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Serial Endoscopic Variceal Band Ligation for Esophageal Varices Due to Portal Hypertension: A Prospective Observational Study from Southern Rajasthan

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Research Article

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Abstract

Background

Esophageal variceal hemorrhage is a major decompensating event in portal hypertension. Endoscopic variceal band ligation (EVBL) controls bleeding by mechanically strangulating varices while avoiding the deeper tissue injury associated with sclerosant injection. Although EVBL is established in acute hemostasis and secondary prevention, the number of sessions required for eradication and the practical pattern of short-term adverse effects may vary with disease severity, referral pathways, and follow-up adherence. This study evaluated serial EVBL in adults treated at a tertiary-care hospital in Udaipur, Rajasthan.

Methods

This hospital-based prospective observational study included 40 adults with portal hypertension and esophageal varices who underwent EVBL at the American International Institute of Medical Sciences between April 2023 and March 2025. Participants were assessed clinically and with routine laboratory testing and abdominal imaging when indicated. Upper gastrointestinal endoscopy was repeated at four-week intervals, with further EVBL until complete variceal obliteration. Outcomes were summarized using frequencies, proportions, and means. The principal outcomes were number of sessions to obliteration, change in endoscopic grade, recurrence at six months, and procedure-related adverse effects.

Results

The participants were 31 men and 9 women, aged 31–80 years. Hematemesis was the leading presenting complaint in 20 patients (50.0%), followed by melena in 10 (25.0%). Cirrhosis was the recorded cause of portal hypertension in 31 patients; the reported etiologic distribution was alcohol-associated disease in 21 (52.5% of the cohort), chronic hepatitis B in 11 (27.5%), and non-alcoholic fatty liver disease in 8 (20.0%). Twenty-six patients (64.0%) were Child–Pugh class A, 12 (30.0%) class B, and 2 (6.0%) class C. At baseline, 10 patients had grade I, 16 grade II, and 14 grade III varices. Five patients achieved obliteration by eight weeks and 35 by 12 weeks; the mean number of sessions was 2.875. At six-month endoscopy, 25 patients returned: 18 had no reappearance and 7 underwent repeat EVBL for recurrent varices. Retrosternal pain occurred in 12 patients (30.0%), fever in 4 (10.0%), and hematemesis in 2 (5.0%); no stricture was recorded.

Conclusions

In this single-centre cohort, serial EVBL achieved documented obliteration in two or three sessions for all patients who completed the eradication protocol, with mostly transient adverse effects. The six-month

assessment was limited by loss to follow-up, and recurrence among reviewed patients supports continued surveillance. The findings support a pragmatic four-week EVBL pathway but should not be interpreted as comparative evidence of superiority over pharmacological or shunt-based strategies.

Introduction

Portal hypertension is a hemodynamic syndrome in which increased resistance and altered splanchnic flow promote portosystemic collaterals. Clinically significant portal hypertension is associated with gastroesophageal varices and upper gastrointestinal hemorrhage. Hepatic venous pressure gradient is a key physiological and prognostic measure 1 2. Endoscopic grading directly identifies lesions that can be treated during the same procedure 3.

EVBL is performed by aspirating a varix into a cap and deploying an elastic band at its base. Local ischemia, thrombosis, necrosis, and sloughing lead to obliteration, while the technique avoids the extensive submucosal inflammatory injury associated with injection sclerotherapy. Early randomized trials comparing ligation with sclerotherapy established the procedural basis for modern EVBL 4 5. Subsequent trials evaluated band ligation against propranolol, nadolol, combination drug therapy, and other approaches in primary or secondary prophylaxis 6 7 8 9. Their results show that the clinical role of EVBL depends on the indication: control of active esophageal bleeding, eradication after bleeding, and primary prevention are related but distinct questions.

The number and timing of sessions are operationally important because patients must return for repeat endoscopy while varices involute. Studies have examined predictors of success, band number, session intervals, and surveillance timing 10 11 12 13. Eradication of one collateral pathway does not necessarily normalize portal pressure, which is relevant to later recurrence 14.

The present study addresses a practical question in a Southern Rajasthan tertiary-care setting: among adults undergoing serial EVBL for esophageal varices associated with portal hypertension, how many sessions are required for endoscopic obliteration, what clinical profile is observed, and what adverse effects and six-month recurrence pattern occur? The study is reported as an original observational analysis of the thesis cohort, not as a literature review or comparative efficacy trial.

