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Anesthetic techniques and perioperative outcomes in patients undergoing transjugular intrahepatic portosystemic shunt: a retrospective cohort study

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Abstract

Background

Portal hypertension is a common clinical manifestation of liver cirrhosis. Transjugular intrahepatic portosystemic shunt (TIPS) is a high-risk procedure that reduces portal pressure and the risk of complications, such as variceal bleeding and refractory ascites. However, there is no consensus regarding the optimal anesthetic technique for this procedure. This study aimed to describe the anesthetic techniques used and the perioperative outcomes in a high-complexity center.

Methods

A retrospective observational study was conducted in adults undergoing TIPS under general anesthesia between January 2015 and July 2025. Demographic, clinical, anesthetic variables, and postoperative outcomes were collected. Patients were grouped according to the anesthetic technique used: balanced general anesthesia (BGA) or total intravenous anesthesia (TIVA). Descriptive statistics were applied, and comparisons were made between groups.

Results

A total of 155 patients were included; 92.9% received BGA and 7.1% received TIVA. Most patients were ASA III, predominantly Chil-Pugh B, with a median MELD score of 11 (IQR 9.5–14). Variceal bleeding was the main indication for TIPS (69.7%), and 46% of the procedures were urgent, reflecting the cohort's high clinical complexity. Invasive arterial monitoring was used in 79.4% of the cases, while central venous catheters were used in only 7.9%. No statistically significant differences were observed between the anesthetic techniques regarding vasoactive requirements, transfusions, ICU admission, or postoperative complications. However, there was a non-significant trend toward a lower post-TIPS portosystemic gradient in the TIVA group (5 vs. 8 mmHg). Postoperative hepatic encephalopathy occurred in 39.4% of patients. In-hospital mortality was 17.4%, with a median survival of 51 days among deceased patients.

Conclusion

Balanced anesthesia was the most frequently used anesthetic technique. Advanced monitoring beyond invasive blood pressure monitoring was uncommon. Although TIVA showed a non-significant trend toward lower post-TIPS portosystemic gradients, no differences were observed in major clinical outcomes. A high rate of ICU admission and in-hospital mortality reflect patients' baseline comorbid status rather than the anesthetic technique used. This study presents data from one of the largest cohorts reported in Latin-American population, highlighting the relevance of its findings and the importance of prospective studies with individualized anesthetic strategies to guide future protocols.

Background

The global prevalence of chronic liver disease has increased substantially in recent decades, driven primarily by the growing incidence of non-alcoholic fatty liver disease (NAFLD) associated with obesity, metabolic syndrome, and chronic viral hepatitis (1). The epidemiological shift has resulted in complications of cirrhosis, such as portal hypertension, remaining a major cause of morbidity and mortality on a global scale. However, in Colombia, there is a current absence of epidemiological data regarding these complications and perioperative management (2).

Portal hypertension is associated with a wide range of clinical manifestations, including esophageal varices, ascites, hepatic hydrothorax, hepatopulmonary syndrome, spontaneous bacterial peritonitis, and hepatic encephalopathy. These conditions have a significant impact on patients' quality of life, healthcare utilization, and survival (1).

Transjugular intrahepatic portosystemic shunt (TIPS) is a well-established therapeutic option for the management of portal hypertension and its complications, particularly in cases of variceal bleeding and refractory ascites. The procedure is performed by creating a shunt between the portal vein and hepatic vein decompressing the portal venous system through the redirection of blood to the systemic circulation (3). Despite its clinical utility, TIPS is a complex, high-risk procedure that is typically restricted to specialized centers with experienced interventional radiology teams (2). The anesthetic management of these patients poses significant challenges due to the complexity of underlying conditions, including advanced liver disease, altered hemodynamics, and the potential impact of anesthetic agents on portal and systemic circulation.

Currently, there is no consensus regarding optimal anesthetic techniques for TIPS. While some authors advocate the use of general anesthesia to ensure airway protection, controlled ventilation, and optimal procedural conditions, others have reported successful outcomes, including hemodynamic stability and a marked reduction in recovery time using different anesthetic approaches, such as sedation. Mohammed M. et al., conducted a retrospective review of different anesthetic techniques used in TIPS, revealing that both techniques can be used successfully and that the complications developed were related to the procedure itself and the patient´s clinical condition (4).

Notably, there is lack of local or national studies characterizing anesthetic practice for TIPS in the Colombian population. A better understanding of patient characteristics, anesthetic techniques, perioperative complications, and postoperative outcomes may contribute to the development of context-specific strategies aimed at improving patient safety and optimizing perioperative care. Therefore, the aim of this study was to describe the anesthetic technique used in patients undergoing TIPS at a high-complexity referral center in Colombia and to evaluate their associated perioperative outcomes.

