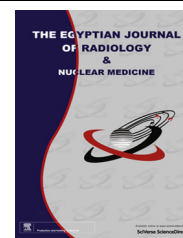




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ORIGINAL ARTICLE

Evaluation of different radiological interventional treatments of Budd–Chiari syndrome



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KEYWORDS

Budd–Chiari syndrome;
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Abstract *Aim:* To evaluate the efficacy of various interventional techniques in treatment of Budd–Chiari syndrome (BCS).

Patients methods: 103 patients with BCS were included in the study. There were 9/103 (8.7%) patients with obstruction of inferior vena cava (IVC) (type I), 17/103 (16.6%) patients with hepatic vein obstruction (type II), 71/103 (68.9%) patients with veno-occlusive diseases (type III) and 6/103 (5.8%) patients with veno-occlusive disease combined with caval thrombosis (type IV). Recanalization techniques of hepatic veins and IVC, and TIPS were used.

Results: Of all the subjects, 101 successfully underwent their procedures, with a technical success rate of 98.06%; only 2 failed to do TIPS. After treatments, 2 patients died after operation because of severe intra-abdominal hemorrhage. One hundred and one patients were followed up for 1–94 months. The mean follow-up of a BCS patient treated with PTA was 52.1 months, with an overall primary patent rate of 69.2% (18/26). The mean follow-up of BCS treated with TIPS was 33.5 months, with an overall primary patent rate of 72.7% (56/77). Eight patients died 7–64 months after the interventions.

Conclusions: Recanalization of IVC/hepatic vein and TIPS can be regarded as safe and effective interventional invasive methods in the treatment of BCS.

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1. Introduction

Budd–Chiari syndrome (BCS) represents a series of pathological changes resulting from occlusive lesions in the hepatic veins and/or the inferior vena cava (IVC). The clinical

manifestations of BCS include hepatomegaly, abdominal pains, ascites, and edema of the low limbs. It is an uncommon worldwide disease, but its incidence in China and other Asian countries is relatively high (1). In Western countries, primary myeloproliferative syndromes, hypercoagulable states and steroidal contraceptives were responsible for most cases. In Asian countries, pregnancy, infections and an inferior vena cava were the dominating causes (2). The prognosis for BCS is poor, and is usually difficult to cure. In recent years,

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Table 1 Classification of 103 patients with BCS based on ultrasound and angiography.

Types	N (%)
Type I: Membranous obstruction of the IVC W/WO thrombosis	9/103 (8.7)
Type II: Solitary hepatic vein obstruction (web/thrombosis)	17/103 (16.6)
Type III: Rudimentary (diffuse thrombosis) of hepatic veins	71/103 (68.9)
Type IV: Rudimentary (diffuse thrombosis) of hepatic veins with caval thrombosis	6/103 (5.8)

interventional therapy is widely used in the treatment of BCS as a safe and effective technique (3). However, there are still many urgent tasks not only in the selection of indicators, but also in the improvement of long-term results. Percutaneous interventional radiology procedures have been recently proposed as an alternative to surgical shunting and liver transplantation (4,5). These interventional techniques depend on the type of BCS. In 2003, a classification scheme of BCS developed and proposed type I as caval occlusion, type II as short segment (<4 cm) isolated hepatic vein occlusion, type III as rudimentary/totally thrombotic hepatic veins and type IV that involves combined thrombosis of the hepatic veins and caval thrombosis (6).

The purpose of our study was to evaluate the feasibility and efficacy of those different interventions for the treatment of patients with BCS.

2. Subjects and methods

This retrospective cohort study was conducted at the National Liver Institute, Menoufiya University from October 2006 to April 2013. It included 103 patients having Budd–Chiari syndrome who were selected and submitted for the treatment with interventional procedures. All patients had informed consents before interventions. Generally, there were 73 females and 30 males. Their ages ranged from 14 to 44 years, with a mean of 29.5 years. The duration of symptoms ranged from 1 to 10 years. Clinical symptoms observed included abdominal pain and distention, hepatomegaly, splenomegaly, ascites and varicose veins in the abdomen and legs.

On the basis of angiography and ultrasonography, 103 patients were classified into 4 types of BCS (Table 1): type I solitary obstruction of the IVC by membrane/thrombosis (9/103; 8.7%), type II solitary short segment/membranous hepatic vein obstruction (17/103; 16.6%), type III rudimentary/diffuse thrombotic obstruction of the hepatic veins (veno-occlusive disease) (71/103; 68.9%) and type IV combined thrombosis of the hepatic veins and retro-hepatic cava (6/103; 5.8%). For those of caval obstruction, the length of obstructed IVC ranged from 1 to 2 cm and the width ranged from 16 to 22 cm. Obstructive hepatic vein ranged from 1 to 4 cm and 0.8 to 1 cm wide. All operations were performed under the guidance of standard angiography (Fluoroscopic X-ray DIGITAL unit: infinix, Toshiba, Japan) with ultrasound guidance (Toshiba-xario with 5 MHz convex transducer and Toshiba nemio XG with 3.75 MHz convex transducer).

