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Full Length Research Paper

Evaluation of modified Eversion Thrombectomy Technique as a Management of Portal Vein Thrombosis in Living Donor Liver Transplantation

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Abstract
Background: Portal vein thrombosis (PVT) complicates 0.6–16% of patients with end-stage liver disease with compensated (Nonami et al.) and up to 35% of cirrhotic patients and hepatocellular carcinoma. Although it was used to be a contraindication, PV thrombectomy during LDLT is part of the routine nowadays. Methods: A retrospective cohort study involving patients suffering of PVT who underwent LDLT at ASCOT (Ain- Shams Center of Transplantation) of Ain-Shams University Specialized Hospital, Wadielneel hospital, and Egyptair hospital by the same surgical team in the period between November 2016 and November 2017. According to the data from the records, the patients (n=33) where allocated in 2 groups, Group A (n=16) underwent eversion thrombectomy using vascular clamps. Group B (n=17) underwent a modified eversion thrombectomy using finger compression method. Results: Mean age was 50.63 years in Group A and 51.65 years in Group B. Lower operative time (mean=8.71 hours, p=0.013), blood loss (median 1500 ml, p=0.029), blood transfusion rate (mean 2.19 units) and hospital stay (mean=15.71 days) were recorded in group B. A single recurrence and 43.8% mortality rate were recorded in Group A with no recurrences and 17.6% mortality in Group B. Conclusion:The minimal blood loss achieved during the procedure, the extent of thrombectomy, the lower operative time, the lower recurrence rate and lower mortality rate, makes the modified eversion technique superior to the conventional one. Further clinical trials and multicentric studies are needed to support this assumption.

Keywords: *Portal Vein Thrombosis, Living Donor Liver Transplantation, Thrombectomy*

Introduction

Portal vein thrombosis (PVT) is a common complication in patients with chronic liver diseases. It is found in 0.6–16% of patients with end-stage liver disease (Nonami et al., Fimognari et al., Sobhonslidsuk et al.), the percentage increases in cirrhotic patients with hepatocellular carcinoma to reach up to 35% (Nonami et al.).

The presence of PVT was considered, one day, to be a contraindication for living-donor liver transplantation (LDLT). As the expected technical difficulties of portal vein reconstruction, long warm-ischemia time, intraoperative blood loss, incidence of postoperative PV anastomotic stenosis and the relapse of PVT was thought to be grave. With time and the advances introduced to techniques, transplantation of patients with PVT is now part of the routine. The standard technique for removal of PV thrombus during LDLT is eversion thrombectomy (Dumortier et al.), however some modified eversion techniques were introduced and they are having promising results (Song et al.). Dealing with PVT in patients undergoing LDLT is now part of the routine in most transplantation centers.

Patients and Methods

This is a retrospective cohort study involving patients suffering of PVT who underwent LDLT at ASCOT (Ain- Shams Center of Transplantation) of Ain-Shams University Specialized Hospital, Wadielneel hospital, and Egyptair hospital by the same surgical team in the period between November 2016 and November 2017.

All patients were candidates for LDLT, portal vein thrombosis was diagnosed pre or intra-operative and the patients were candidates for thrombectomy. Patients with massive PVT extending to SMV and splenic vein and patients died on table were excluded from the study. Preoperative assessment was done as per protocol of the unit for all patients. During the transplantation procedure the thrombectomy was done be either of these procedures;