Materials and Methods

Study design and setting

A prospective observational study was conducted in the Department of General Medicine at the American International Institute of Medical Sciences, Udaipur, Rajasthan, from April 2023 through March 2025. The study population consisted of adults older than 18 years with portal hypertension and esophageal varices who underwent EVBL. Written informed consent was obtained, and the thesis reports approval from the institutional ethical and human research committees.

Eligibility and baseline assessment

Adults with esophageal varices attributable to portal hypertension, including patients diagnosed by imaging or identified during routine or emergency endoscopy for hematemesis, were eligible if they consented to participate. Patients requiring intensive care or those with terminal illness were excluded. The planned sample size was 40. Baseline assessment included history, general and abdominal examination, complete blood count, liver function tests, viral serology for hepatitis B and hepatitis C, and abdominal ultrasonography or computed tomography when clinically indicated. Child–Pugh class and FIB-4 category were recorded as markers of liver disease severity. These variables are relevant because thrombocytopenia, synthetic dysfunction, and liver disease stage influence bleeding risk and procedural prognosis 15 16.

Endoscopy and EVBL protocol

Experienced gastroenterologists performed upper gastrointestinal endoscopy using an Olympus CV 150 video endoscope, with local anesthesia or intravenous sedation according to patient preference and clinical need. Varices were assessed for grade, location, number, extent, and bleeding stigmata. A six-band multiband ligator was used. Banding began at the gastroesophageal junction and proceeded upward in a helical pattern, avoiding circumferential placement at the same level. Patients began with liquids and advanced to soft food after the procedure. Retrosternal pain, dysphagia, fever, hematemesis, and other complications were actively assessed.

Repeat endoscopy occurred every four weeks. EVBL was repeated until complete obliteration was documented. This interval was selected as a feasible local protocol and is consistent with the broad range examined in randomized studies of biweekly, monthly, and other follow-up schedules 17 18 19. Six-month endoscopy was undertaken when patients returned. Reappearance of varices was recorded as recurrence, without assuming that every patient with recurrence had the same severity or bleeding risk.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using SPSS. Continuous variables were summarized as means and categorical variables as frequencies and percentages. The thesis protocol specified t tests, McNemar’s test, and chi-square testing with a significance threshold of 0.05; however, the present report emphasizes descriptive analysis because the available thesis tables do not provide complete paired values, dispersion measures, or comparator-group data for reproducible inferential testing. No claim of causal efficacy or superiority is therefore made. The study was not randomized, was not controlled against nonselective beta-blockers, and was not powered for mortality or rebleeding comparisons.

Results

1. Participant Profile and Clinical Presentation

The evaluated clinical cohort comprised 40 adult patients aged 31–80 years, with a reported mean age of 59.25 years. The demographic distribution demonstrated a male predominance, with men representing 77.5% (n = 31) and women 22.5% (n = 9) of the cohort. Hematemesis was the single most frequent presenting complaint, manifesting in 20 patients (50.0%), followed by black stools (melena) in 10 patients (25.0%), abdominal pain in 7 patients (17.5%), and yellowish skin discoloration (jaundice) in 3 patients (7.5%).

Physical examinations revealed substantial clinical signs associated with portal hypertension and chronic liver disease. Pallor was documented in half of the cohort (50.0%). Splenomegaly alone was identified in 16 patients (40.0%), hepatosplenomegaly in 11 patients (27.5%), hepatosplenomegaly accompanied by ascites in 9 patients (22.5%), and caput medusae combined with splenomegaly in 4 patients (10.0%).

Medical history recordings indicated alcohol consumption in 18 patients (45.0%), previously known esophageal varices in 10 patients (25.0%), acid-peptic disease in 8 patients (20.0%), and a prior history of jaundice in 4 patients (10.0%). Laboratory assessments reflected substantial chronic liver dysfunction and concomitant anemia. The mean hemoglobin was 8.85 g/dL among men and 8.50 g/dL among women. Additional laboratory parameters included a mean serum albumin of 2.75 g/dL, mean INR of 1.90, mean total bilirubin of 2.05 mg/dL, mean AST of 91.0 IU/L, mean ALT of 39.5 IU/L, and mean ALP of 109.2 IU/L. Due to internal transcription inconsistencies present in select source records, these laboratory metrics are presented descriptively rather than utilized for derivative mathematical modeling.

