

Outcomes of Endoscopic Variceal Band Ligation for Esophageal Varices in Children

Nagina Shahzadi, Farzeen Fazal, Zahid Mahmood Anjum, Irum Aslam, Muhammad Imran Khan, Iqra Farooque

ABSTRACT

Objective: To determine outcomes of endoscopic variceal band ligation (EVBL) for esophageal varices (EV) in children presenting to a tertiary childcare hospital of Pakistan.

Study Design and Setting: A prospective observational cohort study was conducted at the Department of Pediatric Gastroenterology, The Children's Hospital and Institute of Child Health, Faisalabad (June 2023–March 2025).

Methodology: Children aged 2–16 years with endoscopically confirmed EV scheduled for EVBL were analyzed. Baseline demographics, EV grade, and etiology were recorded. Follow-up endoscopies were performed at 4-week intervals. Outcomes included number of sessions, grade reduction, obliteration, and rebleeding. Data were analyzed using SPSS v26 with $p=0.05$ considered significant.

Results: In a total of 97 children, the median age was 11 years (interquartile range: 8–13 years), while 51.5% children were female. Endoscopic grading showed Grade III, and IV varices in 67% cases. The mean follow-up was 8.8 ± 2.6 months. Variceal grade reduction was achieved in 93.8%, and complete obliteration in 87.6%. One or two EVBL sessions were sufficient in 82.4%; 17.5% required ≥ 3 . Rebleeding occurred in 8.2%, with no mortality. Higher-grade varices significantly required more sessions ($p=0.0332$), though other outcomes showed no significant grade-wise association.

Conclusion: EVBL is a safe, well-tolerated, and effective modality for the management of EV in children.

Keywords: Children, esophageal varices, endoscopic variceal band ligation, hematemesis, melena

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INTRODUCTION

Upper gastrointestinal (GI) bleeding is a critical clinical entity that requires prompt evaluation and management, particularly when associated with portal hypertension and esophageal varices (EV). In adults, the incidence ranges between 50 to 150 per 100,000 annually, making it a commonly encountered emergency.¹ In contrast, upper GI bleeding is relatively uncommon in children, with global estimates suggesting an annual incidence of only 1 to 2 cases per 10,000 pediatric patients.^{2,3} This rarity, coupled with differences in anatomy, physiology, and etiology between adults and children, makes pediatric upper GI bleeding a unique diagnostic and therapeutic challenge.⁴

In the pediatric population, hematemesis, melena, and signs of hemodynamic instability are classic presenting symptoms. The differential diagnosis is broad, ranging from mucosal lesions such as gastritis or esophagitis, to coagulation disorders, prolapse gastropathy, and esophageal varices.⁴ Esophageal varices, in particular, are dilated submucosal veins that develop as a result of sustained portal hypertension, most commonly secondary to chronic liver disease (CLD) or extrahepatic portal vein obstruction. A recent local study from Pakistan estimated the prevalence of chronic liver disease in children to be 1.6%,² highlighting the potential disease burden in resource-limited settings where late presentation is not uncommon.

The management of variceal bleeding in children requires a structured approach, beginning with hemodynamic stabilization, pharmacologic therapy, and supportive measures including blood transfusion if necessary.⁵ Laboratory investigations, including complete blood count, liver and renal function tests, and coagulation profile, play an integral role in the initial workup and risk stratification.⁵ However, upper GI endoscopy remains the cornerstone of diagnosis and treatment. Ideally performed within 12 to 24 hours of presentation depending on clinical stability, endoscopy allows for both localization of bleeding and definitive intervention.⁶ Endoscopic variceal band ligation (EVBL) has emerged as the first-line endoscopic therapy for esophageal varices due to its high efficacy, lower complication rates, and repeatability, particularly in pediatric patients where sclerotherapy carries higher risks of ulceration and stricture formation. Nonetheless, most guidelines, including the recent 2021 update from the British Society of Pediatric Gastroenterology, Hepatology and Nutrition (BSPGHAN), have acknowledged a lack of robust, high-quality pediatric data to guide practice.⁶

The available literature shows wide variability in EVBL outcomes among children. For instance, one study reported a 100% obliteration rate with 1–4 sessions of EVBL but noted a high rebleeding rate of 60%.⁷ Another study observed rebleeding in 64.1% of cases during the follow-up period.⁸ In contrast, a more favorable study found no rebleeding after the first session, with grade reduction of varices in 56.4% of patients and complete obliteration in 28.2%.⁹ These disparities may be attributed to differences in patient populations, operator experience, underlying disease etiology, and duration of follow-up.

