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AIM AND SCOPE

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FLYLEAF

EDITORS FOR THIS ISSUE

Outcomes of pregnancy in patients with known Budd-Chiari syndrome

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Abstract

AIM
To analyse the risk of pregnancy (a prothrombotic state) in patients with Budd-Chiari Syndrome (BCS).

METHODS
Retrospective study of pregnancy in women with known BCS at single center from January 2001 to December 2015.

RESULTS
Out of 53 females with BCS, 7 women had 16 pregnancies. Median age at diagnosis of BCS in these women was 25 years (range 21-34 years). At least one causal factor for BCS was identified in 6 women (86%). Six women had undergone radiological decompressive treatment. All patients had anticoagulation. Six fetuses were lost before 20 wk gestation in 2 women. There were 9 deliveries over 32 wk gestation and one delivery at 27 wk. All infants did well. Seven babies were born by emergency caesarean section. There were no cases of thrombosis. Two patients had notable vaginal (PV) bleeding in 3 pregnancies. None of the patients had variceal haemorrhage. Two patients were diagnosed with pulmonary hypertension, one during pregnancy

and the other in the post-partum period. There was no maternal mortality.

CONCLUSION

Maternal outcomes in patients with treated BCS are favourable and fetal outcomes beyond 20 wk gestation are good. There has been increased rate of caesarean section. Pulmonary hypertension is an important finding that needs further validation. These patients should be managed in centers experienced in treating high-risk pregnancies.

Core tip: Pregnancy is a prothrombotic state and can cause adverse outcome in patients with Budd-Chiari syndrome (BCS). In our study, maternal outcome in patients with known and treated BCS was good. However, most deliveries were carried out by emergency caesarean section (7/10). There was high incidence of placental disease leading to caesarean section. Fetal outcome beyond 20 wk gestation was also good. With careful monitoring of anti-coagulation, there were no cases of thrombosis and only a minority of patients had noteworthy bleeding complications. Development of pulmonary hypertension in two patients several years after TIPSS is an important finding that warrants further studies.

INTRODUCTION

Budd-Chiari syndrome (BCS) is a rare disorder caused by hepatic venous outflow obstruction and resulting hepatic dysfunction due to sinusoidal congestion, ischaemic injury to the liver and portal hypertension. The main mechanism for BCS is thrombosis of the hepatic veins or of the terminal portion of the inferior vena cava[1,2]. The management using a stepwise regimen is largely successful with anticoagulation and interventional radiology alone. Stepwise regimen includes; (1) anticoagulant therapy for an indefinite period of time; (2) angioplasty or stenting for stenosis of hepatic veins; and (3) decompressive techniques [surgical shunt or transjugular intrahepatic porto-systemic shunts (TIPSS)], for patients who are non-responsive to medical treatment or not candidates for angioplasty/stenting[3]. TIPSS has a lower morbidity

and mortality rate than surgery and is a preferred approach**.** The outcomes are favourable with 10-year survival approaching 90%[4,5].

Usually multiple risk factors for venous thromboembolism are present in patients with BCS[1,6-8]. In one study, 84% of 163 patients with BCS had at least one thrombotic risk factor, and 46% of these patients had more than one prothrombotic risk factor; the most common was myeloproliferative neoplasia (MPN) (49% of 103 tested patients)[9]. In another study of 43 women with BCS, at least one thrombotic risk factor (not considering pregnancy as risk factor) was identified in 40 women (93%) including MPN in 56% of study participants[10]. Other thrombotic risk factors include mutation in Factor V Leiden and prothrombin gene, protein C, protein S or antithrombin deficiency, antiphospholipid syndrome, hyperhomocysteinemia and paroxysmal nocturnal haemoglobinuria. BCS may also be a complication of systemic vasculitides such as Bechet's disease[11].

