Received: 18 June 2018 | Revised: 25 August 2018 | Accepted: 29 August 2018

DOI: 10.1111/liv.13971

WILEY Liver INTERNATIONAL

Outcomes after placement of a SX-ELLA oesophageal stent for refractory variceal bleeding—A national multicentre study

Nikolaus Pfisterer[1,2,3] | Florian Riedl[2,4] | Thomas Pachofszky[3] | Michael Gschwantler[5,6] | Kurt König[7] | Benjamin Schuster[1,2,3] | Mattias Mandorfer[1,2] | Irina Gessl[1,8] | Constanze Illiasch[3] | Eva-Maria Fuchs[3] | Lukas Unger[2,9] | Werner Dolak[1] | Andreas Maieron[4] | Ludwig Kramer[7] | Christian Madl[3,6] | Michael Trauner[1,2] | Thomas Reiberger[1,2]

[1]Divsion of Gastroenterology and Hepatology, Department of Internal Medicine III, Medical University of Vienna, Vienna, Austria

[2]Vienna Hepatic Hemodynamic Laboratory, Medical University of Vienna, Vienna, Austria

[3]Division of Gastroenterology and Hepatology, Krankenanstalt Rudolfstiftung, Krankenanstaltenverbund Wien (KAV), Vienna, Austria

[4]Division of Gastroenterology and Hepatology, Universitätsklinikum St. Pölten, St. Pölten, Austria

[5]Wilhelminenspital, Krankenanstaltenverbund Wien (KAV), Vienna, Austria

[6]Sigmund Freud University, Private Medical School, Vienna, Austria

[7]Division of Rheumatology, Department of Internal Medicine III, Medical University of Vienna, Vienna, Austria

[8]Division of General Surgery, Department of Surgery, Medical University of Vienna, Vienna, Austria

[9]Krankenhaus Hietzing mit Neurologischem Zentrum Rosenhügel, Krankenanstaltenverbund Wien (KAV), Vienna, Austria

Correspondence
Thomas Reiberger, Division of Gastroenterology and Hepatology, Department of Internal Medicine III, Medical University of Vienna, Vienna, Austria.
Email: thomas.reiberger@meduniwien.ac.at

Handling Editor: Frank Tacke

Abstract

Background: Current guidelines favour the use of bleeding stents over balloon tamponade (BT) for refractory variceal bleeding (VB) from oesophageal varices. However, data on the efficacy and safety of self-expandable metal SX-ELLA Danis stents (SEMS) are limited.

Methods: Cirrhotic patients receiving SEMS for VB at four tertiary care centres were included in this retrospective multicentre study. Rates of failure-to-control bleeding (within 5 days) and bleeding-related mortality (6 weeks) were assessed.

Results: SEMS controlled VB in 79.4% (27/34) of patients. In the rest of patients, other rescue treatments including endoscopic band ligation (EBL, n = 3), SEMS renewed (n = 2) or Linton (n = 2) were applied; however, VB was only controlled in one patient. Early rebleeding within six weeks occurred in 17.6% (6/34) patients. Median SEMS dwell time was three (IQR:6) days. Overall n = 13/34 (38.2%) patients died with SEMS in situ. After SEMS removal, rebleeding and bleeding-related death occurred in n = 7 (35%) and n = 5 (14.7%) patients respectively. Only 32.4% (10/34)

Abbreviations: ALD, alcoholic liver disease; ALT, Alanine transaminase; AST, Aspartate transaminase; BT, Balloon tamponade; CPS, Child-Pugh score; EBL, endoscopic band ligation; GGT, Gamma-glutamyl transferase; HCC, hepatocellular carcinoma; INR, international normalized ratio; IQR, interquartile range; MELD, Model for End-Stage Liver Disease; n, total numbers; NSBB, non-selective beta-blocker; OLT, orthotopic liver transplantation; PVT, portal vein thrombosis; SD, standard deviation; SEMS, self-expandable metal SX-ELLA Danis stents; TIPS, transjugular intrahepatic portosystemic shunt; VB, variceal bleeding.

patients did not experience any rebleeding within six weeks after SEMS removal. Bleeding-related mortality was 47.1% (n = 16/34) and the median survival after SEMS placement was 2.1 months. Notably, no patient received an early transjugular intrahepatic portosystemic shunt (TIPS). The most common adverse events were stent dislocations (n = 13; 38.2%), while ulcers/necrosis of the oesophageal mucosa was seen in only four (11.8%) patients.