Table 1
Demographic profile, presenting complaints, clinical signs, and medical history of the patient cohort.

Clinical Parameter / Characteristic	Subcategory / Finding	Patients (N = 40)	Percentage (%)
Age Distribution	Range (31–80 years)	40	100.0%
	Mean Age (59.25 years)	—	—
Gender Distribution	Male	31	77.5%
	Female	9	22.5%
Presenting Complaints	Hematemesis	20	50.0%
	Black Stools (Melena)	10	25.0%
	Abdominal Pain	7	17.5%
	Yellowish Skin Discoloration	3	7.5%
Clinical Signs	Pallor	20	50.0%
	Splenomegaly	16	40.0%
	Hepatosplenomegaly	11	27.5%
	Hepatosplenomegaly with Ascites	9	22.5%
	Caput Medusae with Splenomegaly	4	10.0%
Medical History	History of Alcohol Consumption	18	45.0%
	Previously Known Esophageal Varices	10	25.0%
	Acid-Peptic Disease	8	20.0%
	History of Jaundice	4	10.0%

2. Etiology and Disease Severity

The thesis classification identified 31 patients as having established cirrhosis. The underlying etiologies recorded across the cohort included alcohol-associated cirrhosis in 21 patients (52.5% of the full cohort), chronic hepatitis B in 11 patients (27.5%), and non-alcoholic fatty liver disease (NAFLD) in 8 patients (20.0%). Because these categorical proportions overlap with the cirrhosis denominator, they represent the thesis-recorded etiological distribution rather than independently re-estimated mutually exclusive counts.

Disease severity was further evaluated using non-invasive fibrosis scores and clinical scoring systems. FIB-4 scores were categorized as < 1.3 in 8 patients (20.0%), between 1.3 and 2.67 in 20 patients

(50.0%), and > 2.67 in 12 patients (30.0%). According to the Child–Pugh classification system, Class A was recorded in 26 patients (64.0%), Class B in 12 patients (30.0%), and Class C in 2 patients (6.0%).

Table 2
Etiological distribution of cirrhosis, FIB-4 fibrosis scores, and Child-Pugh class severity.

Parameter Category	Classification / Stratification	Patient Count	Percentage (%)
Cirrhosis Etiology (N = 31)	Alcohol-Associated Cirrhosis	21	52.5%
	Chronic Hepatitis B	11	27.5%
	Non-Alcoholic Fatty Liver Disease (NAFLD)	8	20.0%
FIB-4 Score Stratification (N = 40)	FIB-4 < 1.3	8	20.0%
	FIB-4 1.3–2.67	20	50.0%
	FIB-4 > 2.67	12	30.0%
Child–Pugh Classification (N = 40)	Child–Pugh Class A	26	64.0%
	Child–Pugh Class B	12	30.0%
	Child–Pugh Class C	2	6.0%

3. Endoscopic Response and Number of Sessions

At baseline presentation, variceal grading indicated Grade I varices in 10 patients (25.0%), Grade II in 16 patients (40.0%), and Grade III in 14 patients (35.0%). At the four-week follow-up assessment, the recorded distribution shifted to Grade I in 15 patients (37.5%), Grade II in 14 patients (35.0%), and Grade III in 8 patients (20.0%); no patient had achieved complete obliteration at that juncture. By eight weeks, 18 patients (45.0%) demonstrated Grade I varices, 12 patients (30.0%) demonstrated Grade II, and Grade III varices were entirely eliminated (0%), with 5 patients (12.5%) achieving complete variceal obliteration. At the twelve-week evaluation, the remaining 35 patients successfully achieved complete obliteration, marking 100% eradication across the cohort.

Consequently, 5 of 40 patients (12.5%) achieved total obliteration in two procedural sessions, while 35 patients (87.5%) required three sessions. The mean number of procedural sessions was 2.875. The observed progressive downgrade from Grade III toward lower grades prior to complete obliteration highlights a stepwise anatomical response rather than an immediate binary outcome. While the session requirement compared favorably with older cirrhotic cohorts requiring frequent repeated ligation, direct comparisons remain constrained by differences in patient selection, baseline severity, banding strategy, and definitions of eradication.