BCS mainly affects women of childbearing age and pregnancy can be a crucial issue. There is conflicting data on prevalence of pregnancy related BCS. A systematic review and meta-analysis of twenty studies demonstrated a pooled prevalence of pregnancy-related BCS of 6.8%[12]. However another study showed that pregnancy is unlikely to cause BCS in the absence of other thrombotic risk factors[10].

Pregnancy is a hypercoagulable state and earlier studies reported that women with BCS could be at risk of developing severe exacerbation of their underlying disease during pregnancy[13,14]. Rautou *et al*[15] conducted a study on outcome of pregnancy in women with known and treated BCS and concluded that good maternal outcome could be achieved with current treatment modalities and close surveillance of BCS. Therefore, BCS cannot be considered a contraindication to pregnancy in stable patients with well-controlled disease.

As the available literature on pregnancy complications in women with known BCS remains scarce, we performed this study of women treated at our tertiary centre for BCS who had become pregnant.

MATERIALS AND METHODS

We used the definitions related to outcome of pregnancies as previously described by Rautou *et al*[15]: (1) date of diagnosis of BCS: the first imaging modality showing an obstructed venous outflow tract; and (2) miscarriages: A spontaneous loss of pregnancy before 20 weeks' of gestation. Outcome of the pregnancy: (1) favourable: Live birth occurred at 32 or more completed weeks of gestation, with a healthy infant and no serious obstetrical complication (bar intrahepatic cholestasis); and (2) poor: Otherwise pregnancy outcome. Rotterdam prognostic index was calculated as previously described[16].

The electronic records of all female patients dia-

gnosed with BCS between January 2001 and December 2015 at our tertiary care referral center were retrospectively analysed. The data was collected prospectively and radiology records of these patients were also searched. Those that became pregnant during the follow-up for BCS were included in the study. Patients in whom pregnancy occurred before BCS was diagnosed were excluded.

All patients were tested for the known prothrombotic factors. Combined oral contraceptive pill (OCP) use within the 3 mo preceding diagnosis of BCS was considered a thrombotic risk factor.

Where possible, patients had pre-pregnancy counselling and were made aware of the potential complications that may occur during pregnancy. Patients with known varices or portal hypertension had pre-pregnancy gastroscopy to ensure varices had been treated. These patients had further gastroscopies for variceal surveillance during second trimester. Patients with TIPSS had regular abdominal ultrasound to ensure patency of the TIPSS. The patients were monitored in a joint haematological/obstetric clinic.

Given the risk of embryopathy and fetal loss associated with warfarin, low molecular weight heparin (LMWH) was substituted for warfarin as soon as pregnancy was diagnosed, or prior to conception in one patient who had two *in-vitro* fertilisation treatments. The dose of LMWH was adjusted to maintain therapeutic factor Xa activity in selected cases under haematology supervision. LMWH treatment was replaced by warfarin following the delivery.

RESULTS

Baseline characteristics
Fifty-three female patients under follow-up for BCS were identified. Out of these, 7 patients had 16 pregnancies during the study period.

Median age of diagnosis of BCS was 25 years (range 21-34 years). Five (71%) patients had abdominal pain as the presenting complaint and symptoms were mainly chronic in nature. One patient had variceal haemorrhage and three patients had ascites on presentation of BCS. None of them had hepatic encephalopathy. None of the patients had other significant co-morbidities when the diagnosis of BCS was established. The characteristics of these patients including Rotterdam and Clichy scores at the time of diagnosis of BCS are given in Table 1. The laboratory values were stable at time of conception in all patients and ascites had resolved.

BCS was managed by anticoagulation therapy and radiological interventions with the aim to recanalise any outflow obstruction. Six out of the 7 patients underwent liver decompression procedures before conception. Procedures included dilatation of right hepatic vein (one patient), TIPSS (in four patients) and right hepatic vein stenting (one patient). One patient did not have any intervention for decompression and was managed with oral anticoagulation (warfarin) alone. All patients had anticoagulation. None of the patients in our series required surgical porto-systemic shunting or liver transplantation as a definite treatment of BCS.