In the adult population, EVBL has been extensively validated as a safe and effective intervention.¹⁰ However, in children, the evolving nature of guidelines, differences in disease spectrum, and variable responses necessitate more targeted pediatric research. Understanding the number of sessions required, the timeline for obliteration, and risk of complications such as rebleeding is vital for developing standardized protocols that can guide both acute management and long-term surveillance. This study was therefore designed to evaluate the frequency and pattern of outcomes following EVBL in children with esophageal varices, with a particular emphasis on real-world data from a tertiary pediatric center in a low- to middle-income country setting. Disease etiologies in children such as extrahepatic portal vein obstruction, congenital hepatic fibrosis, and metabolic liver diseases differ significantly from those seen in adults, potentially influencing treatment response and outcomes. By systematically analyzing a prospectively followed cohort, this study aims to fill this gap by providing detailed evidence on procedural success, complications, rebleeding rates, and the number of sessions required for variceal obliteration. The findings are expected to inform the development of

locally relevant protocols, guide resource allocation, and aid pediatric gastroenterologists and hepatologists in decision-making regarding endoscopic surveillance and intervention. Ultimately, the study aspires to enhance the safety, effectiveness, and consistency of care for children with esophageal varices in similar clinical settings.

METHODOLOGY

A prospective observational cohort study was conducted at the Department of Pediatric Gastroenterology, The Children's Hospital and Institute of Child Health, Faisalabad, from June 2023 to March 2025. Ethical approval was obtained from the institutional review board prior to the commencement of the study (Ref. No. 59-60, dated: 15-05-2023). Informed written consents were obtained from parents or legal guardians of all eligible participants. The inclusion criteria were children of either gender, aged 2-16 years, diagnosed with EV and scheduled to undergo EVBL. Diagnosis of esophageal varices was confirmed on upper GI endoscopy performed by a consultant pediatric gastroenterologist.¹¹ Children were excluded if they had a previous history of EVBL or endoscopic sclerotherapy, presence of gastric varices, an international normalized ratio (INR) greater than 1.8, or platelet count below 50,000/mm³. A sample size of 97 was calculated using the OpenEPI online sample size calculator, with a 95% confidence level, 8% margin of error, and anticipated rate of variceal obliteration of 79.8%.¹² Sampling was performed using a non-probability consecutive technique.

Baseline demographic and clinical data including age, gender, residence, presenting symptoms, and etiology of varices were recorded. All patients underwent EVBL under sedation according to institutional protocol. The grade of EV (I–IV) was assessed endoscopically at the time of the first session, using the Paquet classification system. Follow-up endoscopy was scheduled at four-week intervals to assess for grade reduction and obliteration. EVBL was repeated as required based on endoscopic findings. The number of sessions, time to obliteration, and any adverse events were recorded. Rebleeding was defined as recurrence of hematemesis or melena after initial EVBL, and was further categorized into early (within two weeks of the procedure) and late (beyond two weeks).¹³ All patients were scheduled for follow-up endoscopy at four-week intervals until variceal obliteration was achieved. Compliance with follow-up was actively monitored through reminder phone calls and counseling of parents/guardians at discharge. Children who missed their scheduled follow-up were contacted and motivated to attend subsequent visits to minimize loss to follow-up. A special form was designed to record all relevant study data throughout the study period.

Data analysis was conducted using IBM-SPSS, version 26.0. Quantitative variables such as age, and follow-up duration were reported as mean±standard deviation (SD) or median

and interquartile range (IQR), while categorical variables such as gender, variceal grade, and EVBL outcomes were expressed as frequencies and percentages. The Chi-square test was applied for comparison of categorical data, with a p -value = 0.05 considered statistically significant.