2.1. Methodology

2.1.1. Treatment of type I Budd–Chiari by caval recanalization (9 patients)

Caval recanalization by dilatation with or without shunting is considered the best option for such patients. In all patients, we used primarily the femoral vein to obtain inferior vena cavography to evaluate for the site and degree of occlusion. In cases of incomplete occlusions, the contrast passed to opacify the heart. In such cases, we passed the guide wire through the stenosis followed by the large-diameter balloon (20–24 mm) and dilatation was obtained. If occlusion was complete, RUPS-100 (Rosch-Uchida Puncture Set) device or J-type Brockenbrough needle (Cook, Chicago, USA) was passed from the jugular vein. While the pigtail catheter was in cava (from femoral vein), lateral view was obtained to have alignment straight positioning. Once optimal alignment was obtained in anterior and lateral projections, the Rups100 or Brockenbrough needle was pushed slowly to penetrate the occlusion segment till it reaches the other side. Blood was aspirated to confirm luminal position and then wire was advanced while the needle is removed. The large-diameter balloon was then advanced to dilate the segment (Figs. 1 and 2).

2.1.2. Treatment of type 2 by hepatic vein recanalization (17 patients)

For recanalization of one of the hepatic veins, transjugular or trans-hepatic approach was used. In some cases, combined approaches were used. As a rule, we used the transjugular approach at first, where a long sheath was inserted. Catheter manipulation was done to go through the narrowed ostium. After passing, 10–12 mm balloon was inserted and the ostium was dilated. In case of failure to pass through the stenosis (total occlusion), the RUPS-100 needle was inserted at the osteal occlusion and pushed to get the balloon after. If transjugular approach failed, trans-hepatic approach was used. Under US guidance, the proper hepatic vein was punctured and manipulation was performed to pass the occluded segment to get the dilatation (Figs. 3–5).

2.1.2.1. Shunting of cava and hepatic vein. We used shunts for patients with type 1 and type 2 in case of immediate recoil at the time of operation, in case of failure to dilate or in late cases with recurrent stenosis/occlusion.

For caval shunting, balloon-mounted shunts of diameter 2–4 mm larger than the diameter of cava and longer by 2–3 cm from that of the occlusion length. The shunt was introduced through the suitable sheath (12 Fr). The shunt set was advanced

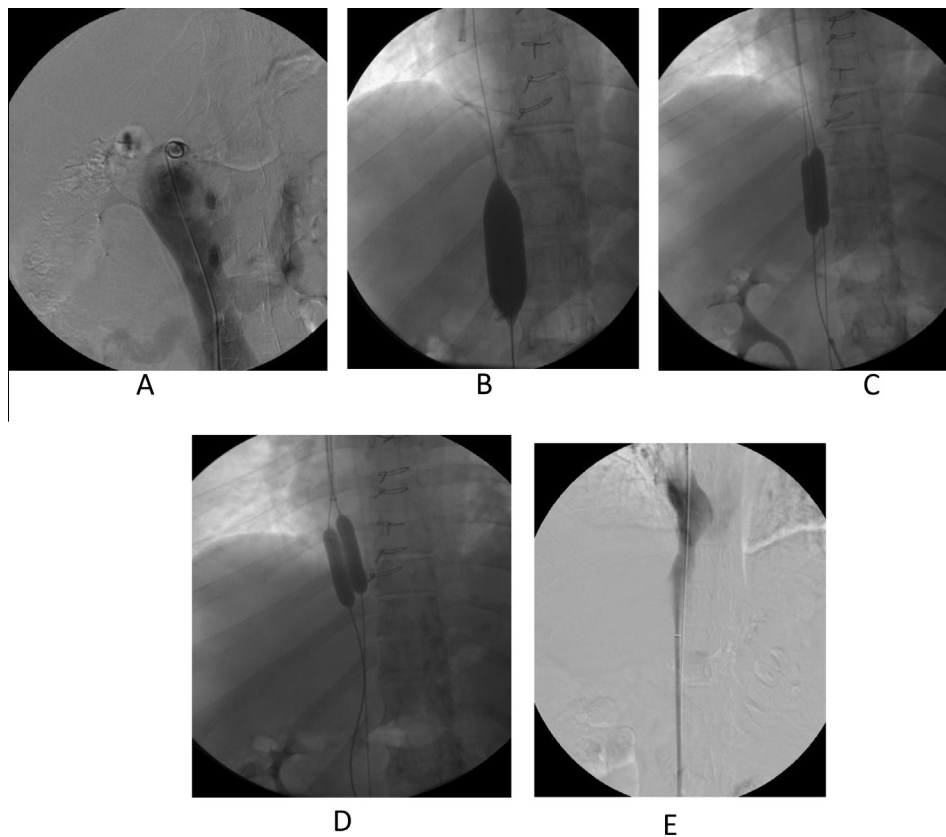


Fig. 1 Dilatation of totally occluded membranous web of the IVC. (A) Vena cavography through femoral approach showed a 2 cm long caval obstructing web with no flow to the heart. The occlusion could be passed and a large balloon dilatation was done (B). Serial dilations of the obstructing segments by kissing balloons; from the jugular and femoral approaches (C and D). Post-dilatation of the web with free flow to the heart (E).