At least one causal factor for hepatic vein obstruction was identified in 6 of these 7 women (86%). JAK 2V617F mutation alone was seen in 2 patients; factor V Leiden alone in one; JAK 2 mutation and factor V Leiden in one patient; JAK 2 mutation and OCP use in one patient; and factor V Leiden and OCP use in one patient. One patient did not have any identifiable risk factor.

Pregnancy course
Median age at conception was 32 years (range 23-39). Median time between diagnosis of BCS and conception was 5 years (range 3 mo-13 years). Follow up after the diagnosis of BCS in the seven women with pregnancies was for a median of 7 years (range 3-14 years). All patients that became pregnant had well compensated liver disease at the time of each conception and stigmata of decompensation of liver disease (ascites, in majority of patients at presentation) were no longer present at the time of any pregnancy. Gestational course is detailed in Table 2.

Aspirin (along with LMWH) was administered to one patient in 2 pregnancies (patient 6) for Essential Thrombocytosis. This patient was also treated with interferon for JAK 2 positive MPN. No patient was treated with beta-blockers during pregnancy.

Six out of the 16 (38%) pregnancies miscarried with fetal loss before 20 wk gestation. Six miscarriages/failed pregnancies occurred in 2 patients. One miscarried at 5 wk when she presented with vaginal bleeding. She was not aware of the pregnancy. The other patient had 5 miscarriages over a 9-year period. Two out of 5 were after the first trimester and these were attributed to cervical weakness and, therefore, she had cervical sutures in the following pregnancies (after 13 wk of gestation) leading to two successful deliveries.

Out of the 10 pregnancies reaching beyond 20 wk gestation, there were 3 vaginal deliveries and 7 caesarean sections. There was one very preterm birth at 27 wk and 5 preterm deliveries between 32 and 35 wk gestation, all with favourable neonatal outcomes. Four pregnancies resulted in delivery after 36-wk gestation, again all with favourable outcome.

Seven (70%) infants were delivered *via* emergency caesarean sections. Indications for caesarean section were varied, including fetal distress in three pregnancies; pre-eclampsia in one, breech presentation in one, bleeding from placenta praevia in one patient and difficult labour due to cervical suture in one patient.

Specific complications
Four patients developed intrahepatic cholestasis of pregnancy (ICP) in five pregnancies and they were treated with ursodeoxycholic acid. One patient had pre-eclampsia needing emergency caesarean section.