RESULTS

A total of 97 children underwent EVBL for EV. Of these, 47 (48.5%) were male and 50 (51.5%) were female. The median age was 11 years (IQR: 8-13 years), while 54 (55.7%) children were aged between 2-10 years. Sixty-one (62.9%) children were from rural areas. Table-1 is showing baseline demographic and clinical characteristics of children with esophageal varices. Portal vein thrombosis was the leading underlying cause of esophageal varices, identified in 42 (43.3%) cases. Chronic liver disease accounted for 14 (14.4%) cases, with Wilson disease ($n = 2$, 2.1%), Caroli disease ($n = 1$, 1.0%), post-Kasai chronic liver disease ($n = 4$, 4.1%), and congenital hepatic fibrosis ($n = 5$, 5.2%) comprising the spectrum of chronic liver diseases (Figure-1). Endoscopy revealed the distribution of EV grades was as grade-I, II, III, and IV in 4 (4.1%), 28 (28.9%), 36 (37.1%), and 29 (29.9%) children, respectively (figure-2).

The mean duration of follow-up was 4.8 ± 2.6 months. A reduction in variceal grade was noted in 91 (93.8%) children. Regarding the number of EVBL sessions required, 40 (41.2%) children achieved the desired outcome (grade reduction or obliteration) with a single session, 40 (41.2%) required two sessions, and 17 (17.5%) needed three or more sessions. Complete obliteration of varices was achieved in 85 (87.6%) children, whereas 12 (12.4%) required further sessions or alternative management. Vomiting was reported in 7 (7.2%), and mild retrosternal pain in 5 (5.2%) children. These complications were self-limited and managed conservatively. Rebleeding was observed in 8 (8.2%) children during the follow-up period. Of these, 5 (5.2%) experienced early rebleeding within two weeks of the procedure, while 3 (3.1%) had late rebleeding. All episodes of rebleeding were successfully managed with endoscopic intervention, and no child required surgical management. No mortality was reported during the study period. Significant association ($p=0.0332$) was found between initial grade of EV and number of EVBL sessions required, with higher-grade varices (III-IV) more likely to need ≥ 2 sessions. Other outcomes such as obliteration, rebleeding, and complications did not show statistically significant associations with variceal grade, though numerically worse outcomes were noted with Grade III-IV (table-2).

Among males, 27 (57.4%) required more than two sessions compared to 30 (60.6%) females ($p=0.798$). Grade reduction was achieved in 44 (93.6%) males, and 47 (94.0%) females ($p=0.937$), while complete obliteration occurred in 41 (87.2%) and 44 (88.0%) patients ($p=0.909$). Complications were observed in 6 (12.8%) males and 6 (12.0%) females

($p=0.909$). In the 2–10 years age group, 33 (61.1%) required more than two sessions compared to 24 (55.8%) in the 11–16 years group ($p=0.599$). Among children living in rural areas, 38 (62.3%) required more than two sessions compared to 19 (52.8%) in urban areas ($p=0.358$). Table-3 is showing details about the association of outcomes with respect to demographic variables.

Table 1: Demographic and clinical characteristics of children with esophageal varices ($n=97$)

Parameter	Categories	Frequency (%)
Gender	Male	47 (48.5%)
	Female	50 (51.5%)
Age Distribution	2-10 years	54 (55.7%)
	11-16 years	43 (44.3%)
Residence	Rural	61 (62.9%)
	Urban	36 (37.1%)
Frequency of clinical presentation	Hematemesis	52 (53.6%)
	Melena	28 (28.9%)
	Hematemesis and melena	17 (17.5%)

Figure-1: Frequency of causes of esophageal varices ($N=97$)