Methods

We conducted an observational, retrospective cohort study at a tertiary referral hospital in Bogotá, Colombia, that included adult patients undergoing TIPS by the interventional radiology service under general anesthesia, between January 2015 and July 2025. Patients were excluded if they had incomplete medical records, documented history of previous TIPS placement, or if the procedure was unsuccessful due to inability to deploy the stent. All eligible patients within the study period were consecutively included using a non-probabilistic sampling approach. The medical records and anesthesia data base (Claris FileMaker Pro 19) were examined to ascertain the presence of all pertinent data. In instances where data was incomplete, the medical records were screened to identify cases where further information was required. When necessary, cases with missing information were reviewed and excluded. All data was anonymized prior to export. The following variables were collected and studied:

- **Demographic and clinical variables**: Age, sex, ASA, etiology of liver disease, MELD/MELD-Na score, Chil-Pugh classification, indications for TIPS, comorbidities, and portal hypertension-related complications prior to the procedure.
- **Intraoperative variables**: Anesthetic technique (BGA or TIVA), duration of anesthesia, type of intraoperative monitoring, use of vasoactive agents, blood product transfusion, pre and postTIPS portal pressure gradient, and right atrial pressures.

Balanced general anesthesia (BGA) consisted of inhalational anesthesia with sevoflurane or isoflurane, combined with intravenous fentanyl. Total intravenous anesthesia (TIVA) was administered via continuous propofol and remifentanil infusions. The attending anesthesiologist determined the anesthetic technique based on clinical judgement and institutional practice at the time of the procedure.

- **Postoperative variables**: Recovery location (post-anesthesia care unit or intensive care unit (ICU)), requirement for mechanical ventilation, length of ICU stay, occurrence of postTIPS complications, in-hospital mortality, and cause of death.

Descriptive univariate statistics were used to report the study variables. For quantitative variables, means or standard deviations, or the median and interquartile range was reported. The normality of the variable was evaluated using the Shapiro-Wilk normality test. For categorical variables, absolute and relative frequencies were reported. A descriptive approach was employed to characterized sociodemographic and clinical characteristics of the patients, based on the type of anesthesia received (balanced general anesthesia vs TIVA).

All statistical analyses were conducted using R software, version 4.2.2.

Given the retrospective design of the study, potential sources of bias included information bias related to the quality and completeness of medical records, as well as selection bias inherent to the inclusion of patients from a single tertiary referral center. To mitigate these limitations, data were extracted from institutional electronic medical records using standardized definitions, and incomplete records were excluded from the analysis.

Results

A total of 166 medical records corresponding to the period between January 2015 and July 2025 were reviewed. According to the exclusion criteria, 11 patients had incomplete information, resulting in 155 patients being analyzed (Fig. 1). The female population constituted 65.2% of the sample, while the male population constituted 34.8%, with a median age of 58 years (IQR 46.5–64).

In terms of etiological diagnoses, the following frequency distribution was identified: autoimmune causes (43.5%), metabolic causes (24.5%), causes associated with alcohol consumption (14.3%), viral causes (9.7%), vascular causes (4.5%), and cryptogenic causes (3.2%) (Fig. 2).

Concerning the Child-Pugh classification, 59.4% of patients were classified as B, 34.8% as A, and 5.8% as C. The MELD/MELD-Na score exhibited a median of 11 (IQR 9.5–14). The primary indications for TIPS included variceal bleeding (69.7%), refractory ascites (23.9%), and surgical indications (6.5%).

The prevalence of comorbidities and the history of liver disease were also examined. The results indicated that 29.7% of the patients had a history of hepatic encephalopathy, 70.3% reported a history of ascites, 23.9% had presented with portosplenomesenteric axis thrombosis, and 85.2% had variceal bleeding, of which 8.4% required prior embolization. The prevalence of other comorbidities, including hepatic hydrothorax (6.5%) and hepatocellular carcinoma (3.2%), was observed to be low among the study population (Table 1).

Table 1. Sociodemographic characteristics.