Table 1 Baseline characteristics of the patients at presentation

Patient ID	1	2	3	4	5	6	7
Age at diagnosis (yr)	34	21	30	21	31	24	25
Symptoms at presentation	Ascites	Oesophageal variceal haemorrhage, abdominal pain	Abdominal pain; ascites	Abdominal pain, ascites	Abdominal pain, fever, mouth ulcers	Ascites, renal failure and sepsis (ITU admission)	Abdominal pain
Risk factors for BCS	JAK 2 positive MPD; OCP	JAK 2 positive mutation	None identified	Factor V Leiden; OCP	JAK2 positive MPD (Essential Thrombocythaemia); Factor V Leiden	JAK 2 positive mutation	Factor V Leiden
Encephalopathy	None	None	None	None	None	None	None
Ascites	Moderate	Mild	Mild	Mild	None initially	Severe	Moderate
INR	1.7	1.4	1.2	1.3	1.7	1.4	1.5
Albumin (g/L)	28	37	49	49	49	25	26
Bilirubin (umol/L)	19	18	20	18	11	51	32
ALT (U/L)	-	31	-	57	-	-	-
AST (U/L)	134	49	20	34	27	277	43
Urea (mmol/L)	2.7	2.3	2.9	4.7	2.9	4.4	2
Creatinine (mmol/L)	72	43	70	68	51	92	70
Sodium (mmol/L)	143	137	143	142	140	130	133
MELD	19	14	6	10	12.37	14	17
UKELD	53	53	48	49	49	49	55
Hb (g/L)	137	121	155	128	150	147	88
WCC (10^9/L)	7.9	9.6	10.9	5.7	5.7	28.8	6.8
Platelets (10^9/L)	345	183	307	247	411	400	226
Rotterdam PI	1.116	0.072	1.12	0.07	1.08	1.244	1.168
Clichy PI	4.39	1.99	3.13	4.04	3.44	7.54	7.55
Liver biopsy	Not done	Not done	Not done	Suggestive of hepatic vein obstruction	Consistent with Hepatic venous outflow obstruction	Not done	Not done
Level of obstruction	Left hepatic vein	Hepatic vein	Hepatic vein	Hepatic Vein	Right Hepatic Vein	Left Hepatic vein	Hepatic vein
Radiological intervention	TIPSS	TIPSS	None	Angioplasty and Stenting to Hepatic vein	Right Hepatic Vein dilatation	TIPSS	TIPSS
Type of TIPSS	Viatorr (covered)	Viatorr (covered)	-	-	-	Memotherm, then Viatorr	Memotherm (Uncovered)
Medications post intervention	Warfarin	Warfarin	N/A	Warfarin	Warfarin	Warfarin, Interferon	Warfarin
Duration of follow up (yr)	4	5	7	3	13	14	14
Comments/complications following intervention	TIPSS Stent redilatation after a week of insertion	TIPSS stent stenosis - needed to be re-dilated in 2 yr	Maintained on oral anticoagulation (warfarin) and did not require any intervention	Vascular Wallstent was re-canalized after 2 yr	Inferior RHV dilated 5 yr after the diagnosis (developed ascites and had compliance issues).	Bleeding from hepatic nodule (with INR > 9). Managed conservatively. Later stent was changed to a covered one for TIPSS stenosis	-

MPD: Myeloproliferative disorder; TIPSS: Trans-jugular intrahepatic posto-systemic shunt; OCP: Oral contraceptive pills; INR: International normalised ratio; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; MELD: Model for end-stage liver disease; UKELD: United Kingdom model for end-stage liver disease; Hb: Haemoglobin; WCC: White cell count.

Significant PV bleeding occurred after 3 pregnancies in 2 patients (patients 3 and 6 in Tables 1 and 2). One patient (patient 3) had a primary post-partum haemorrhage secondary to a retained placenta that was surgically removed. The other patient (patient 6) had a complicated first pregnancy with placental abruption at 27 wk gestation and needed emergency caesarean section. In her second pregnancy, she had secondary postpartum haemorrhage following caesarean section for suspected placental abruption. It was treated with surgical evacuation of uterine clot and insertion of a Rusch Balloon. There were no cases of variceal haemorrhage.

One patient, (patient 5) underwent regular gastroscopies for banding of (non-bleeding) oesophageal varices. That patient was not treated with beta-blockers during pregnancy. There were no cases of thrombosis in any of the pregnancies.