Table 3
Longitudinal distribution of esophageal variceal grades and obliteration milestones across 12 weeks.

Time Point	Grade I Varices	Grade II Varices	Grade III Varices	Complete Obliteration
Baseline Presentation	10 (25.0%)	16 (40.0%)	14 (35.0%)	0 (0.0%)
4 Weeks Post-Procedure	15 (37.5%)	14 (35.0%)	8 (20.0%)	0 (0.0%)
8 Weeks Post-Procedure	18 (45.0%)	12 (30.0%)	0 (0.0%)	5 (12.5%)
12 Weeks Post-Procedure	0 (0.0%)	0 (0.0%)	0 (0.0%)	35 (87.5%) [Cumulative 100%]

4. Six-Month Follow-Up and Adverse Effects

At the six-month follow-up evaluation, 25 patients underwent repeat endoscopy while 15 patients were lost to follow-up. Among the 25 reviewed patients, 18 showed no variceal reappearance. Seven patients experienced recurrence of esophageal varices and subsequently underwent repeat endoscopic variceal band ligation (EVBL). Among the returning patient subset, the recurrence rate was 28.0% (7/25). This figure represents the recurrence within the assessed subset rather than a cohort-wide rate, as patients lost to follow-up could have experienced either outcome. Recurrence following successful eradication is biologically expected in the setting of persistent portal hypertension and active para-esophageal or portosystemic collateral pathways.

Post-procedural adverse effects were generally mild and self-limiting. Retrosternal pain was the most frequent adverse effect, reported in 12 patients (30.0%), followed by post-procedural fever in 4 patients (10.0%). Hematemesis occurred in 2 patients (5.0%): one attributed to recurrent variceal bleeding and the other to ulcer formation at a banding site. No esophageal strictures were recorded. These findings align closely with expected local tissue ulceration and transient post-ligation symptoms documented in standard clinical trials of EVBL.

Table 4
Six-month follow-up endoscopic status and recorded post-procedural adverse effects.

Outcome / Adverse Effect Category	Specific Finding / Clinical Status	Patient Count	Percentage (%)
6-Month Follow-up Status (N = 40)	Completed Follow-up Endoscopy	25	62.5%
	Lost to Follow-up	15	37.5%
Variceal Status in Reviewed (n = 25)	No Variceal Reappearance	18	72.0% (of reviewed)
	Reappearance of Varices (Recurrence)	7	28.0% (of reviewed)
Adverse Effects (N = 40)	Retrosternal Pain	12	30.0%
	Fever	4	10.0%
	Hematemesis (Total)	2	5.0%
	— Variceal Bleeding	1	2.5%
	— Banding Site Ulcer Bleeding	1	2.5%
	Esophageal Stricture	0	0.0%

Discussion

This prospective single-centre study found that serial EVBL achieved endoscopic obliteration in all 40 enrolled patients within two or three sessions under the local four-week protocol. The principal practical finding was concentration of the treatment burden: 12.5% required two sessions and 87.5% required three, producing a mean of 2.875 sessions. The result is useful for scheduling but is not universal. Eradication time depends on baseline grade, technique, treatment, and return at the planned interval 29 30 31.

The reduction in high-grade disease before eradication provides a more informative signal than the final endpoint alone. Grade III varices decreased from 14 at presentation to none at eight weeks, while five patients were already eradicated. This pattern supports repeat endoscopy because visible improvement does not eliminate risk from residual channels, ulcers, portal pressure, or poor liver reserve. Studies of hemodynamics after EVBL and portal-pressure-guided treatment reinforce the need to distinguish local endoscopic control from correction of the underlying portal hypertensive state 32 33.

The cohort was predominantly male and had a high burden of anemia, hypoalbuminemia, and prolonged INR. Alcohol-associated disease was the most frequently recorded etiologic category, followed by hepatitis B and NAFLD. These observations describe the referral population rather than the population prevalence of causes. They may reflect local epidemiology and referral patterns. Importantly, the study

did not include a noncirrhotic portal-hypertension subgroup, so its findings cannot be generalized to extrahepatic portal vein obstruction, idiopathic noncirrhotic portal hypertension, or schistosomiasis. Comparative evidence indicates that treatment response and the balance between EVBL and propranolol can differ between cirrhotic and noncirrhotic disease 34 35.