Sociodemographic variables	Total (n = 155)
Age	58 (46.5–64)
Sex	
Female	65.16%
Male	34.84%
Etiology	
Autoimmune	43.23%
Cryptogenic	3.23%
NASH	24.52%
OH	14.19%
Vascular	4.52%
Viral	9.68%
Child-Pugh	
A	34.84%
B	59.36%
C	5.81%
MELD/MELD-Na	11 (9.5–14)
Indications for TIPS	
Refractory ascites	23.87%
Surgical	6.45%
Variceal bleeding	69.68%
Comorbidities	
Previous HE	29.68%
HCC	3.23%
Porto-splenomesenteric axis thrombosis	23.87%
Variceal bleeding	85.16%
Ascites	70.32%
Hepatic hydrothorax	6.45%
* Median (IQR) or frequency (%)	

Sociodemographic variables	Total (n = 155)
Variceal embolization	8.39%
* Median (IQR) or frequency (%)	

The anesthetic techniques employed in these procedures revealed a predominant use of balanced general anesthesia (BGA), with 92.9% of cases falling into this category. In contrast, total intravenous anesthesia (TIVA) was utilized in 7.1% of cases. The hemodynamic parameters measured during the procedure revealed that the pre-TIPS pressure had a median of 21 mmHg (IQR 11–29), while the pre-TIPS gradient had a median of 11 mmHg. Subsequent to the placement of the stent, the post-TIPS gradient exhibited a median of 8 mmHg (IQR 5–10). The most prevalent diameter of stent utilized was 8 mm, accounting for 74.2% of cases.

In regard to complications that arose during the subsequent medical monitoring, 39.4% of patients exhibited post-TIPS hepatic encephalopathy, with 28.4% of these patients demonstrating moderate to severe forms (grade ≥ 2 according to West Haven Criteria) and a median time to onset of 31 days (IQR 12–96). In contrast, recurrent encephalopathy occurred in 16.1% of the subjects. Primary TIPS dysfunction was observed in 11% of cases, while post-TIPS variceal bleeding was documented in 7.1%. The mortality rate within the hospital setting was 17.4%, with a median survival time of 51 days for these patients.

The total in-hospital mortality rate was 27 patients (17.4%), with a median survival time for these patients of 51 days (IQR 17–227). The leading causes of death were as follows: acute liver failure (3 patients), hypovolemic shock (6 patients), pneumonia (3 patients), sepsis (ten patients), acute lung injury due to transfusion (1 patient), massive pulmonary embolism (2 patients), acute respiratory failure (1 patient), and autoimmune encephalitis with refractory status epilepticus (1 patient) (Table 2).

Table 2
Postoperative outcomes.

Postoperative Outcomes	Total (n = 155)
Post-TIPS variceal bleeding	7.10%
Primary TIPS dysfunction	10.97%
Hepatic encephalopathy	39.36%
Recurrent encephalopathy	16.13%
In-hospital mortality	17.42%
Overall survival (days)	51 (17–227)

Comparison of total intravenous anesthesia (TIVA) and balanced general anesthesia (BGA)

Of the 155 patients included in the study, 144 (92.9%) received BGA, while 11 (7.1%) received TIVA. The median age was comparable in both groups (58 years (IQR 46–64) and 59 years (IQR 54–62,5)), with a predominance of females (64.6% and 72.7%), respectively. A higher proportion of Child-Pugh B patients was observed in the BGA group (62.5%) and Child-Pugh A in TIVA (81.8%).

The MELD/MELD-Na score exhibited comparable median values between the two groups, with a median of 12 (IQR 10–14) in the BGA group and 10 (IQR 7.5–10.5) in the TIVA group. The most prevalent etiology was autoimmune, accounting for 43.1% and 45.5% of cases in the two groups, followed by metabolic factor (25% and 18.2%) and viral etiologies (8.3% and 27.3%). The most prevalent indication for TIPS was variceal bleeding, with a higher frequency observed in the TIVA group (90.9%) compared to the BGA group (68.1%).

With regard to hemodynamic parameters, the pre-TIPS gradient demonstrated marginally elevated values in the TIVA group (17 mmHg, IQR 14-19.5) in comparison to the BGA group (10.5 mmHg, IQR 0–19). Conversely, the post-TIPS gradient exhibited a downward trend in the TIVA group (5 mmHg, IQR 4-8.5) in comparison to the BGA group (8 mmHg, IQR 6–10) (Table 3) (Graph 2).

Table 3. Intraoperative parameters according to anesthetic technique.