Table 2 Gestational course and perinatal complications in 16 pregnancies

Patient No.	Pregnancy No.	Age at gestation (yr)	Anticoagulation during pregnancy	Mode of delivery	Weeks gestation	Birth weight	Foetal/infant condition	Maternal condition
1	1	37	LMWH	Vaginal	36	2645 g	Neonatal jaundice, treatment with antibiotics for suspected infection	
2	2	24	LMWH	Emergency caesarean section	35	2140 g	Fetal distress (reduced foetal movements)-Healthy baby	ICP OGDs during pregnancy, no varices seen
3	3	35	LMWH	Vaginal delivery	35	2600 g	Mild Jaundice	*In-vitro* fertilization treatment
3	4	37	LMWH	Vaginal delivery	37	2450 g	Healthy	*In-vitro* fertilization treatment Primary post-partum haemorrhage secondary to retained placenta that was surgically evacuated
4	5	23	LMWH	Caesarean section	37	2645 g	Fetal distress - Healthy baby post delivery	…
5	6	36	LMWH and Aspirin (switched from warfarin and Hydroxyurea at 22 wk when pregnancy was diagnosed)	Emergency caesarean section	37	3115 g	Breech presentation	Had several gastroscopies (OGD) and banding to Oesophageal Varices during pregnancy
5	7	39	Warfarin	Miscarriage	5	-	-	PV bleeding; was not aware of conception
6	8	31	LMWH	Emergency Caesarean Section	27	Not available	Healthy boy	Bleeding secondary to placental abruption ICP from 25 wk
6	9	37	LMWH, Aspirin, interferon for MPD (Myeloproliferative disorder)	Emergency Caesarean section	35	Not available	Fetal distress. Healthy baby	ICP Minor subchorionic bleeding at 12 and 23 wk. LMWH reduced, aspirin stopped temporarily. Changes resolved on subsequent scans. Presentation with PH and suspected placental abruption at 35 wk Secondary post-partum haemorrhage treated with surgical of uterine clot evacuation and Rusch Balloon
7	10	25	LMWH	Miscarriage	9	-	-	-
7	11	27	LMWH	Miscarriage	20	-	Congenital pneumonia and mild amnionitis	Weakness of cervix;
7	12	28	LMWH	Miscarriage	19	-	-	Placental abruption Weakness of cervix; Placental abruption
7	13	29	LMWH	Emergency Caesarean Section	35	2974 g	Healthy boy	Dyspnoeic during 3rd Trimester; ICP in 20 wk onwards; C-Section for difficult labour (cervical suture could not be removed)
7	14	31	LMWH	Failed Pregnancy	10	-	-	Surgical removal of retained products of Contraception
7	15	33	LMWH	Miscarriage	7	-	-	-
7	16	34	LMWH	Emergency Caesarean Section	35	2440 g	Healthy boy	Pre-eclampsia; Breathlessness during 3rd trimester, PH diagnosed after pregnancy

LMWH: Low molecular weight heparin; ICP: Intrahepatic cholestasis of pregnancy; PH: Pulmonary hypertension.

Two patients (patients 6 and 7) developed sym- ptoms of pulmonary hypertension (PH) during the

course of pregnancy and are described as follows.

Case 1

This patient had second pregnancy at the age of 37 years (13 years after the diagnosis and treatment of BCS). She had minor subchorionic bleeding noted on ultrasound during pregnancy. At 35 wk of gestation, this patient had emergency caesarean section for suspected placental abruption and developed respiratory failure post operatively. Trans-thoracic echocardiography (TTE) suggested PH with pulmonary artery systolic pressure estimated at 60-65 mmHg. CT scan excluded pulmonary embolism and showed patent TIPSS and mild spleno-megaly. Right heart catheterisation confirmed the presence of PH with mean pulmonary artery pressure (mPAP) of 37 mmHg and pulmonary artery wedge (PAWP) pressure of 12 mmHg. She is being treated with Sildenafil (phosphodiesterase inhibitor) and Macitentan (endothelin receptor antagonist) for PH. Follow up investigations demonstrated improved exercise toler-ance with no significant limitations in activities of daily living (patient 6; Tables 1 and 2).

Case 2

This patient delivered her second child at 34 years of age, 9 years after the diagnosis and treatment of BCS. Caesarean section was performed at 35-wk gestation for pre-eclampsia. Dyspnoea on exertion was noted during the pregnancy and six months after delivery she was admitted with right heart failure. CTPA excluded pulmonary embolus; but noted dilatation of pulmonary artery, moderate to severe dilatation of right atrium and moderate dilation of right ventricle with a degree of right ventricular hypertrophy. TIPSS was shown to be patent. TTE demonstrated severe PH, severely dilated right ventricle with impaired systolic function. Right heart catheterisation confirmed PH (mPAP 53 mmHg, PAWP 11 mmHg). The patient has been treated with sildenafil and intravenous Iloprost (along with warfarin) for PH and is being considered for lung transplantation assessment (patient 7; Tables 1 and 2).