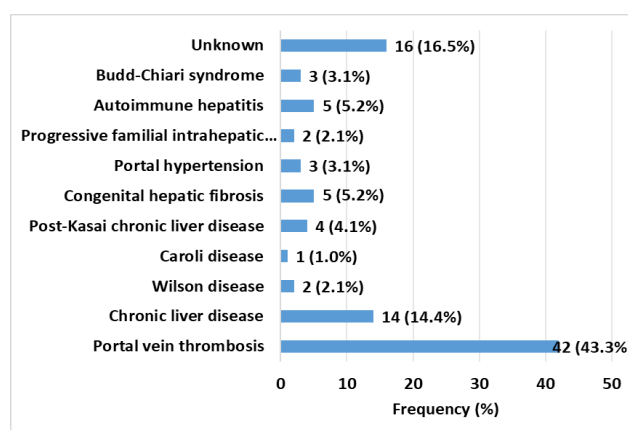
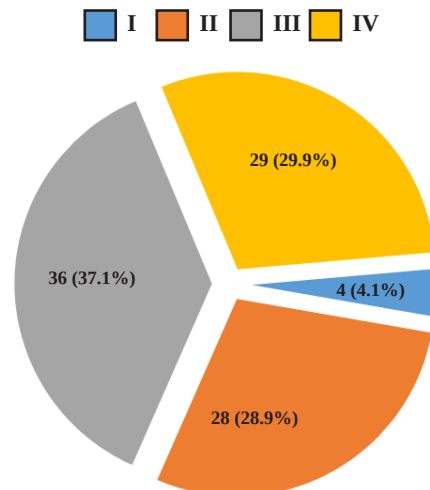


Figure-2: Grades of Esophageal varices ($n=97$)



DISCUSSION

This study reported higher rates of variceal grade reduction, observed in 93.8% of the children, and the achievement of complete obliteration in 87.6% of cases. Vroniak et al.,⁹ reported grade reduction in 56.4% of pediatric patients after just one EVL session, with obliteration achieved in 28.2% of cases. The findings from Celinska-Cedro et al.,¹⁴ also align with this study's results, where variceal obliteration was achieved in 90.3% of children after an average of two EVL sessions. These findings reaffirm the current study's outcomes and underscore the safety and efficacy of EVBL in achieving sustained variceal obliteration in the pediatric population. The association between the initial grade of varices and the number of EVBL sessions required was found to be statistically significant ($p=0.0332$). Higher-grade varices (grades III and IV) were more likely to require two or more sessions.^{10,15} Studies like Farhana et al.,¹⁶ Mahmud et al.,⁷ also demonstrated that children with hepatic causes required multiple EVBL sessions, whereas 50% of those with pre-hepatic portal hypertension achieved obliteration in a single session. Re-bleeding was observed in 8.2% of children in the present study, with early re-bleeding occurring in 5.2% and late re-bleeding in 3.1%. These findings are in agreement with those of Kang et al.,¹⁷ who documented four

re-bleeding episodes over a 3-year follow-up period among 37 children. The low re-bleeding rate in both studies reflects the durability of EVBL as a secondary prophylactic intervention in pediatric patients with portal hypertension. Contrary to these findings, Mahmud et al.,⁷ reported a much higher re-bleeding rate, especially among children with hepatic causes of portal hypertension, where re-bleeding occurred in all hepatic cases. The lower re-bleeding rate in the current study may reflect a higher proportion of extra-hepatic etiologies (e.g., portal vein thrombosis), which constituted 43.3% of the study population.

Complications observed in this study were minimal and self-limited, with vomiting (7.2%) and mild retrosternal pain (5.2%) being the most common. No mortality or procedure-related severe adverse events were reported. These findings are consistent with the studies by Kim et al.,⁸ and Li et al.,¹⁸ which documented complication rates ranging from 4.8% to 10.3% in children undergoing EVBL. The contemporary data confirm the safety profile of EVBL in pediatric populations, with no cases of perforation or embolization reported.^{8,18}

An important clinical implication of this study is the identification of a significant correlation between initial variceal grade and treatment intensity, suggesting that children

Table-2: Association of outcomes of Endoscopic Variceal Band Ligation with respect to Esophageal varices grades