Conclusion: SEMS controlled refractory VB in most patients. However, bleeding-related mortality remained high. While SEMS dislocations were frequent, ulcers/necrosis of the oesophagus was rare. Further studies should investigate whether the wider use of early TIPS reduces bleeding-related mortality after SEMS placement.

KEYWORDS

cirrhosis, portal hypertension, self-expandable metal stent, variceal bleeding

1 | INTRODUCTION

Variceal bleeding (VB) is a serious complication of portal hypertension in patients with cirrhosis. Despite improvements in the management of VB, mortality remains as high as 12%-20%, with most deaths occurring within the first five days after acute bleeding.[1-3] Refractory bleeding and early rebleeding are associated with a high mortality (30%-50%).[2,4,5]

According to current guidelines, the standard treatment for VB is hemodynamic stabilization, vasoactive drugs (terlipressin, somatostatin or analogues) and antibiotic prophylaxis, followed by esophagogastroduodenoscopy and variceal band ligation within 12 hours (ideally within the first 6 hours after admission).[6,7] Control of VB can be achieved in 80%-90% of cases.[8,9] If standard treatment fails, balloon tamponade (BT), self-expandable metal stent (SEMS) and/or rescue transjugular intrahepatic portosystemic shunt (TIPS) are indicated.[6,7] Early and rescue TIPS are effective, but their use is limited by technical difficulties and availability.[10,11] However, high-risk patients with presence of advanced liver failure, active variceal bleeding despite vasoactive drugs or high-risk portal hypertension (≥20 mm Hg) benefit from early TIPS placement. In a recent randomized controlled trial, early TIPS placement led to a decrease in failure-to-control bleeding, decreased rates of rebleeding and, ultimately, decreased mortality in these high-risk patients.[12]

Previously, BT (eg, Sengstaken tube) was the most commonly used treatment for uncontrolled bleeding.[13-15] Older data have shown that compression of bleeding varices had a bleeding control of up to 90%, but half of the patients had rebleeding events after deflation of BT.[4,13-16] Moreover, complications—some of them life-threatening (ie, perforation and aspiration pneumonia)—were observed in up to 60%.[4,13-15,17,18] Finally, because of the risk of pressure-induced necrosis in the oesophagus, the BT can only be used for 24-48 hours.[19]

The self-expanding metal stent (SEMS) SX-ELLA Stent Danis can be deployed without endoscopic guidance and may be left in place for up to seven days.[20] Several studies have shown successful and immediate bleeding control in about 70%-100% of patients.[21-24] Moreover, perforation and aspiration pneumonia seemed to occur less often with SEMS as compared to BT, while no difference in survival was observed.[25,26]

Current guidelines recommend the use of SEMS because of its favourable safety profile, although evidence regarding efficacy is scarce.[7]

Thus, we conducted a national multicentre study aiming to assess the safety and efficacy of SEMS in patients with refractory VB.

Lay Summary

Patients with cirrhosis might bleed from oesophageal varices, which might even cause death. In this study, we show that severe bleeding that cannot be stopped by endoscopy can be controlled with specialized stents placed in the oesophagus. However, while complications related to the stent placement are rare, the mortality remains high in patients with refractory variceal bleeding, which might be decreased by additional treatments such as early TIPS.

2 | PATIENTS AND METHODS

2.1 | Study design

This retrospective study comprised patients with cirrhosis and refractory bleeding from oesophageal varices from four tertiary centres in Vienna, Austria (Vienna General Hospital of the Medical University of Vienna, Krankenanstalt Rudolfstiftung, Wilhelminenspital and Krankenhaus Hietzing). Patients undergoing self-expanding metal stent (SEMS; SX-ELLA Stent Danis, ELLA-CS, Hradec Kralove, Czech Republic) placement between 01/2009 and 12/2016 were included. Exclusion criteria were age