DISCUSSION

The majority of the patients affected by BCS in Western countries are women of childbearing age[1,16], with the peak incidence in the third decade for women and in the fourth decade for men[17]. Fertility is generally unaffected in women with BCS as only a minority becomes cirrhotic.

Several previously reported observations suggest that pregnancy in BCS women could cause deterioration of the liver disease and pregnancy was associated with development of ascites in several women with known BCS[17-19]. Rautou *et al*[15] showed that the maternal outcome, in 14 women with 24 pregnancies is good in women becoming pregnant after the diagnosis and treatment of BCS. All mothers were alive at a median

follow-up of 34 mo after last delivery and only one of them required liver transplantation after 73 mo follow-up.

In our series, there were no thrombotic events occurring during pregnancy or the postpartum period. This is comparable to previous study[15] where 2 of 17 pregnancies on anticoagulation therapy were complicated by portal vein thrombosis[15]. Subclavian and portal venous thrombosis has been reported in a pregnant patient with known and treated BCS secondary to (JAK 2 negative) essential thrombocytosis on anticoagulation[20].

Two patients had notable bleeding related to 3 deliveries in contrast to 6 patients with 7 bleeding episodes during pregnancy or postpartum in the previous study[15], signifying the importance of careful management of anticoagulation in pregnancy.

Both of our patients who developed pulmonary hypertension (mPAP $\geq$ 25 mmHg at rest) had the diagnosis of BCS and insertion of TIPSS several years ago. TIPSS has been regarded as a cardiac stress by suddenly increasing the preload leading to increased cardiac diastolic volumes and diameters, and a transient PH for 3-6 mo[21,22]. It is usually accommodated rapidly and is then associated with a reduction in systemic vascular resistance and a reduction in afterload[22]. However, development of PH after one and half years following TIPSS insertion has been reported[23]. In a recent study looking at the long-term cardiopulmonary outcome following TIPSS in cirrhotic patients, authors found higher prevalence of PH in the TIPSS group, 1 to 5 years post TIPSS implantation[24]. Although the patients in that study[24] could could have had associated cirrhotic cardiomyopathy, conversely there appears to be a potential long-term risk of development of PH in non-cirrhotic patients with a patent, functional TIPSS. Therefore, further studies on the interactions of TIPSS and cirrhotic cardiomyopathy are warranted[25].

PH has also been reported as a common finding in MPN[26]. This possible association of PH with MPN has also been suggested by small case series and studies[27-30] and the exact incidence and prevalence of PH in this group of patients remain poorly defined[31]. MPN could possibly have had an impact on the development of PH in one of our patients (patient 6).

Current recommendations are to offer endoscopic screening for varices in patients with portal hyper-tension, when conception is planned and during the second trimester if not already on prophylaxis. One patient (patient 2) who had originally presented with variceal haemorrhage underwent gastroscopy in second trimester for variceal screening and was found not to have varices. Another patient (patient 5, who had right hepatic vein dilatation) had several gastroscopies for oesophageal variceal band ligation during pregnancy. None of the patients suffered variceal bleeding during pregnancy or were administered non-selective beta-blockers during pregnancy given concerns regarding

use of beta-blockers in pregnancy[32,33].

The number of deliveries by caesarean section was higher in our group of patients (7 in 10 deliveries, 70%) than in the general obstetric population in England (26%)[34] and the previous study (8 caesarean sections in 17 pregnancies, 47%)[15]. Although some of the indications for caesarean section were clearly not related to the presence of BCS (*e.g.,* breech presentation, placenta praevia), the high incidence of placental disease (abruption, pre-eclampsia, fetal distress) leading to caesarean section may be related to the underlying causative aetiology of the BCS. Therefore, close maternal and fetal surveillance for placental disease should be considered in these patients.