Outcomes		Frequency (%)	Esophageal varices grade				P-value
			I (n=4)	II (n=28)	III (n=36)	IV (n=29)	
Number of EVBL sessions required	1	40 (41.2%)	2 (50.0%)	17 (60.7%)	14 (38.9%)	7 (24.1%)	0.0332
	2	40 (41.2%)	1 (25.0%)	9 (32.1%)	18 (50.0%)	12 (41.4%)	
	>3	17 (17.5%)	1 (25.0%)	2 (7.1%)	4 (11.1%)	10 (34.5%)	
Grade reduction in EVB	Yes	91 (93.8%)	4 (100%)	27 (96.4%)	34 (94.4%)	26 (89.7%)	0.6862
	No	6 (6.2%)	-	1 (3.6%)	2 (5.6%)	3 (10.3%)	
Complete obliteration achieved	Yes	85 (87.6%)	4 (100%)	25 (89.3%)	31 (86.1%)	25 (86.2%)	0.8580
	No	12 (12.4%)	-	3 (10.7%)	5 (13.9%)	4 (13.8%)	
Post-EVBL complications	Re-bleeding	8 (8.2%)	-	1 (3.6%)	3 (8.3%)	4 (13.8%)	0.5036
	Vomiting	7 (7.2%)	-	1 (3.6%)	3 (8.3%)	3 (10.3%)	0.7154
	Transient retrosternal pain	5 (5.2%)	-	1 (3.6%)	2 (8.3%)	2 (6.9%)	0.9175

Table-3: Association of outcomes of with respect demographic variables (N=97)

Variables		>2 sessions required	Grade reduction	Complete Obliteration	Complications
Gender	Male	27 (57.4%)	44 (93.6%)	41 (87.2%)	6 (12.8%)
	Female	30 (60.6%)	47 (94.0%)	44 (88.0%)	6 (12.0%)
Age groups (years)	P-value	0.798	0.937	0.909	0.909
	2-10	33 (61.1%)	51 (94.4%)	47 (87.0%)	8 (14.8%)
	11-16	24 (55.8%)	40 (93.0%)	38 (88.4%)	4 (9.3%)
	P-value	0.599	0.773	0.843	0.413
Residence	Rural	38 (62.3%)	57 (93.4%)	53 (86.9%)	8 (13.1%)
	Urban	19 (52.8%)	34 (94.4%)	32 (88.9%)	4 (11.1%)
	P-value	0.358	0.843	0.772	0.772

with higher-grade varices require closer monitoring and possibly more aggressive follow-up to achieve obliteration.¹⁹ This highlights the need for individualized treatment plans based on baseline variceal grading. The high obliteration rate and low rebleeding rate observed support the role of EVBL as a safe and effective strategy in the secondary prophylaxis of EV in children.^{20,21}

Limitations: Certain limitations must be acknowledged as well. Although the sample size was adequate for primary outcome assessment, it may be underpowered for detecting subtle differences in complication rates or stratified analyses based on etiology. The absence of a control group, such as children undergoing sclerotherapy or receiving non-endoscopic management, limits comparative interpretation.²² The study focused on short- to mid-term outcomes; long-term durability of obliteration, variceal recurrence, and survival could not be assessed. The absence of control or comparator group was another limitation of this study.

CONCLUSION

EVBL is a safe, well-tolerated, and effective modality for the management of EV in children. EVBL achieved high rates of variceal grade reduction and obliteration with low rebleeding and complication rates. EVBL was clearly most efficient in Grade I–II, with outcomes progressively less favorable in Grades III–IV. The significant association between higher-grade varices and the need for multiple sessions has clinical implications for individualized patient care and resource allocation. Further large-scale, multicenter, randomized studies are warranted to explore the long-term efficacy and optimal follow-up strategies in EV.

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Authors Contribution:

Nagina Shahzadi: Data collection, Drafting, proof reading, critical revisions, approved for publication

Farzeen Fazal: Data collection, Drafting, proof reading, critical revisions, approved for publication

Zahid Mahmood Anjum: Concept and design, data analysis, critical revisions, approved for publication

Irum Aslam: Concept and design, literature review, proof reading, critical revisions, approved for publication

Muhammad Imran Khan: Data collection, data synthesis, proof reading, critical revisions, approved for publication

Iqra Farooque: Data collection, Drafting, proof reading, critical revisions, approved for publication

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