Intraoperative parameters	**BGA**	**TIVA**
Pre-TIPS gradient	10.5 (0–19)	17 (14-19.5)
Post-TIPS gradient	8 (6–10)	5 (4-8.5)
Invasive blood pressure monitoring**	79.40%	70%
Central venous support**	7.90%	0%
Vasoactive support**	65.10%	60%
Transfusion support**	17.50%	10%
Anesthesia time (minutes)**	180 (135–240)	197.5 (180–300)
* Median (IQR) or frequency (%)		

** The data correspond to a subsample of patients who had hemodynamic data (76 patients).

Post-TIPS hepatic encephalopathy occurred in 40.3% of the BGA group and 27.3% of the TIVA group, with moderate to severe forms (grade ≥ 2) in 29.2% and 9.1%, respectively. Primary TIPS dysfunction occurred in 11.8% of patients with BGA, while none in the TIVA group presented with TIPS dysfunction.

The incidence of post-TIPS variceal bleeding of fatalities was non-existent in the TIVA group, while the mortality rate within the BGA group was 18.8% during the hospital stay (Table 4).

Table 4. Postoperative outcomes according to anesthetic technique.

Postoperative outcomes	BGA	TIVA
Variceal bleeding	7.64%	0.00%
Primary TIPS dysfunction	11.81%	0%
Hepatic encephalopathy	40.28%	27.27%
Recurrent encephalopathy	17.36%	0.00%
In-hospital mortality	18.75%	0%
* Median (IQR) or frequency (%)		

Discussion

This study described the clinical characteristics, anesthetic techniques used, and postoperative outcomes in patients undergoing TIPS at a high-complexity center between 2015 and 2025. The primary finding of this study indicates that the balanced technique was the most prevalent, accounting for 92.9% of cases, while TIVA was utilized in 7.1%. No statistically significant differences were identified between the anesthetic techniques in relation to postoperative outcomes; however, clinically relevant trends were identified that warrant further analysis.

The cohort under study exhibited a clinical profile characterized by high morbidity, as evidenced by the predominance of ASA III patients, a higher proportion of patients classified as Child-Pugh B, and elevated MELD/MELD-Na values. These factors have been associated with increased perioperative risk and early mortality. In accordance with these findings, a high frequency of variceal bleeding (85.16%), ascites (70.32%), and hepatic encephalopathy (29.68%) was observed prior to the procedure. These findings are consistent with those reported by DeGasperi et al., who identified ascites and encephalopathy as predictors of mortality in the first months following the procedure (5). Furthermore, Pomier-Layragues et al., have indicated the elevated MELD scores are associated with a marked increase in the risk of early mortality, particularly when exceeding a threshold of 25 points (6).

This baseline severity profile is comparable to that reported by DeGasperi et al., who described a 49% prevalence of ASA III and 11% of ASA IV in their series of 150 patients (5). In this context, of high clinical complexity, the selection of anesthetic techniques assumes particular significance, given the elevated risk of hemodynamic instability and perioperative complications.

The current literature indicates that sedation is an available option for this procedure. For instance, Mohammed M. et al., documented a low complication rate with this anesthetic technique and proposed that complications are more contingent on the patient's clinical condition than on the technique employed (4). However, in our cohort, no patient underwent TIPS under sedation as an anesthetic technique, which is consistent with reports such as that of Chana et al., who suggest advantages of general anesthesia, including airway protection and hemodynamic stability (1). During the intraoperative period, the predominant anesthetic agent utilized was balanced general anesthesia (92.9%), which is likely indicative of an institutional predilection for inhaled anesthesia. This preference is presumably influenced by the clinical team´s familiarity, accessibility, and expertise with this particular technique.

Concerning intraoperative monitoring, 79.4% of patients had an invasive arterial line, while only 7.9% had a central venous catheter. The utilization of BIS, NIRS, and TOF was employed in a limited number of cases. These figures contradict the recommendations outlined in the extant literature: Chana et al. And Vaja et al. recommend the routine use of invasive blood pressure monitoring given the frequent hemodynamic instability during shunt creation (1, 7). DeGasperi et al. similarly underscore the significance of invasive blood pressure and CVP/RAP measurement for guiding precise fluid management, with the aim of averting cardiac decompensation or pulmonary edema (5).

While the implementation of advanced monitoring instruments in our study was lower than observed in other studies, the results were consistent with those previously documented. This finding indicates that the implementation of monitoring strategies is contingent upon the experience of the teams and the evolution of the procedure. Consequently, the monitoring strategy is customized to align with the patient ´s clinical condition and comorbidities. The impact of different monitoring strategies is an aspect that could be explored in future studies.

The utilization of vasoactive support was a prevalent practice in the cohort under study, with a predominant use of vasopressors in 65.3% of cases. According to Vaja et al., this phenomenon can be attributed to the hyperdynamic physiology characteristics of patients with advanced cirrhosis, marked by elevated cardiac output and diminished systematic vascular resistance (7). In this context, intraoperative hypotension may be prevalent, and the initiation of vasopressors should be considered once cardiac filling pressures have been optimized.