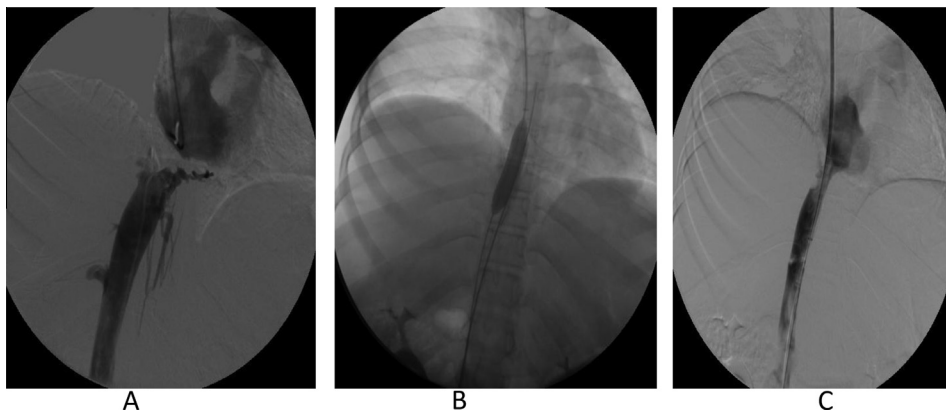


Fig. 2 Treatment of caval obstructing web/old thrombosis. (A) A 2 cm long caval obstructing web with no flow to the heart. Sheath from the jugular vein contains the TIPS needle meeting the pig tail from femoral approach. (B) Kissing balloons; from the jugular and femoral approaches. (C) Post-dilatation of the web with free flow to the heart.

till the occlusion site and the balloon was inflated to deploy the shunt.

For hepatic vein shunting, self-expandable metallic shunts such as Wallshunt (Schneider shunt Inc., Minneapolis, Minnesota, USA) of 10–12 mm diameter was used. The shunt was advanced and centered in position. The outer sheath was then pulled back to allow shunt expansion.

2.1.3. Treatment of type 3 and type 4 by porto-systemic shunting (77 patients)

Porto-systemic shunting was utilized for groups 3 and 4 BCS with ascites or hemorrhage of the upper digestive system when no chance to re-canalize the cava or hepatic veins. The diagnosis of diffuse obstruction of the hepatic vein mainly depended on ultrasonography or CT. Because of the diffuse obstruction

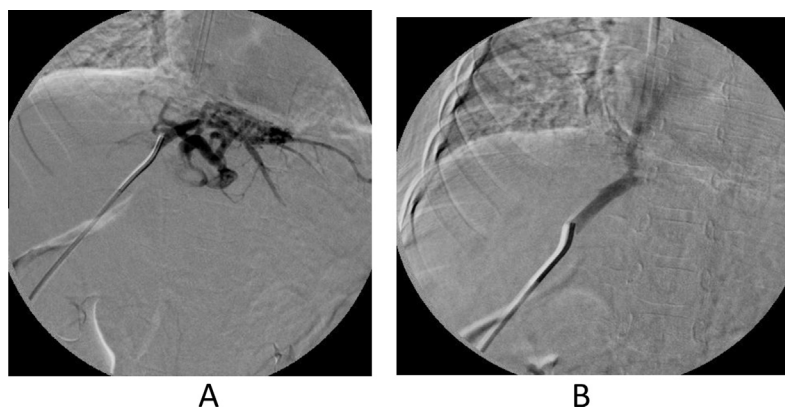


Fig. 3 Middle Hepatic vein balloon dilatation for isolated hepatic vein obstruction. (A) Middle hepatic venography via percutaneous approach showed total occlusion of the hepatic vein at the junction with the cava with numerous venous collateral. (B) Angiography after dilatation shows patent middle hepatic vein with free flow to the heart and absent collateral channels.

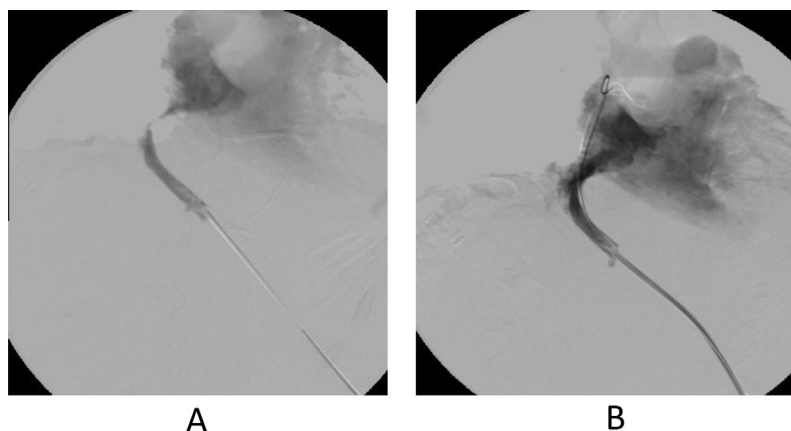


Fig. 4 Percutaneous balloon dilatation of the left hepatic vein for isolated hepatic vein obstruction. (A) Hepatic venography via percutaneous approach showed subtotal occlusion of the hepatic vein at the junction with the cava. (B) Angiography after dilatation shows patent orifice of the hepatic vein with free flow to the heart.

