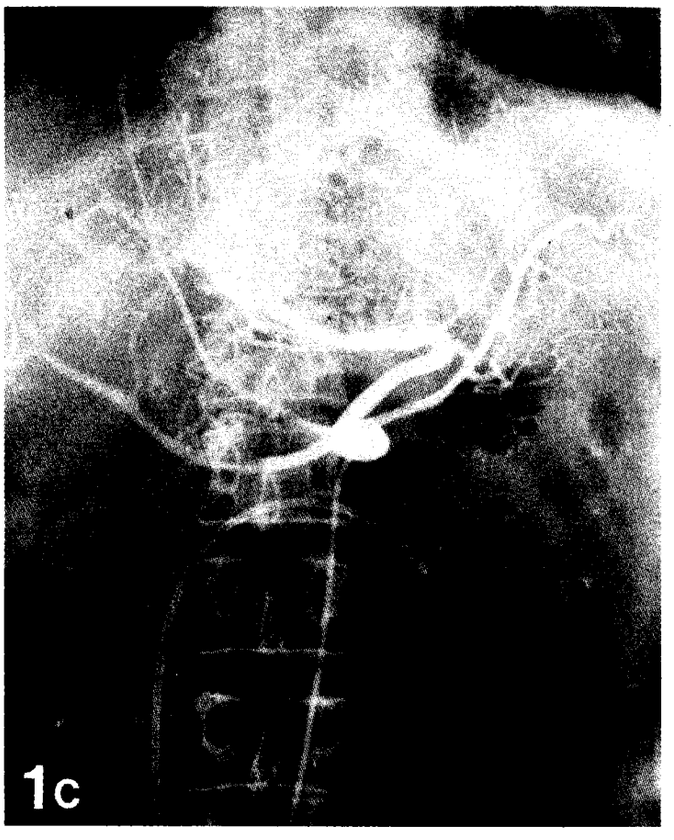
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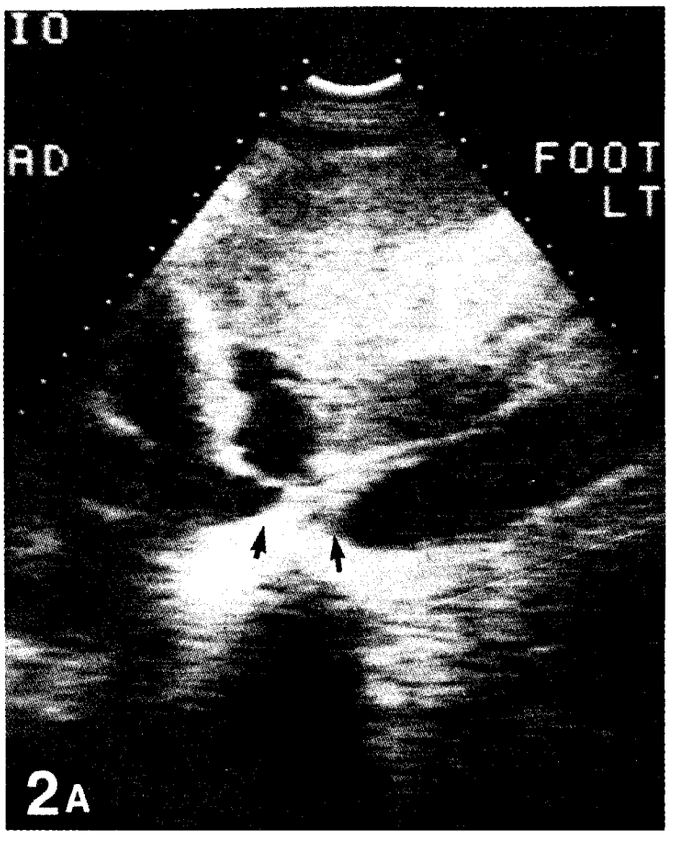
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