In relation to hepatic hemodynamics, a decrease in the post-TIPS portosystemic gradient was noted, with a median value of 3 mmHg, and lower values observed in the TIVA group. These findings may have clinical implications concerning the efficacy of the procedure. Agarwalla proposes that TIVA could offer theorical advantages for patients with advanced liver failure by avoiding some of the cardiovascular depressant and potentially hepatotoxic effects of inhaled agents (8). However, other authors have described the potential of intravenous anesthetic agents to modify splanchnic vascular resistance, a phenomenon that warrants cautious interpretation, as it may influence the measurement of the venous gradient and, consequently, the assessment of the technical success of TIPS (9). In the present study,

this discrepancy did not attain statistical significance; consequently, the trend must be confirmed with larger sample sizes.

Intraoperative complications associated with the procedure have an estimated prevalence of 3 to 5%, as reported in the extant literature. These complications primarily include arrhythmias vascular injury, or rupture of the hepatic capsule. Despite its low overall incidence, typically less than 2%, bleeding remains a critical event due to the presence of portosystemic collaterals. The absence of significant intraoperative complications in our cohort is indicative of the proficiency of the treating team and the efficacy of the standardized procedure. Nevertheless, their prevalence underscores the necessity for meticulous hemodynamic monitoring and the provision of large-caliber venous accesses, in conjunction with blood products.

The global complication rate in the present cohort was 53.3%, which is consistent with the range reported in the existing literature. Research conducted by Suhocki et al, and Chana et al. documents an incidence of intra-abdominal adverse events ranging from 1% to 5% among patients undergoing TIPS (1, 10). The absence of complications in the TIVA group may be attributable to the reduced sample size or to disparities in the patients´ preoperative clinical status. In this context, complications could be explained by the baseline clinical status of patients rather than by the anesthetic technique used.

Postoperative hepatic encephalopathy was among the most prevalent complications observed in this cohort, with an incidence of 39.36%, exhibiting no significant differences between anesthetic techniques. This figure aligns with the findings reported by Suhocki et al., who documented an incidence ranging from 5% to 35% during the initial months, with 5% to 10% of cases progressing to a chronic state (10). Its high frequency could be associated with the severity of the underlying condition and the necessity for ventilatory support or an extended stay in the intensive care unit.

A significant proportion of patients required ICU management, and the necessity for mechanical ventilation was comparable among different anesthetic techniques. This observation aligns with the findings reported by Suhocki et al., who advocate for meticulous post-TIPS surveillance due to the elevated risk of encephalopathy, which manifests in 30–40% of patients within 210 days following the intervention (10). Consequently, there is a risk of respiratory and hemodynamic complications, including acute pulmonary edema, hepatic hydrothorax, or congestive heart failure, which necessitates postoperative care in the ICU. While the anesthetic technique did not demonstrate a direct impact on these outcomes, the findings support transfer to the intensive care unit after the procedure.

Hospital mortality was 18.8% in the total cohort, with no deaths in the TIVA group, likely attributable to the limited number of patients undergoing this technique. Newman et al. and Agarwalla posit the hypothesis that TIVA may exert a reduced hepatotoxic effect, thereby facilitating enhanced recovery in these patients (8, 11). Nevertheless, the restricted sample size precludes the drawing of definitive conclusions.

A notable strength of this study is its status as one of the first to provide a detailed account of anesthetic practice for TIPS in Colombia, as performed at a Latin American reference center. The inclusion of a complete cohort over a period of eight years allows for the description of the clinical variability and anesthetic techniques used, as well as perioperative outcomes in a special population of high-risk patients, offering a realistic picture of local practices.

However, the retrospective design is subject to inherent limitations, including incomplete records and comparison groups that exhibit significantly different sizes, which limits the ability to infer causal relationships between anesthetic technique and clinical outcomes.

From a clinical standpoint, the findings underscore the imperative for standardized anesthesia protocols, particularly in patients with advanced liver disease. TIVA could be considered a viable alternative in patients with severe liver dysfunction; nonetheless, further clinical trials are needed to validate its clinical impact.

In the interest of advancing the scientific understanding of this field, future studies should prospectively evaluate real-time hemodynamic variables, as well as the need for invasive monitoring techniques such as NIRS or BIS, whose use was limited in this cohort.