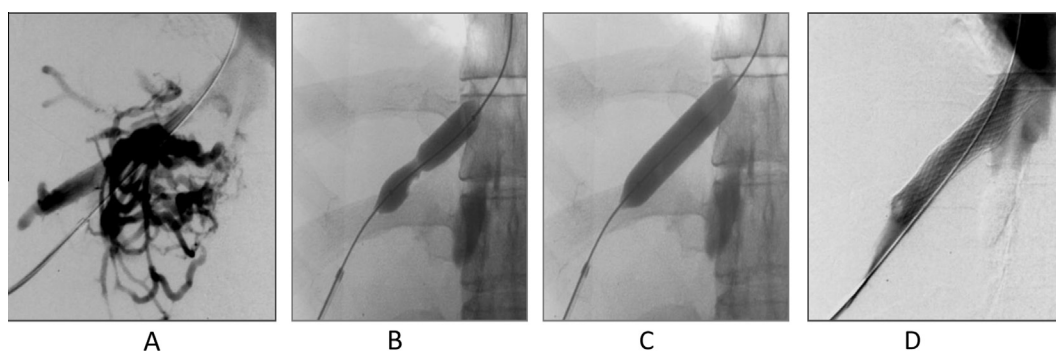


Fig. 5 Middle Hepatic vein dilatation and shunting for isolated hepatic vein obstruction. (A) Hepatic venography via percutaneous approach showed total occlusion of the hepatic vein at the junction with the cava with numerous venous collateral. A snare passed from jugular approach to catch the wire to pass the suitable balloon. (B and C) Dilatation of the hepatic vein ostium by a balloon passing from the jugular vein. Waist is seen in (B) and lost in (C) signifying efficient dilatation. Angiography after dilatation and shunting shows patent vascular channel with free flow to the heart and absent collateral channels (D).

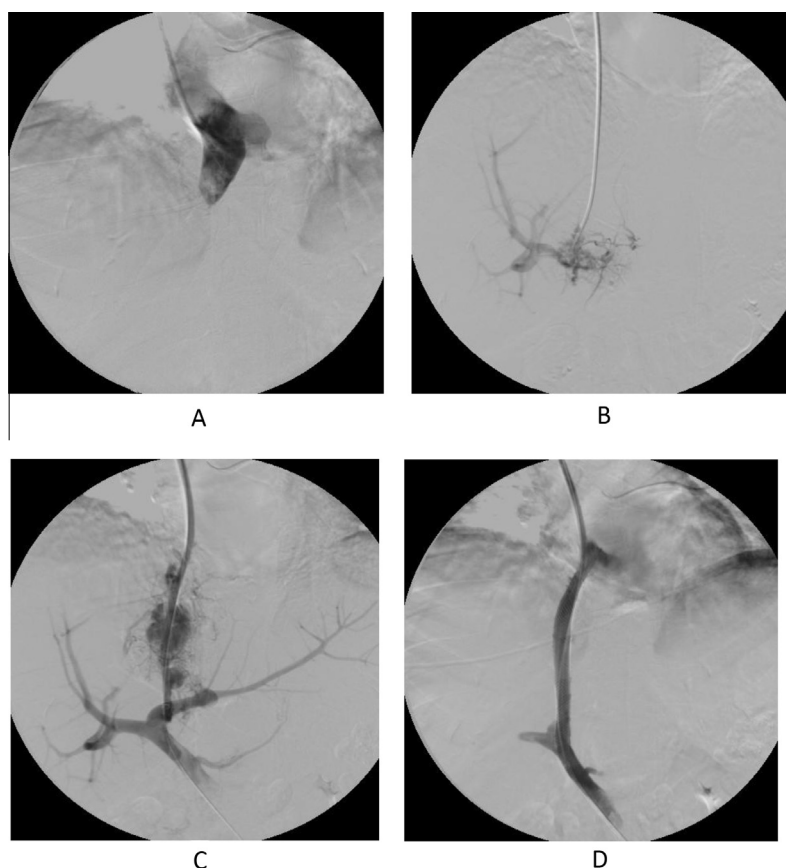


Fig. 6 TIPS in Budd–Chiari patient: The TIPS needle is advanced through the inferior cavogram (A). The needle was then advanced through the caval wall inside the liver tissue to reach the right PV (B). Sheath replaced the needle in (C). Two Wallshunts were then deployed between the PV and cava and portography (D) shows good intra-shunt flow.