The adverse-effect profile was favorable in severity, although not negligible in frequency. One in three patients reported retrosternal pain, one in ten had fever, and two had hematemesis, including one attributed to a post-banding ulcer. No stricture was recorded. EVBL deliberately creates a shallow ulcer and can therefore cause pain, dysphagia, or ulcer bleeding. Trials have examined whether band number, mucosal protection, or combination treatment changes recurrence and adverse effects 36 37 38.

The six-month observation is important because eradication is not synonymous with cure. Of 25 patients reviewed, 7 had recurrent varices, and all underwent repeat EVBL. The denominator limitation is central: 15 patients were lost, so the result demonstrates recurrence among observed survivors rather than a complete six-month incidence estimate. Loss to follow-up may be non-random. The finding nevertheless supports planned surveillance after eradication. Trials of three- versus six-month endoscopic follow-up and studies of recurrence predictors suggest that the surveillance interval should be adapted to patient risk and local feasibility rather than abandoned after eradication 39 40 41.

The study’s interpretation must also be placed within contemporary management, without converting this report into a review. EVBL is appropriate for acute esophageal variceal hemorrhage and for eradication in patients requiring endoscopic secondary prophylaxis, but modern care commonly integrates vasoactive drugs, antibiotic prophylaxis, restrictive transfusion, nonselective beta-blockers, and early or rescue TIPS in selected high-risk patients. Randomized work has assessed somatostatin or terlipressin duration, beta-blocker strategies, and TIPS compared with endoscopic therapy plus medication 42 43 44 45. The present cohort cannot estimate the incremental contribution of these treatments because their use was not analyzed as a controlled exposure.

The main strength is prospective capture of a complete local EVBL course with repeated endoscopic documentation. The study also reports clinically meaningful patient-centred outcomes—pain, fever, hematemesis, stricture, and return for surveillance—rather than only technical obliteration. Its limitations are substantial: small sample size, single-centre referral bias, absence of a comparator, incomplete six-month follow-up, lack of detailed bleeding severity and mortality outcomes, and exclusion of noncirrhotic portal hypertension. In addition, the thesis tables contain transcription inconsistencies in some laboratory and physical-examination entries. We therefore retained the recorded results but avoided reconstructing unreported statistics or presenting unsupported subgroup claims. Future multicentre studies should prespecify baseline variceal grade, active bleeding status, vasoactive and beta-blocker use, transfusion, MELD and Child–Pugh scores, time to hemostasis, rebleeding, mortality, quality of life, and complete follow-up. Noninvasive portal-pressure and spleen-stiffness measures may improve risk stratification before and after eradication 46 47 48 49 50.

Conclusion

In this prospective observational cohort from Southern Rajasthan, serial EVBL performed at four-week intervals achieved documented eradication of esophageal varices in two or three sessions, with a mean of 2.875 sessions. Most adverse effects were transient, and no stricture was recorded. Reappearance of varices among returning patients at six months demonstrates that eradication requires continuing surveillance, while the 37.5% loss to follow-up prevents a complete recurrence estimate. The findings support EVBL as a feasible local eradication strategy but do not establish comparative superiority, reduce the need for portal-hypertension management, or replace individualized risk assessment.

Declarations

Data availability and ethics

This manuscript is derived from the attached institutional thesis. The thesis reports institutional ethical clearance, written informed consent, confidentiality safeguards, and the right of participants to withdraw. No patient-identifying information is reproduced here. The underlying master chart was not independently re-audited; consequently, the paper preserves the reported aggregate values and explicitly identifies limitations that affect interpretation.

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Conflicts of interest/Competing interests

The authors declare that they have no conflicts of interest or competing interests.

Ethics approval

The study was approved by the Institutional Ethics Committee of American international institution of medical sciences (Approval No. AIIMSUDR/2023/4462 dated 20/02/2023).

Consent to participate

Written informed consent was obtained from all individual participants included in the study (or from their legally authorized representatives in case of inability to provide consent).

Written consent for publication

Patients signed informed consent regarding publishing their data and clinical details. Identifying information has been removed to maintain anonymity.