Conclusions

The most frequently utilized anesthetic technique in patients undergoing TIPS was balanced general anesthesia, reflecting standard clinical practice at our center. A meticulous examination revealed no statistically significant discrepancies between BGA and TIVA with respect to major perioperative outcomes, including overall complications (53.3%), vasoactive support requirements, intensive care unit admission, and in-hospital mortality (17,4%). PostTIPS hepatic encephalopathy was the most frequent complication, occurring in 39.36% of patients. These outcomes appear to be more closely related to the baseline severity of liver disease than to the anesthetic technique itself.

In regard to hepatic hemodynamics, a more pronounced reduction in the post-TIPS portosystemic gradient was observed in patients who received TIVA; however, this difference did not attain statistical significance. Given the limited size of the TIVA group, these findings should be interpreted with caution and prospective multicenter studies with larger cohorts are required to validate these findings.

Abbreviations

TIPS
transjugular intrahepatic portosystemic shunt
ICU
Intensive Unite Care
BGA
Balanced General Anesthesia

TIVA
Total intravenous Anesthesia
MELD/MELD-Na
Model for End-Stage Liver Disease-Sodium
NASH
Non-alcoholic steatohepatitis
OH
Alcohol-associated cirrhosis.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the principles of the Declaration of Helsinki. Due to its retrospective nature and use of anonymized data, the requirement for informed consent was waived. The study protocol was reviewed and granted approval by the institutional ethics committee of Fundación Cardioinfantil (approval number: 017-2023).

Consent for publication

Not applicable.

Availability of data and materials

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

Competing interests

The authors declare that they have no competing interests.

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Author´s contributions

MJCM: investigation, data curation, writing - original draft and writing – review & editing; **HPGL:** investigation, data curation, writing - original draft and writing – review & editing; **LCBZ:** methodology, investigation, data curation and writing – original draft; **HAM:** conceptualization, methodology, validation, formal analysis, writing – review & editing and supervision; **YAS:** conceptualization, methodology, validation and supervision.