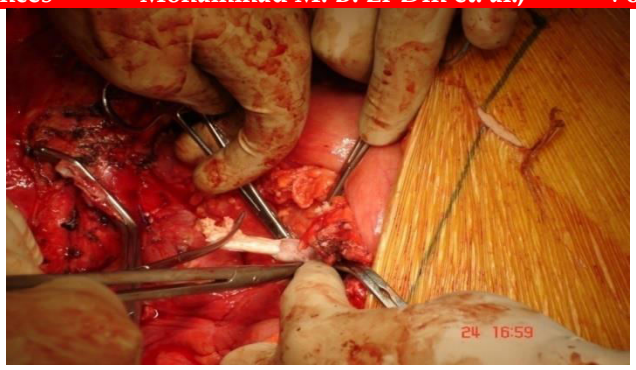

Fig 1; Eversion thrombectomy technique

Eversion thrombectomy technique; it was done under complete visual control. A vascular clamp was applied to control the PV inflow which removed at the when reaching lower extent of the thrombus. The PV was dissected to determine the extent of the thrombus. By maintaining the PV open using three clamps at 3, 9 &12 o'clock, after having tied its right and left branches, the cleavage plane between the thrombus and the intima was found using the endarteriectomy dissector. The clot was freed with the use of a clamp by everting the PV wall with clamping of the free edge of the clot with a clamp. This maneuver should be extended to the splenic and/or SMV if needed. After pulling the clot out, PV patency was assessed by introduction of the operator's index. The blood flow in the recipient PV was assessed by removing the clamp before the completion of the anastomosis. The PV was flushed with blood in order to remove residual and newly formed blood clots. Subsequently, portal flow was restored by end-to-end anastomosis. The ligation of any collateral circulation, especially the spontaneous splenorenal shunt, was done to optimize good portal flow.

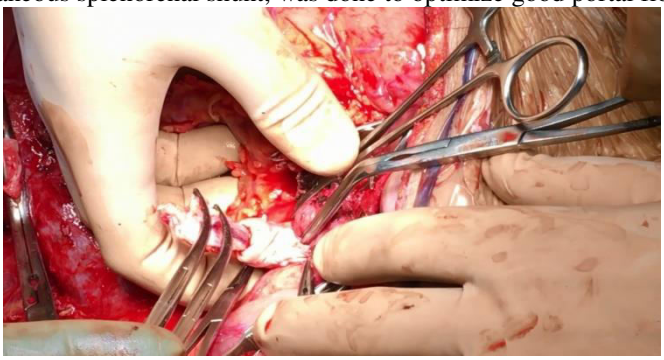

Fig 2: Modified Eversion thrombectomy technique

Technical procedures of the modification of eversion thrombectomy; Eversion thrombectomy was done as previously described with some modifications. In order to control the inflow, instead of applying a vascular clamp to control the inflow from the PV, the middle finger of the left hand of the assistant surgeon is used to push the PV against the pancreas. No sharp instrument was used for dissection, only a curved Kelly clamp with a blunt tip to prevent tearing of the PV wall. The dissection is carried out in a rotation pattern of 360°; anterior right side, then anterior left side, then posterior sides, and then again anterior right side and so on. The wall of the PV is not everted but tented by lifting it upward even when reaching the deeper part of the thrombus near the bifurcation of splenic vein and SMV.

And according the procedure used the study population were divided into 2 groups; Group A (n=16) underwent eversion thrombectomy using vascular clamps. Group B (n=17) underwent a modified eversion thrombectomy using finger compression method. Complete thrombectomy of the PVT was attempted in every case, but if the risk of PV tearing was presumed to be too risky while attempting complete thrombectomy and adequate PV flow was obtained after incomplete thrombectomy, the PV was reconstructed with the native PV with remnant PVT.

Intraoperative Doppler is done routinely after completion of the anastomosis and after abdominal closure. In cases of weak portal flow despite successful thrombectomy due to preexisting large collateral vessels, we ligated the collateral vessels to improve the PV flow or ligation the left renal vein.

Postoperative anticoagulation with Heparin then subcutaneous low molecular weight heparin (LMWH) and antiplatelets were used until discharge. Oral anticoagulant and antiplatelets were given for 1-6 months after discharge according to the suspected risk of rethrombosis. Thrombi from patients with PVT and HCC were sent for histopathology. Follow-up of the patients was from the date of surgery to Mid-Decemper 2017, by Doppler US daily in the first week, then twice per week till patient discharge, then every month in first year postoperative, then every 3-6 months after one year. CT portography was done for suspected cases of PVT or weak PV flow.

Statistical analysis

Data were collected, revised, coded and entered to the Statistics Open for ALL (SOFA) version 1.5.3. The quantitative data were presented as median with inter-quartile range (IQR) and ranges and mean with standard deviation while qualitative variables were presented as number and percentages.

The comparison of qualitative data was done by using Chi-square test and/or Fisher exact test. Mann-Whitney test was used for the comparison between two independent groups with quantitative data and non-parametric distribution while with parametric distribution was done by using Independent t-test.

Results:

Age of patients in Group A ranged from 34 to 65 years with mean of 50.63 years while in Group B it ranged from 35 to 60 years with mean of 51.65 years. As regard sex, 56.3% (n= 9) of Group A were males the rest were females (43.8%) while in Group B there 17.6% (n=3) were females and 82.4% (n=14) were male.