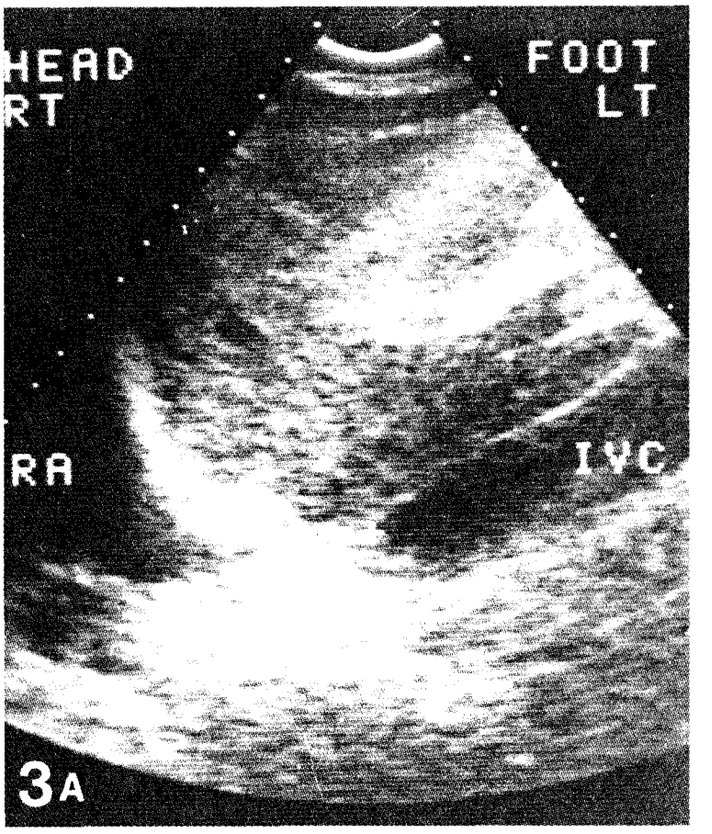
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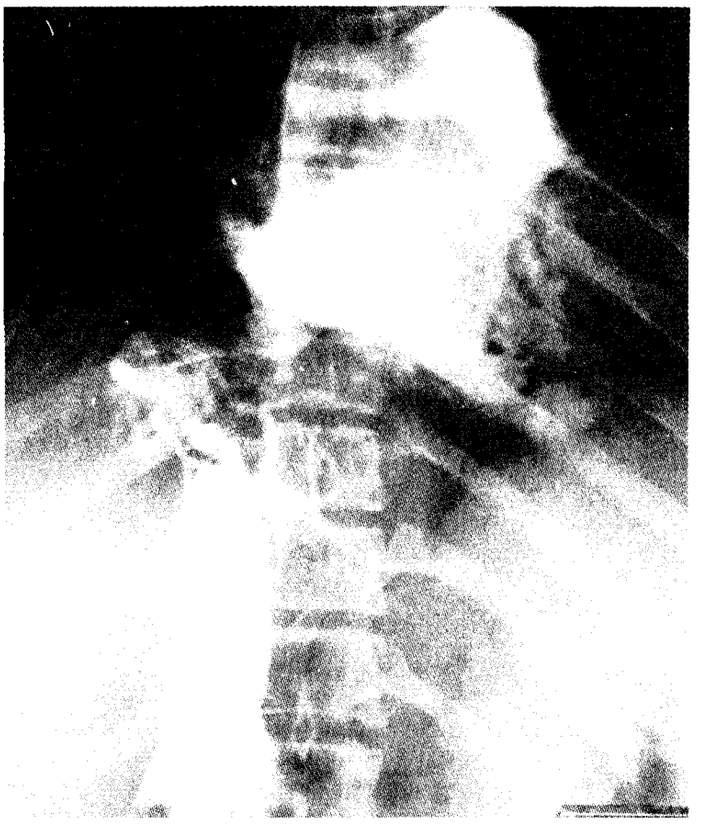