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Figures

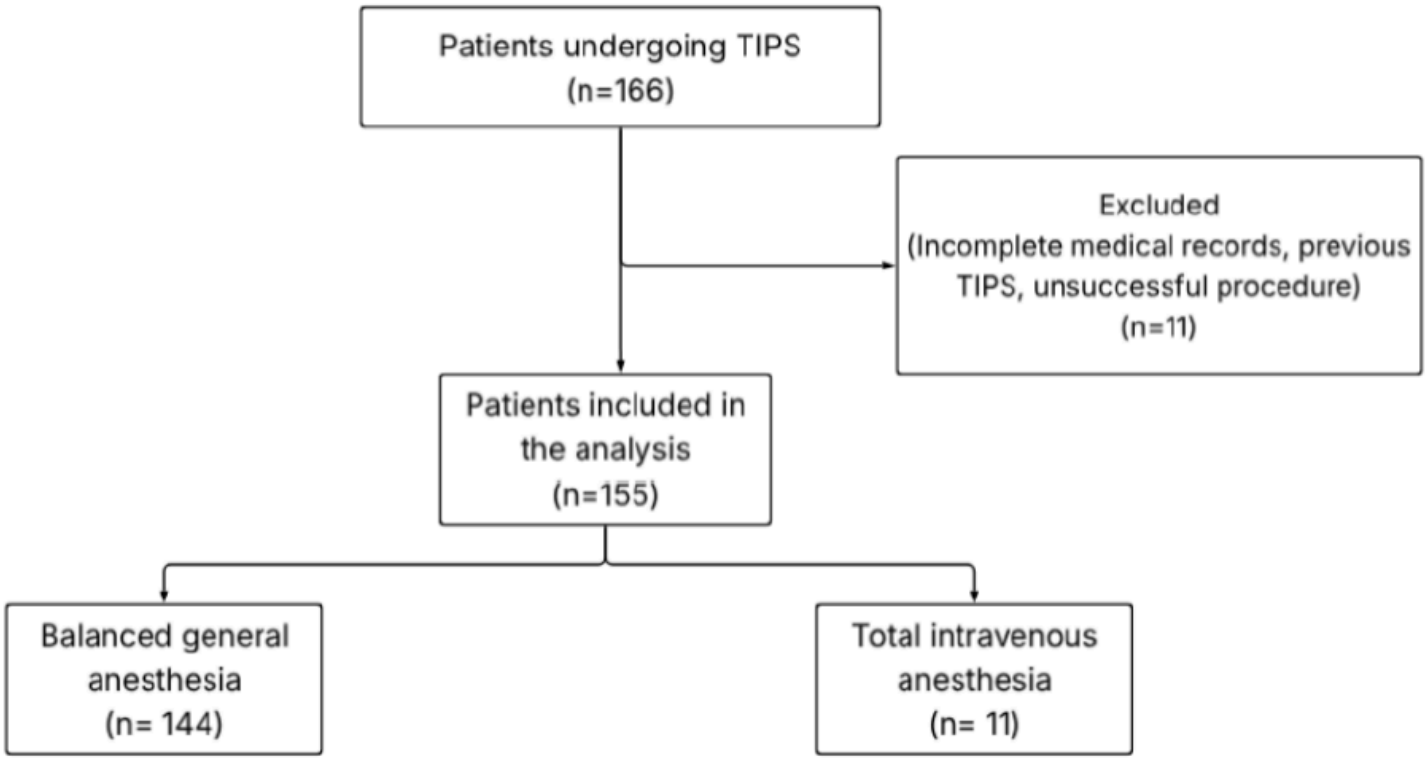


Figure 1

Flow diagram of patient selection and allocation according to anesthetic technique.

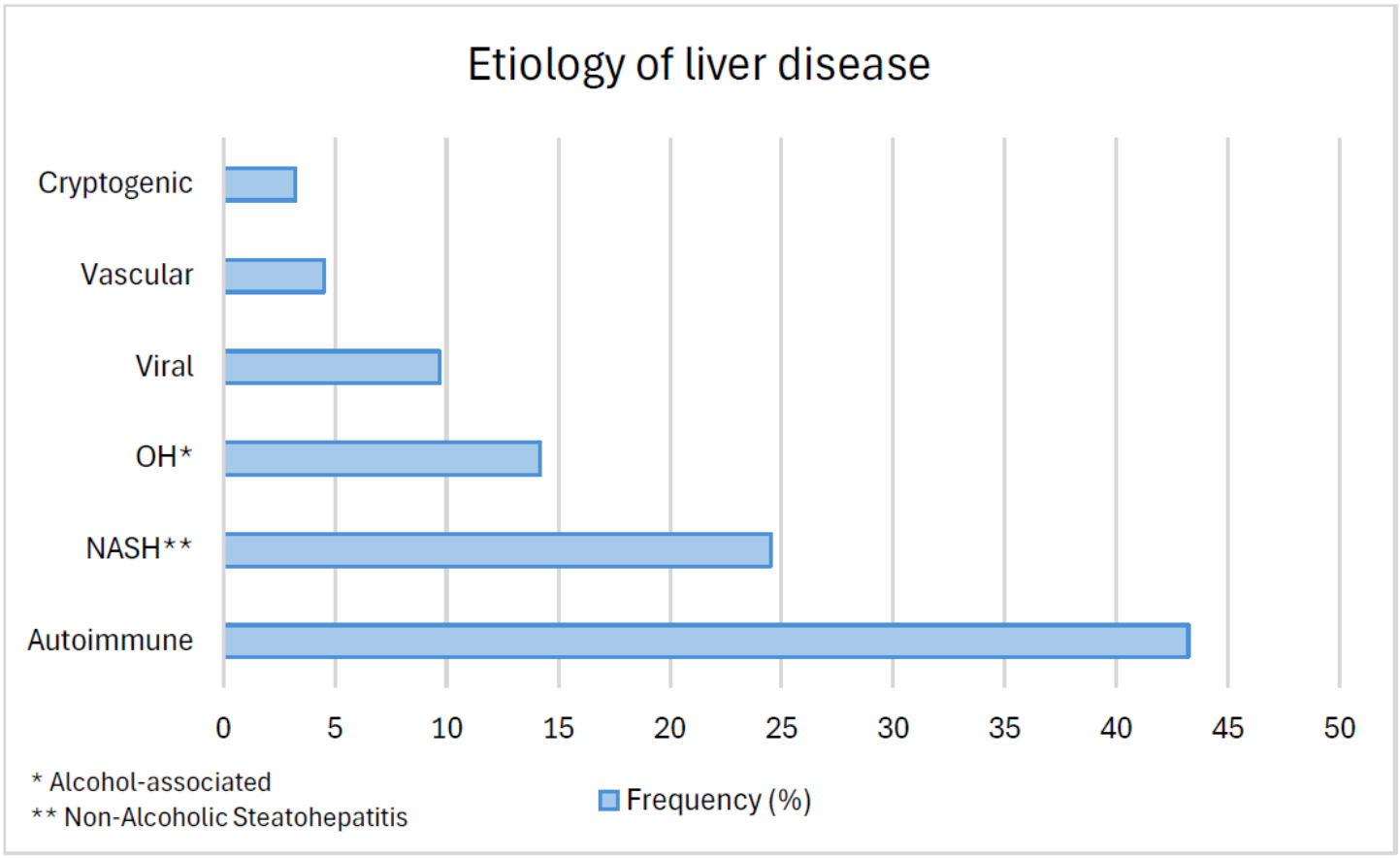


Figure 2

Etiology of liver disease.