Availability of data and material

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Code availability

Not applicable (no custom code or software was used).

Author contributions

SF: Conceptualization, supervision, critical revision of the manuscript, Data curation, investigation, original draft writing, Methodology, formal analysis, writing – review & editing, correspondence

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Figures

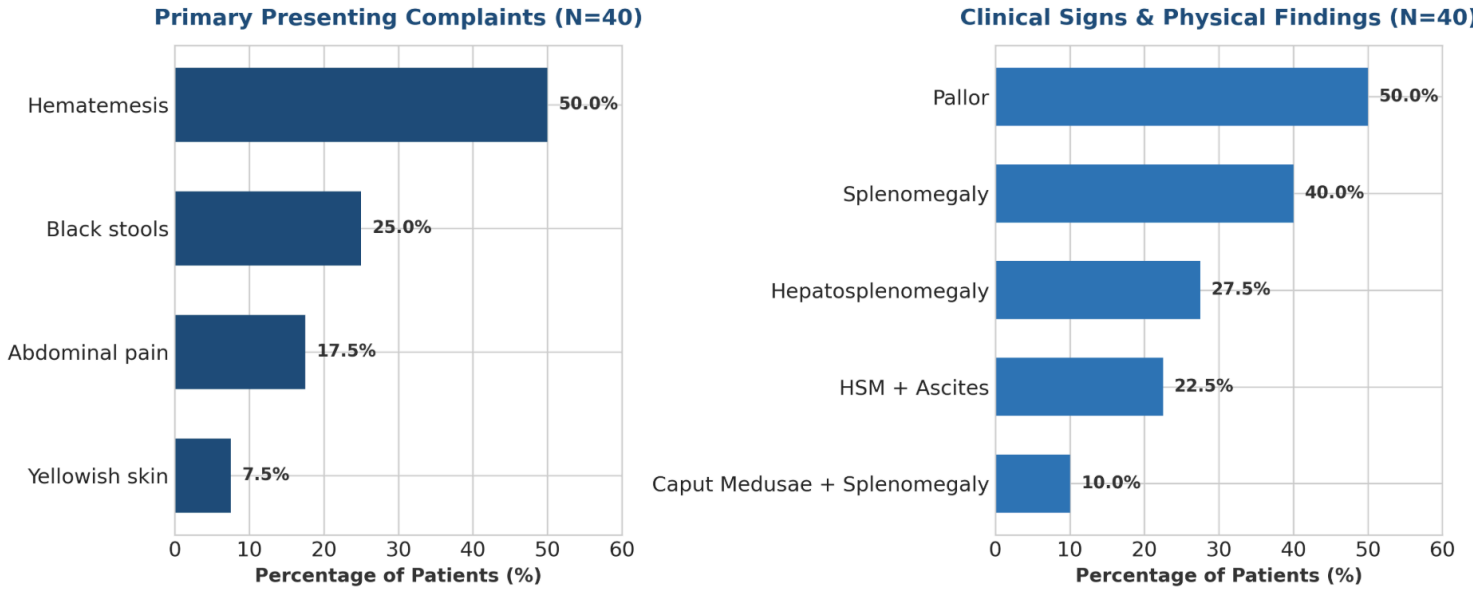


Figure 1

Visual distribution of primary presenting complaints and clinical signs among the cohort.