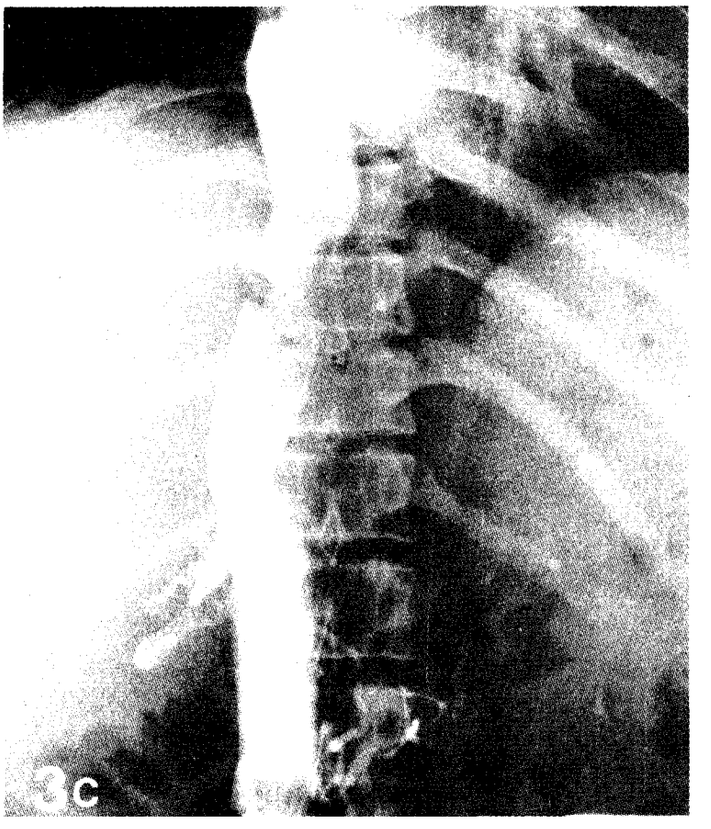
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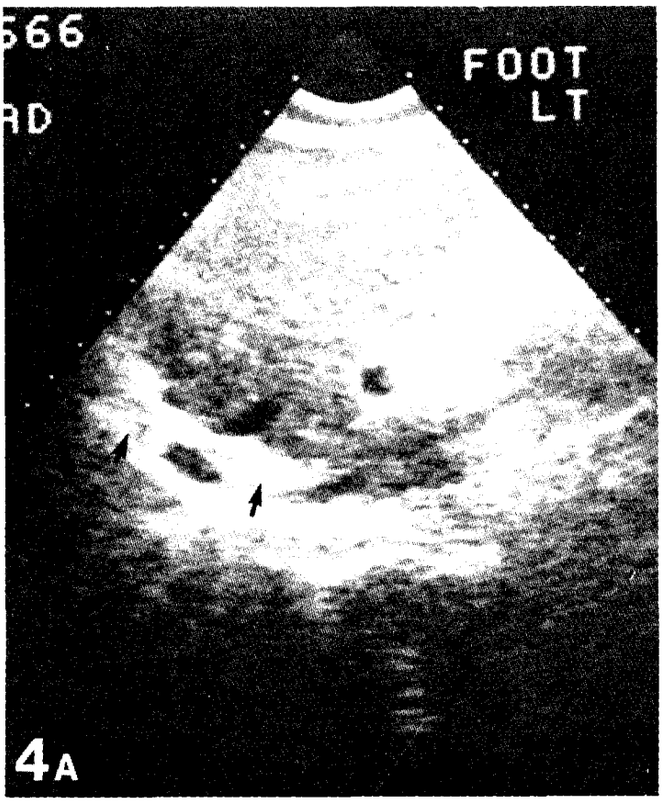
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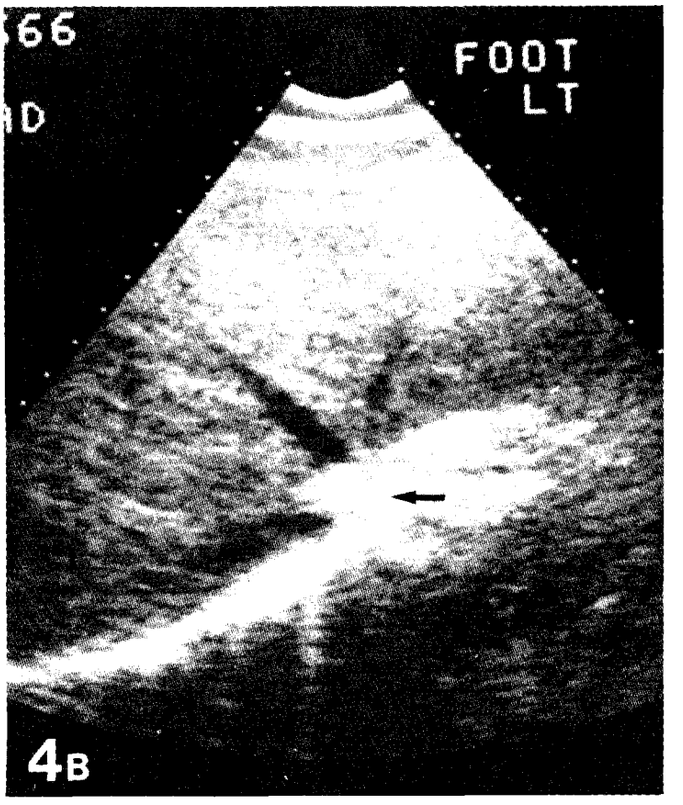
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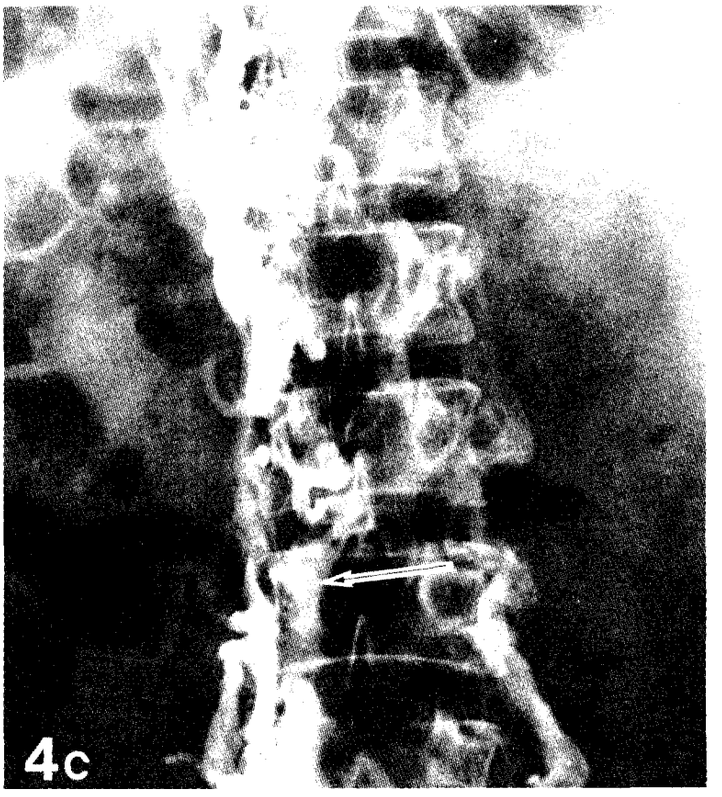
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LEGENDS FOR FIGURES