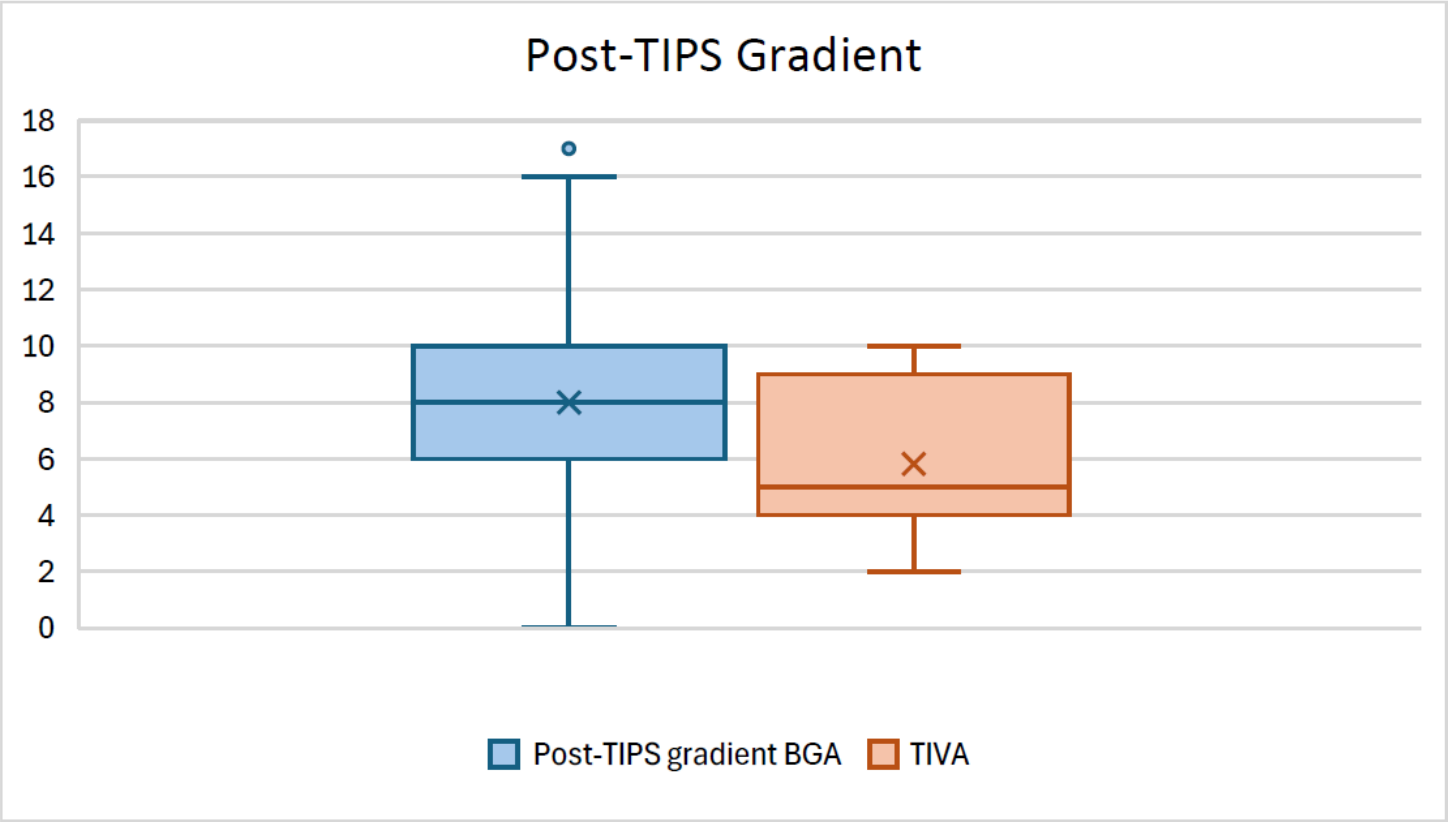


Figure 3

Post-TIPS gradient according to anesthetic technique.