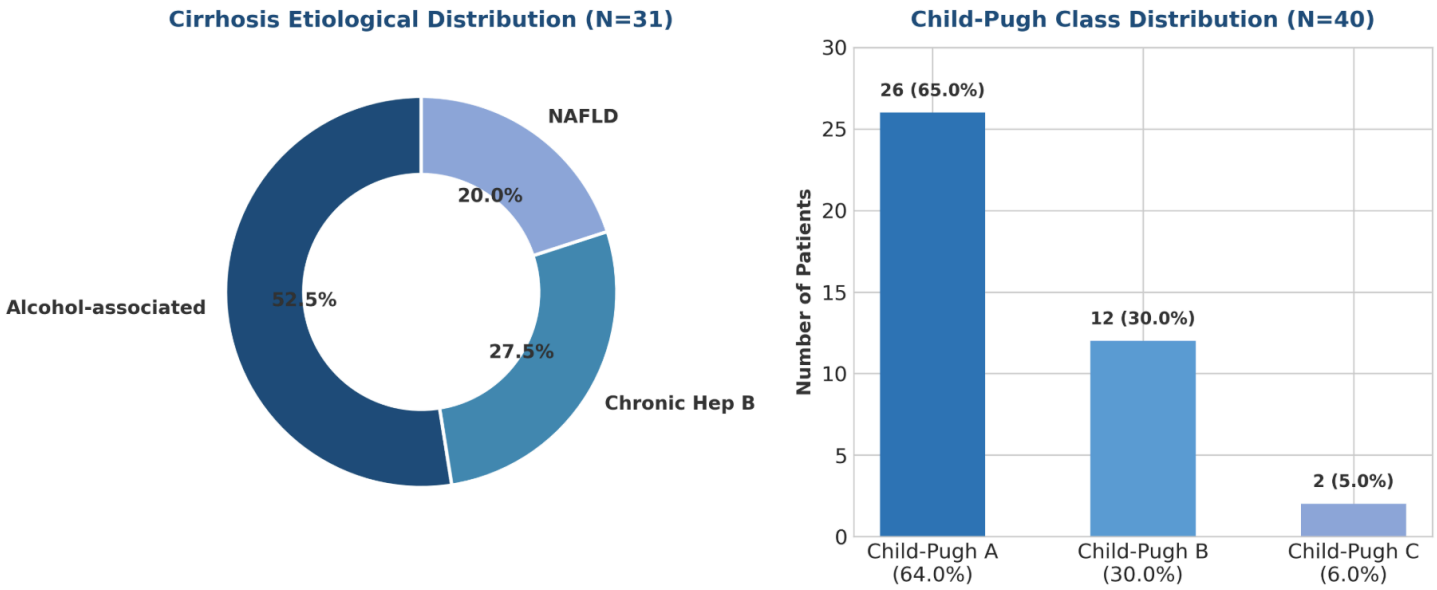


Figure 2

Etiological breakdown of cirrhosis and patient distribution across Child-Pugh clinical classes.