Table (1): Comparison between old and new technique regarding age, sex

		Old technique	New technique	Test value	P-value	Sig.
		No. = 16	No. = 17			
Age	Mean ± SD	50.63 ± 8.37	51.65 ± 6.14	-0.402•	0.691	NS
	Range	34 – 65	35 – 60			
Sex	Females	7 (43.8%)	3 (17.6%)	2.659*	0.103	NS
	Males	9 (56.3%)	14 (82.4%)			

*P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant *: Chi-square test; •: Independent t-test*

Four patients were classified as Child B (25%) and 12 as Child C (75%) in Group A while in Group B consisted of 9 patients with Child B class (52.9%) & 8 Child C class (47.1%). The MELD score in Group A ranged from 9 to 24 (mean = 15.81); while in Group B it ranged from 10 to 21 (mean = 14.82).

Table (2): Comparison between old and new technique regarding child class, child score and MELD score

		Old technique	New technique	Test value	P-value	Sig.
		No. = 16	No. = 17			
Child class	A	0 (0.0%)	0 (0.0%)	2.695*	0.101	NS
	B	4 (25.0%)	9 (52.9%)			
	C	12 (75.0%)	8 (47.1%)			
Child score	Mean ± SD	10.06 ± 1.53	9.06 ± 1.78	1.731•	0.093	NS
	Range	7 – 13	7 – 13			
	Median (IQR)	10 (9.5 – 11)	9 (7 – 10)			
MELD score	Mean ± SD	15.81 ± 4.07	14.82 ± 2.90	0.808•	0.425	NS
	Range	9 – 24	10 – 21			
	Median (IQR)	15.5 (12.5 – 18.5)	16 (13 – 16)			

*P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant *: Chi-square test; •: Independent t-test*

The operative time in Group A ranged from 7 to 12 hours with mean of 10.03 hours while in Group B it ranged from 7 to 11 hours with mean of 8.71 hours, this carried a significant difference with a p-value of 0.013. The hospital stays in Group A varied in the range of 2 to 65 days (mean = 17.63), while in Group B varied in the range of 2 to 35 days (mean = 15.71).

Table (3): Comparison between old and new technique regarding operative time

Surgical time	Old technique	New technique	Test value•	P-value	Sig.
	No. = 16	No. = 17			
Mean ± SD	10.03 ± 1.44	8.71 ± 1.45	2.633	0.013	S
Range	7 – 12	7 – 11			
Median (IQR)	10 (9.75 – 11)	8 (8 – 10)			

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant •: Independent t-test

The blood loss during surgery in Group A ranged between 1500ml and 4000 ml with median of 2000 ml while in Group B ranged between 400 and 4000 ml with median of 1500 ml, this was a statically significant difference (p-value=0.029). The blood transfusion during the surgery ranged from 2 to 4 units (mean=2.44) in Group A and Group B ranged from 0 to 3 units (mean = 2.19).

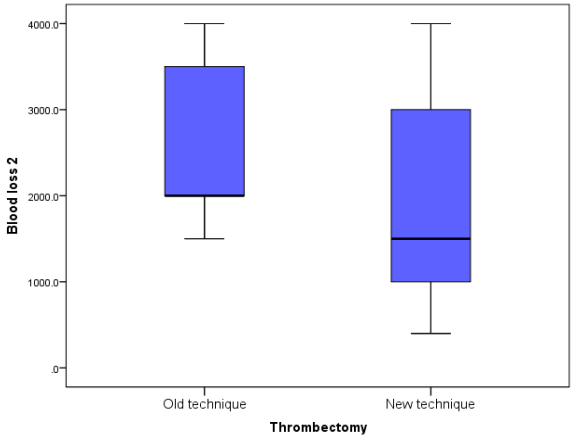

Fig 3: Comparison between old and new technique regarding blood loss.