of the hepatic vein, it was often difficult to find the right hepatic vein; therefore, the portal vein was punctured directly from the IVC to establish a portal-IVC shunt (Figs. 6 and 7). Two types of shunts were used. The first was the uncovered type that was Wallshunt while the second was covered type that was Viatorr shunt (GORE Company USA). The following two approaches were used to insert the porto-caval shunt:

a. Trans-jugular intra-hepatic portosystemic shunt (TIPS) (55 patients)

Right internal jugular access was used. TIPS cannula (Transjugular Liver Access Set; Cook, Bloomington, IN, USA) was used, but its curvature was modified whenever required. The image intensifier was kept 45 degrees oblique toward the left side. Trans-abdominal US in oblique sagittal plane provided excellent guidance for estimating the length and course of the shunt. The fluoroscope and US were perpendicular to each other. A point just below the expected HV confluence level was selected to initiate the tract. The cannula and needle were directed toward the right branch of portal vein, close to the portal confluence.

The punctures were performed using a Rosch Uchida needle (Cook). Care was taken not to traverse beyond the portal vein. Additional manipulations were sometimes required to direct the glide wire toward the main portal vein instead of its

right branch. After accessing the portal vein, pressure gradient was measured. Balloon angioplasty was performed prior to placement of the shunt. An extra length of the shunt was kept in the IVC, so that its end was directed upwards rather than against the opposite wall of the IVC. Check venogram and pressure gradient measurements were performed.

b. Direct intrahepatic porto-systemic shunts (DIPS) (22 patients)

Punctures were made into the right portal vein to the IVC using a freehand technique. In these patients, an intercostal approach was necessary so that ascetic fluid could be drained before the procedure to facilitate percutaneous puncture. Right portal venous puncture to the right anterior portal vein was performed close to the right portal venous trunk. When portal venous puncture was accomplished, contrast medium was injected for visualization of the location of the needle tip, and the needle was further advanced without a change in the insertion angle to puncture the IVC. The position of the needle was again confirmed with injection of contrast medium. A stiff 0.035-inch guidewire was advanced through the Chiba needle to the IVC. Guidewire manipulation was kept to a minimum to reduce the risk of shearing the coating of guidewires introduced through a beveled needle. At this stage, an 8-French sheath was placed into the IVC through the right internal jugular vein. A Dormia basket was introduced

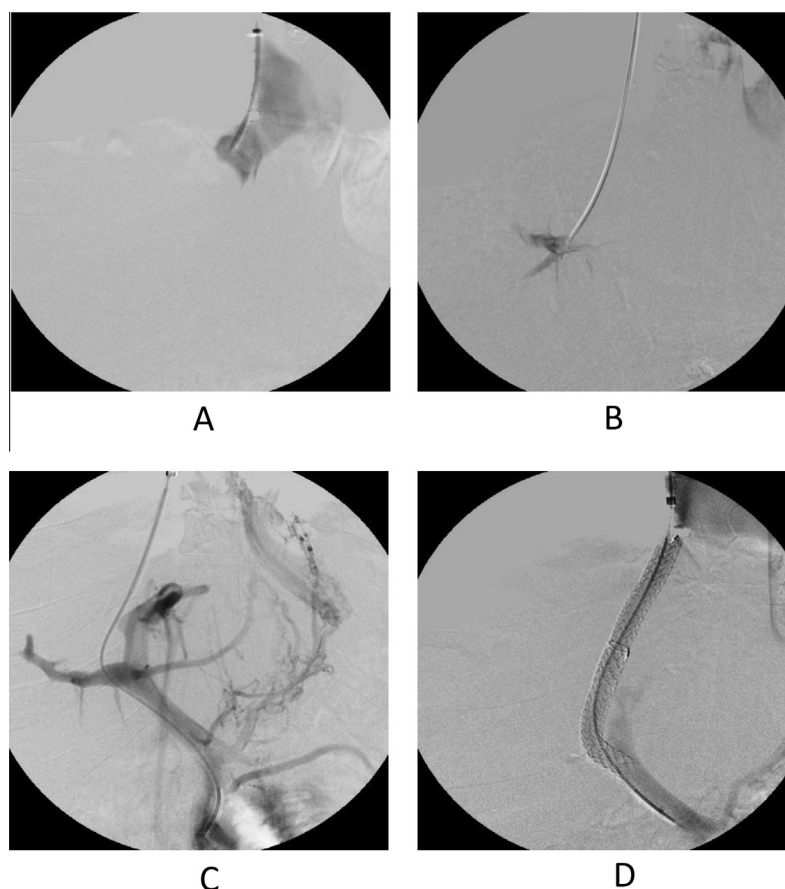


Fig. 7 TIPS in Budd–Chiari patient of group (4): The inferior cavogram (A) showed IVC and TIPS needle. Trans-caval puncture was performed to reach the RPV (B). The catheter was advanced to reach main portal to get portography (C) before shunting. Two Viatorr shunts were implanted and portography (D) shows good intra-shunt flow to the heart.

through the right internal jugular vein to capture the guidewire to achieve through-and-through access. The Chiba needle was pulled back 2 cm to dilate the intrahepatic track with an 8-mm ultrathin balloon advanced through the 8-French sheath. When the balloon catheter was advanced to the intrahepatic track, sonography was performed to determine that the balloon was not advanced beyond the entrance to the portal vein. An 8-French sheath was advanced to the entrance of the portal vein. A 5-French cobra catheter and a 0.035-inch guidewire were introduced through the sheath, and both catheter and guidewire were manipulated into the main portal vein and the superior mesenteric vein. Heparin (5000 IU) was administered IV. The through-and-through guidewire was kept in place for safety. After portography and pressure measurement, a 0.035-inch Amplatz guidewire was advanced to the portal system. The hepatic track was again dilated with an 8-mm balloon the through-and-through.