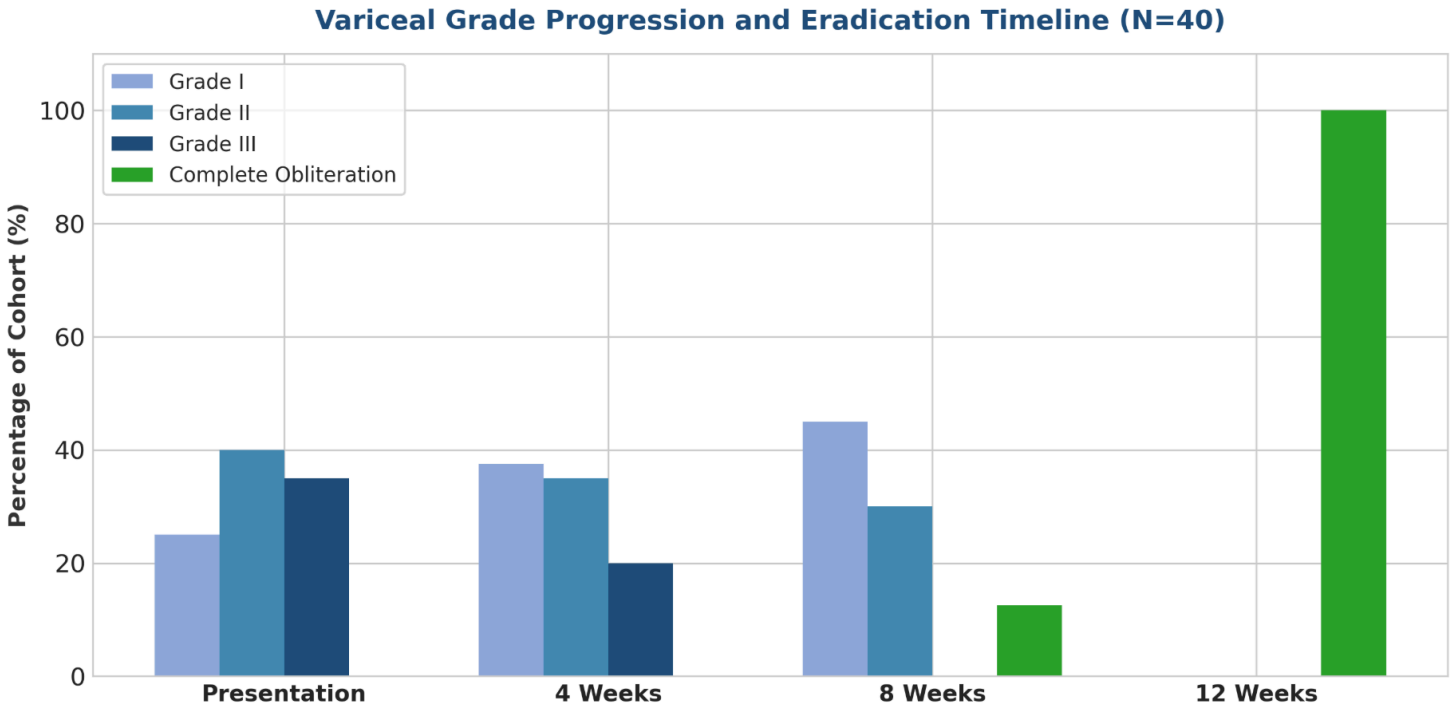


Figure 3

Progression of variceal grading and cumulative eradication timeline over the 12-week follow-up.

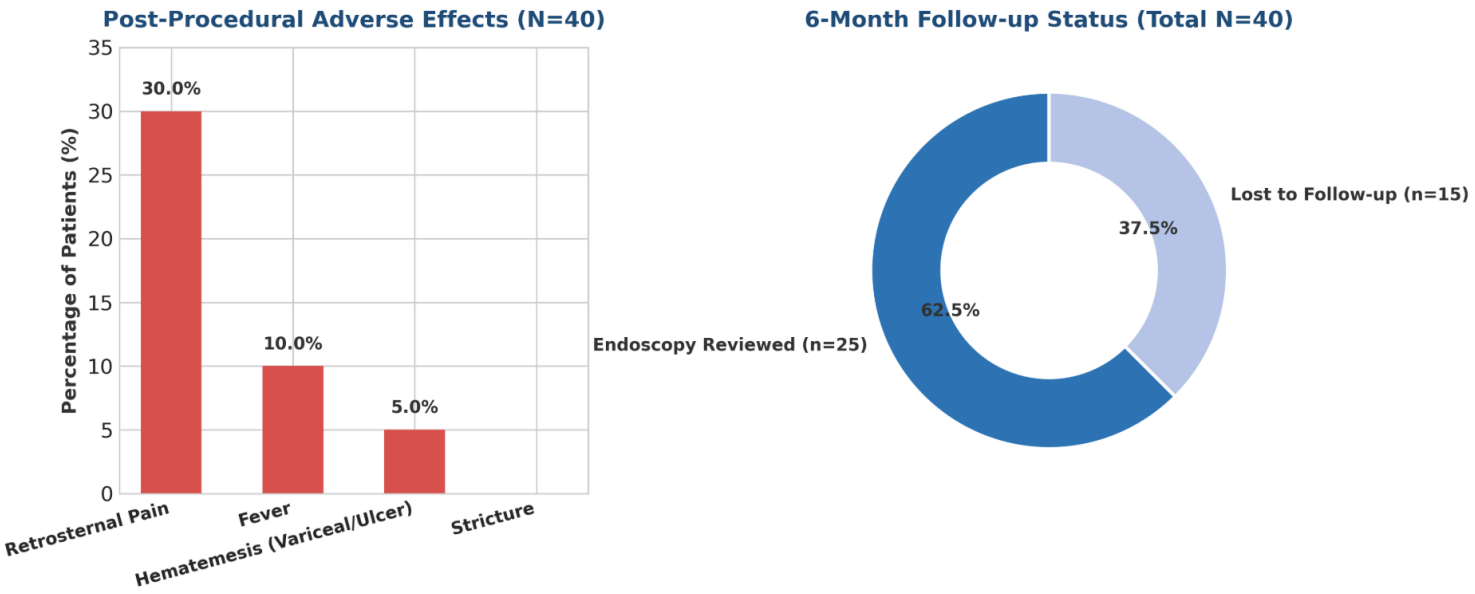


Figure 4

Post-procedural adverse effect profile and 6-month patient follow-up disposition.