Fig. 1. (Case 1) Membranous obsturction of IVC with hepatoma

A) Right parasagittal longitudinal scan reveals focal high echogenic obstructing lesion at subdiaphragmatic IVC, suggesting membrane (arrow). Medial segment of left lobe of liver shows in homogenous echogenic mass (Small arrows).

B) Smooth domed obstruction at subdiaphragmatic area due to membrane (arrow). Collaterals through capsular to phrenic and intercostal vein. Left paravertebral mass density (arrow heads) due to tortuous dilation of hemiazygos vein.

C) Celiac arterigraphy discloses hypervascular mass in left lobe of liver with enlarged left hepatic artery.

Fig. 2. (Cast 4) Membranous obstruction with transhepatic collaterals.

A) Longitudinal scan shows high echogenic segment (small arrows) of subdiaphragmatic level and dilated IVC below the obstruction.

B) Segmental membranous obsturction (arrow) with transhepatic collaterals (arrow heads) is demonstrated by venacavography with two catheters.

Fig. 3. (Case 5) Segmental membranous obstruction.

A) Segmental occlusion of subdiaphragmatic IVC replaced with segmental high echogenecity.

B) Venacavography with two catheters showing segmental membranous obstruction with transhepatic collaterals.

C) Post-operative state of side to side bypass Teflon graft.

Fig. 4. (Case 6) Thromobotic obstruction of whole length.

A) Right parasagittal scan shows segmenal high echogenic tract (arrows) at hepatic segment of IVC. The lumen of IVC can not be identified below the hepatic segment either.

B) Transverse scan demonstrates the high echogenecity (arrow) at the place of IVC.

C) Venacavography reveals ill-defined obstruction (arrow) of IVC at infrarenal segment and deep collateral channels.