2.2. Treatment after operation

Patients were systemically treated with low molecular weight heparin with oral anticoagulants for a period of 5–7 days. This is to adjust the INR between 2 and 3. Some patients were given aspirin and dipyridamole orally for 6 months.

2.3. Follow-up evaluation

Symptoms including ascites and dilated parietal abdominal veins were observed (Fig. 8). Follow-up ultrasonographies were performed every 3–6 months and follow-up venographies were performed once or twice over a year according to requirements.

3. Results

One hundred and three patients with Budd–Chiari were subjected to the interventional treatments, either by recanalization or by porto-systemic shunting. Treatment succeeded technically in 101/103 patients giving an overall success rate of 98.06%. Among the 103 patients, there were 26 patients for recanalization in either cava (9 patients) or the hepatic veins (17 patients). The rest of the patients (77 patients) were treated by porto-systemic shunts.

Generally, for recanalization techniques, 9 patients with caval lesions had complete occlusion (4 patients) or incomplete occlusion vein lesions (5 patients). All of them had membranous obstruction with different thicknesses ranging from 0.5 to 2 cm. The lesions of the hepatic venous obstruction ranged from 1 to 4 cm.

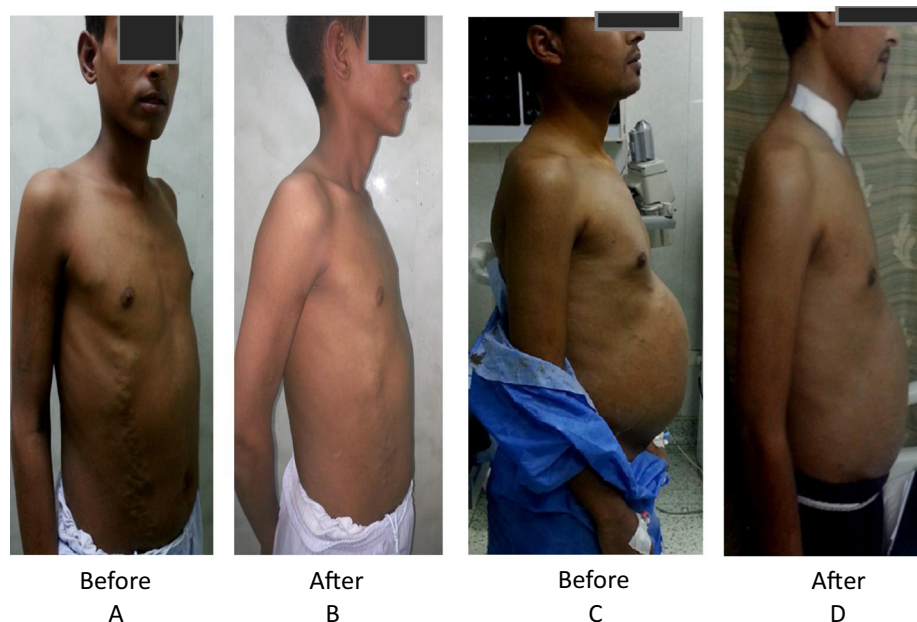


Fig. 8 Clinically this young boy (A and B) complained of dilated venous channels on the lateral abdominal wall (A). After dilatation of his obstructed cava, most of the veins disappeared. Residual small veins are still seen (B). The other 2 pictures for another 21 year old boy having ascites and dilated abdominal veins (C). These disappeared after doing TIPS (D).

The overall recanalization success rate was 100%. However, shunting was done for the first time in 2/26 patients (7.6%) and both patients had hepatic vein lesion. None of the caval lesion was shunted primarily.

For portosystemic shunting, 77 patients out of 103 of the Budd–Chiari were subjected to such operation. Shunt insertion succeeded technically from the first trial in 75/77 patients giving overall success rate of 97.4%. Shunt insertion failed in 2 patients because of inability to reach the portal vein inside the liver. The shunt was inserted using the TIPS approach in 55 patients while DIPS approach in 22 patients. The uncovered Wallshunt was used in 59 patients while the covered Viatorr shunt was used in 16 patients.