Table (4): Comparison between old and new technique regarding blood loss & intraoperative blood transfusion

		Old technique	New technique	Test value≠	P-value	Sig.
		No. = 16	No. = 17			
Blood loss (ml)	Mean±SD	2593.75 ± 969.86	1806.25 ± 1160.73	-2.186	0.029	S
	Range	1500 – 4000	400 – 4000			
	Median (IQR)	2000 (2000 - 3500)	1500 (1000 - 3000)			
IO Blood Trans. (units)	Mean±SD	2.44 ± 0.73	2.19 ± 0.98	-0.244	0.807	NS
	Range	2 – 4	0 – 3			
	Median (IQR)	2 (2 - 3)	2.5 (1.5 – 3)			
Cell saver	Mean±SD	1500 ± 345	1300 ± 332	1.697	0.099	NS
	Range	0 – 4500	0 – 4000			
	Median (IQR)	1600 (1100 – 2300)	1550 (1000 – 2200)			
FFP	Mean±SD	2.5 ± 0.85	2.3 ± 0.95	0.636	0.529	NS
	Range	1 – 7	0 – 7			
	Median (IQR)	2 (1 – 4)	3 (2 – 5)			
Platelets	Mean±SD	1.2 ± 0.5	1.1 ± 0.74	0.452	0.654	NS
	Range	0 – 3	0 – 3			
	Median (IQR)	1 (0 – 2)	1 (0 – 2)			
Albumin	Mean±SD	7.3 ± 1.65	6.8 ± 1.32	0.964	0.342	NS
	Range	5 – 10	3 – 10			
	Median (IQR)	7 (6 – 9)	6 (4 – 8)			

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant ≠: Mann-Whitney test

There was a single case of PVT recurrence in Group A, on the other hand there were no recurrences in Group B. Regarding mortality rate, it was 7 cases (43.8%) in Group A and was 3 cases (17.6%) in Group B.

Discussion

Portal vein thrombosis remains a serious challenge during LDTL, thrombectomy was attempted and had an initial success rate of 31–95% (Bertelli et al.).In our study, eversion thrombectomy with using the 2 methods " the traditional and the modified " was possible in all patients with success rate of 100% (33/33); Song et al published his work with success rate of 98% (55/56) (Song et al.). In this study the average age of patients underwent LDLT with PVT was 51.15 years, the same average published in most of recent studies, with dominance of male sex (69.6 %) which is a risk factor, this agrees with most of studies, whoever Zakaria et al. reported predominance of the female sex (88.89 %) with no clear reason to explain this. Patients involved in this study scored on average 9.55 on the Child Pugh score, which agrees to many studies approaching alike population, whoever the MELD score was 15 in average which is lower than the average of most of the current studies (MELD=19) (Song et al., Mori et al.) this is due to the relatively short waiting list we have. We recorded average operative time of 9.35 hours, while most of the publications reported longer time (10 – 14.4 hours)(Song et al., Zakaria et al.).Recurrence rates in literature ranged from 13.33 – 25% (Ghabril et al., Mori et al., Zakaria et al.). In

this study we recorded a recurrence rate of 3% this is because of the short follow up period unlike other studies which scored up to 13 years follow up period.

There is a significant discrepancy regarding blood loss and intraoperative transfusion for such cases in literature ranging from an average of 2,000 ml blood loss and 2 units transfusion (as recorded in this work) up to an avarge of 13,000 ml blood loss and 11 units transfusion (Zakaria et al.). The recorded mortality rate in our study was 30.3% (10 cases: 6 cases of graft failure, 3 cases of sepsis, and a case failed extubation after surgery), it is higher than that reported by Mori et al. (19%)(Mori et al.), but lower than that reported by in Song et al. and Zakaria et al. which were 32.8 %, 35.6 % and 41.6 %, respectively (Song et al., Zakaria et al.).

This technical modification on the conventional eversion thrombectomy allows the surgeons to dissect the thrombus 10 cm more deeply compared to when the vascular clamp is applied, offers better control of bleeding during thrombectomy due to ease of manipulation of inflow, and offers tactile sense of the thrombus and of the instruments used for dissection allowing a much safer dissection hroughout the thrombectomy process. We believe this process is very important in preventing tearing of the PV at the deeper area as the instruments can perforate the wall if it is redundant resulting in a catastrophic event.

This modification was reported only few times in literature. Our recorded operative time (8.71 hours), average intra-operative blood transfusion (2.5 units), recurrence rate (0%) and mortality rate (17.6%), were more favorable than that found in literature for the same parameter's with using the same technique; which was operative time of 10 hours, average intra-operative blood transfusion of 9 units, recurrence rate of 8.9% and mortality rate 32.8 %(Song et al.).

Conclusion and Recommendation

The minimal blood loss achieved during the procedure, the extent of thrombectomy, the lower operative time, the lower recurrence rate and lower mortality rate, makes the modified eversion technique superior to the conventional one. Further clinical trials and multicentric studies are needed to support this assumption.

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