Interestingly, for unknown reasons, incidence of ICP has been higher in our patients (4 patients in 5 pregnancies) than the normal obstetric population (0.7%-1.5%)[35,36].

Our study supports that the maternal outcome is good in women becoming pregnant after the diagnosis and treatment of BCS. This favourable maternal outcome is likely to be attributable to improvement in management of BCS including effective decompressive treatment, management of the underlying conditions, anticoagulant therapy with careful follow-up; and management of pregnancy and delivery in multi-disciplinary settings. A possibly decreased level of significant bleeding and no thrombosis implies the benefits of very close monitoring of anticoagulation through joint clinics.

In contrast to the good overall maternal outcome seen in our set of patients, the livebirth rate of 62.5% is lower than in the general obstetric population (84%[37] and 85%-88%[38]), but is better than earlier reports and in line with the finding of Rautou *et al*[15]. Importantly, failed pregnancies occurred in only 2 out of 7 patients. One patient (patient 7) had 5 fetal losses over a 9-year period (83% of the incomplete pregnancies reported here).

Our study supports the conclusion that BCS cannot be considered a contraindication to pregnancy in stable patients. Development of PH is an important finding that needs further validation. Such patients should be managed at tertiary level care centres with multi-disciplinary involvement.

COMMENTS

Background
Budd-Chiari syndrome (BCS) is a rare condition that results from hepatic venous outflow obstruction mainly due to the thrombosis of the hepatic veins and leading to hepatic dysfunction and portal hypertension. Patients with BCS usually have risk factors for venous thromboembolism (VTE). BCS mainly affects young women. Pregnancy is one of the risk factors for VTE and earlier studies reported that women with BCS could be at risk of developing severe exacerbation of BCS during their pregnancies.

Research frontiers
Pregnancy is an important issue in young women with known BCS. There are very few literature sources concerning the pregnancy related complications in women with known BCS. This study hotspot is to look at the outcome of pregnancies in women treated at the centre for BCS and to help other peers understand this important relationship.

Innovations and breakthroughs
Several previously reported observations suggest that pregnancy in women with BCS could cause deterioration of the liver disease. In this series, maternal outcome was good. There were no thrombotic events occurring during pregnancy or the postpartum period, comparable to a large previous study. Only two patients had notable bleeding related to 3 deliveries signifying the importance of careful management of anticoagulation in pregnancy. Two out of 7 patients developed pulmonary hypertension several years after the diagnosis of BCS and insertion of TIPSS. Higher prevalence of PH up to 5 years post TIPSS in cirrhotic patients has been reported recently. There appears to be a potential long-term risk of development of PH in non-cirrhotic patients with a patent, functional TIPSS that needs further exploration. There was higher incidence of deliveries by caesarean section (7 in 10 deliveries) in this study group and was attributed to the placental disease that could be related to the underlying causative aetiology of BCS.

Applications
This study supports that the maternal outcome in women becoming pregnant after the diagnosis and treatment of BCS is good. Fetal outcome beyond 20 wk gestation is also good. Close maternal and fetal surveillance for placental disease should be considered in these patients. Development of PH post TIPPS is an important finding that needs further validation. Such patients should be managed at tertiary level care centres with multi-disciplinary involvement.

Terminology
The BCS is named after a British Physician, George Budd in 1845 and a pathologist Hans Chiari who first described the features of BCS caused by the hepatic venous outflow obstruction in 1899. TIPSS-transjugular intrahepatic portosystemic shunt or transjugular intrahepatic portosystemic stent shunting is an artificial connection within the liver between the inflow portal vein and the outflow hepatic vein. This procedure is usually performed to reduce the portal pressure.

Peer-review
This is an interesting observational analysis of BCS in relation to pregnancy. Previous data are scarce and heterogeneous. The manuscript is nicely written.

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