In our series, patients with BCS achieved satisfactory results after the therapy of much improved venous drainage. Venography showed that the diameter of recanalized veins reached more than 80% of the normal diameter. Collateral circulation disappeared. The average venous pressure in the distal area of the hepatic vein was markedly lower. After PTA or shunt implantation, pressure in the hepatic vein declined from 43.8 ± 12.9 to 16.4 ± 2.3 cm H₂O, while pressure in IVC increased from 13.4 ± 3.6 to 28.9 ± 9.8 cm H₂O.

3.1. Re-occlusion after interventions

The 26 patients (hepatic vein 17 and IVC 9) who had undergone recanalizations, were followed up for an average period of 52.1 months (1–94 months). The primary patency rate for PTA was 41.6% as 10/24 patients had re-stenosis (9 in hepatic veins and 1 in the IVC). Ten patients had undergone shunt implantation including 9 patients with hepatic vein re-stenosis and 1 patient with re-stenosed cava. The average follow-up period for them was 33.5 months (3–62 months).

The primary-assisted patency rate was 100% with these 10 patients having shunting after re-stenosis. The re-stenosis rate for hepatic vein occlusion treated with PTA was (9/15) 60% while it was 0% when treated with shunt implantation. The rate of re-stenosis for the IVC treated with PTA was 11.1%. The rate of re-stenosis in hepatic veins (60%) having undergone PTA was higher than that of the IVC with the same treatment (11.1%), while the same rate for hepatic veins (0%) having undergone shunt as that of the IVC with the same treatment (0%). No patient out of the 11 patients of the hepatic vein shunting got restenosed. Shunt thrombosis (early complications) occurred in 3/11 (27.2%) patients and all of them were treated by thrombolysis and thrombus suction.

Regarding shunt patency of different approaches for shunt insertion, 14/22 patients with DIPS approach got occluded first year of follow-up with primary patency rate of 36.3%. For patients with TIPS, 7/53 patients got occluded first year of follow-up with primary patency rate of 86.7%. Those patients were treated with shunt dilatation.

The results of the porto-systemic shunt patency with different types of shunts are shown in [Table 2](#).

3.2. Clinical end points

Of the 101 patients who completed the treatment, in 91 patients (90.1%), the symptoms of ascites completely resolved. In 9 patients (8.9%) symptoms of ascites partially (incompletely) resolved. So, the overall response rate was 99%. Only one patient did not show any improvement. The clinical data of Budd–Chiari before and 2 months after treatment are shown in [Table 3](#). In the 75 patients who underwent porto-systemic shunts, only 3 patients died in the first year because of liver function failure with mortality rate of 4% at one year.

Table 2 Porto-systemic shunt patency.

	Entire cohort (75)		Uncovered shunt (59)		Covered shunt (16)	
Primary patency	56/75	74.6%	41/59	69.4 %	15/16	93.7%
Reintervention rate	40%		62.5%		14.2%	
Assisted-primary patency	71/75	93.3%	55/61	90.1%	16/16	100%

Table 3 Clinical and biochemical data of the patients before and 2 months after interventions.

	Baseline	After 60 days
Ascites, no.	98/103	8/103
Dilated abdominal veins	9/103	1/103
Haematemesis, no.	6/103	1/15
ALT ¹ , IU/L	332 (17–619)	31 (18–64)
AST ¹ , IU/L	368 (198–734)	39 (26–64)
GGT ¹ , IU/L	164 (77–297)	123 (55–254)
Albumin, g/dl	3.3 (22–39)	3.5 (33–38)
Bilirubin, mg/dl	2.7 (1.9–3.9)	2.1 (1.7–2.7)

4. Discussion

Budd–Chiari syndrome is an uncommon fatal disorder of the liver. Recently it was classified into 4 pathological types. Types (1) and (2) involve short occlusion at supra hepatic cava (type 1) or hepatic veins (type 2). For types 3 and 4, there is total occlusion of the hepatic vein without (type 3) or with cava (4). For type (1) and type (2), there is recanalization in the best treatment option to restore the normal venous circulation of the liver. However, for types 3 and 4 a shunt between portal vein and cava (porto-systemic shunt) is the only option to alleviate liver congestion and prevent the ongoing liver failure (7,8).

The aim of our study was to evaluate the different radiological techniques treating Budd–Chiari patients regarding the technical and clinical outcomes.

Regarding caval occlusion (type 1), we have treated 9 patients, using caval angioplasty. In 4 cases, occlusion was total and needed web penetration by RUPS-100 needle. Such technique was difficult as in the last years and many authors (9,10) have used different tools (11) as the stiff end of the guide wires. Results were somehow not satisfactory and the complication rates were high (8%). We have used another technique that was safe and effective to re-open the totally occluding web. Such technique depends on the anatomical features of the cava. In anterior view of the cavogram, the cava looks to evacuate contrast direct view and the cava looks to have postero-anterior direction. Based on such course, we used the curved Brockenbrough needle to pass through the totally occlusive membrane. However, to be more accurate, a pigtail catheter was put in the IVC toughing the occlusion point. When the antero-posterior and lateral views confirm the alignment of both needle and catheter, the needle is pushed to penetrate the web. This technique proved to be effective in recanalization of cava. This confirmed the results of other reports (12) that described this technique.

Recanalization of one of the hepatic veins is more difficult than that of the cava. Percutaneous transhepatic approach was used before to complete the procedure (12,13). However, tran-

shepatic approach has more evident complication, mostly bleeding (14). We used transjugular approach in most of our patients (8 patients) or combined with transhepatic approach in 6 patients. Regarding the transjugular approach, we used the Brockenbrough needle that has a curve of 30°. However because the angle between the cava and hepatic vein ranges from 30° to 90°, the curve of the needle is increased to adopt. We used the transhepatic approach only in cases of failure, to have a guide wire land-marking the vein ostium.

Regarding the technical outcome, our results conformed to others (15) who reported technical success rate of 100%. In general, our 26 patients were subjected to recanalization by dilatation as a primary treatment. Recurrence of stenosis was high and reached and such patients were subjected to shunting. After shunting, the primary-assisted rate got higher than the primary dilatation.

We found that re-stenosis rate of the hepatic vein dilatation is higher than that of caval lesions which may be related to the narrowness of the hepatic vein vessel and the fact that the blood stream returns through the IVC angulately. The cause of re-stenosis after PTA and shunt implantation is uncertain, but the following factors may play a role: (1) injury to blood vessels causes proliferation, migration and excretion of smooth muscle cell matrix and causes proliferation of the intima, (2) injury to endothelial cells and laceration of intima causes local blood vessel thrombosis and organization, and (3) rebound of blood vessel causes re-stenosis (16). Long-term anticoagulation post-operation is an effective method of preventing re-stenosis. The patients that took aspirin and agacore orally after treatment procedures had better outcomes. Other methods for the prevention of re-stenosis include covered, biodegradable and electrolytic shunts.

Regarding types 3 and 4 Budd–Chiari disease, the totally occluded hepatic vein makes recanalization impossible: whether because of the widespread thrombosis or diffuse inflammatory station. So, such patients should be treated by portosystemic shunting (17). However, the absence or the thrombosis of the right hepatic vein makes shunt insertion very difficult. In such cases we could reach the right portal vein either by transjugular approach alone or by combined transhepatic transjugular approaches (DIPS). We found that the TIPS is more effective than DIPS regarding the patency rates.

Regarding our patients, porto-systemic shunt could be tried in 77 patients, with technical success of 97%. Regarding the covered shunts, we used Viatorr shunts that are covered by expanded polytetrafluoroethylene membrane.

Some authors reported that tips for cases of terminal Budd–Chiari could prolong life for liver transplantation. It also improves their clinical station for longer list for liver transplantation. We also confirm these reports, where the overall survival for one year was 86% and the clinical and biochemical findings were improved. For our subgroup of porto-systemic shunt who were subjected to combined tran-

sjugular and transhepatic approaches, the re-stenosis rate was high. On the other hand group for conventional TIPS showed better patency rates. This could be attributed to the shape and pattern of shunt position. In combined approaches, the curve of shunt is higher and showed higher rate of thrombosis, compared to the relatively straight course of shunt in conventional TIPS.

Porto-systemic shunt failure or inefficacy of its periodic revisions does not preclude the performance of a subsequent surgical operation (18).

The disadvantages of portosystemic shunts are essentially shunt malfunctions caused by stenosis and/or occlusion of the intrahepatic tract due to intimal hyperplasia or thrombosis that generally caused by biliary contamination. In addition, BCS is characterized by thrombophilia and hypercoagulability, which, if not effectively corrected by anticoagulation therapy, increase the incidence of shunt thrombosis up to 80% after 1 year, with resulting reappearance or worsening of the complications of portal hypertension (19,20). In recent years, new shunts covered with polytetrafluoroethylene (PTFE) membranes have become available that dramatically reduce the rate of shunt malfunction/thrombosis and consequently the need for periodic revisions, which were very frequent when only bare shunts were used (21). A recent study compared TIPS with uncovered and covered shunts in 13 patients with BCS, reporting primary patency rates of 16.7% vs 100%, respectively, at 6 months and 0% vs 85.7% at 12 months (22).

Similarly, in our study the subgroup of patients with covered shunts had significantly higher primary patency rates than those with uncovered shunts (93.7% vs 69.4%) and very low rates for shunt revision (14.2%).

Shunting the blood decreases portal pressure and could alleviate gastro-intestinal bleeding and ascites. Moreover, the liver decongestion improves the liver functions and prevents deterioration. In most cases, TIPS was very effective in controlling the clinical symptoms and significantly reducing the portosystemic pressure gradient and consequently the complications of portal hypertension (63.3% reduction in the portosystemic pressure gradient) (23,24).

In conclusion, our study confirms previous reports on the feasibility and efficacy of different interventional techniques in controlling the complications of portal hypertension and in improving liver function and consequently the clinical status of patients with BCS. These techniques proved to be safe and effective.

Conflict of interest

We, the authors below, certify that there is no conflict of interest with any financial organization regarding the material discussed in the research paper titled "Evaluation of different radiological Interventional treatments of Budd–Chiari syndrome".

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