TABLE 1 Baseline characteristics

All (n)	34
Age (average, SD)	55.5 (11.5)
Sex (m/f, %m)	28/6 (82.4%)
Aetiology of cirrhosis	
Alcoholic liver disease (ALD), n (%)	16 (47.1%)
Viral hepatitis, n (%)	8 (23.5%)
Combined ALD/viral hepatitis, n (%)	4 (11.8%)
Other, n (%)	3 (8.8%)
Cryptogenic, n (%)	3 (8.8%)
HCC, n (%)	6 (17.6%)
PVT, n (%)	4 (11.8%)
History of variceal bleeding, n (%)	18 (52.9%)
Oesophageal varices, n (%)	34 (100%)
Additional gastric varices, n (%)	3 (8.8%)
Laboratory parameters	
Creatinine (mg/dL, IQR)	0.95 (0.75)
Albumin (g/L, IQR)	28.9 (8.2)
INR (IQR)	1.5 (0.45)
Bilirubin (mg/dL, IQR)	2 (3.7)
MELD (IQR)	18 (10)
Ascites	21 (72.4%)
Child-Pugh class, n (%)[a]	
CPS A	1 (2.9%)
CPS B	10 (29.4%)
CPS C	8 (23.5%)
AST (U/L, IQR)	84 (125)
ALT (U/L, IQR)	38.5 (48)
GGT (U/L, IQR)	130 (322)

%m, percentage of male; ALD, alcoholic liver disease; ALT, alanine transaminase; AST, aspartate transaminase; CPS, Child-Pugh score; EBL, endoscopic band ligation; F, female; GGT(gamma-glutamyl transferase; HCC, hepatocellular carcinoma; INR, international normalized ratio; IQR, interquartile range; M, male; MELD, Model for End-Stage Liver Disease; mg/dL, milligram per decilitre; n, total numbers; PVT, portal vein thrombosis; SEMS, self-expanding SX-ELLA Danis metal stent; U/L, units per litre
[a]Information on Child-Pugh score was available in n = 19 patients.

TABLE 2 Outcomes after SEMS placement for refractory variceal bleeding

All (n)	34
Treatment failure *unsuccessful EBL prior to SEMS placement*	12 (35.3%)
Bleeding control within 5 days	27 (79.4%)
Death within 5 days *owing to uncontrolled bleeding*	7 (20.6%)
Death within 6 weeks *bleeding-related mortality*	9 (26.5%)
Death *with SEMS* in situ	13 (38.2%)
Bleeding control *without rebleeding within 6 weeks*	10 (29.4%)
Overall stent removal	21 (61.8%)
Median dwell time of SEMS (IQR)	3 (6.3) days
Median dwell time of SEMS (IQR) *in patients who survived ≥14 days*	5 (6.8) days
Rebleeding *at SEMS removal*	3 (8.8%)
Rebleeding *after successful SEMS removal*	7/20 (20.6%)
Rebleeding *while stent* in situ	5 (14.7%)
Death within 5 days owing to uncontrolled bleeding *after SEMS removal*	1 (2.9%)
Bleeding-related death within 6 weeks *after SEMS removal*	4 (11.8%)
Early TIPS placement	0 (-)
Elective TIPS after SEMS placement	4 (11.8%)
Overall mortality (n)	22 (64.7%)
Median survival (d, IQR)	2.1 (17.7)

d, days; IQR, interquartile range; n, total numbers; TIPS, transjugular intrahepatic portosystemic shunt; SEMS, SX-ELLA Danis metal stent

<18 years, the absence of cirrhosis and insufficient medical/endoscopic records.

Number of endoscopies, prior endoscopic band ligation (EBL) treatments in emergency setting, laboratory parameters, concomitant non-selective beta-blocker (NSBB) prescriptions, size of varices and the bleeding episodes were recorded. Child-Pugh score and MELD (UNOS 2016 updated Model for End-Stage Liver Disease including sodium) were calculated.[27]

Rebleeding rates and mortality after SEMS placement were defined as primary efficacy endpoints. Moreover, SEMS dwell time, adverse events and the patients' clinical course were recorded.

Rates of successful bleeding control (≤5 days), early rebleeding (≤6 weeks) and rebleeding rates within one year were assessed. Furthermore, death within 5 days, bleeding-related mortality (≤6 weeks) and overall mortality were recorded. Successful SEMS removal was defined as no rebleeding or death within 1 day after stent removal.

Refractory acute variceal bleeding (failure-to-control bleeding) with vasoactive drugs and endoscopy was defined according to the Baveno IV and V guidelines: [19,28] fresh haematemesis or aspiration of >100 mL of fresh blood via the nasogastric tube beyond two hours after the endoscopy and/or a 3 g/dL drop in haemoglobin without blood transfusion. According to the Baveno V guidelines, rebleeding was defined as evidence of rebleeding from portal hypertensive sources (haematemesis, melaena, aspiration of >100 mL of fresh blood in patients with a nasogastric tube and/or decrease in haemoglobin of 3 g/dL without blood transfusion).[28]

No informed consent has been obtained in this retrospective study. Patients were followed up to their last clinical consultation or death.

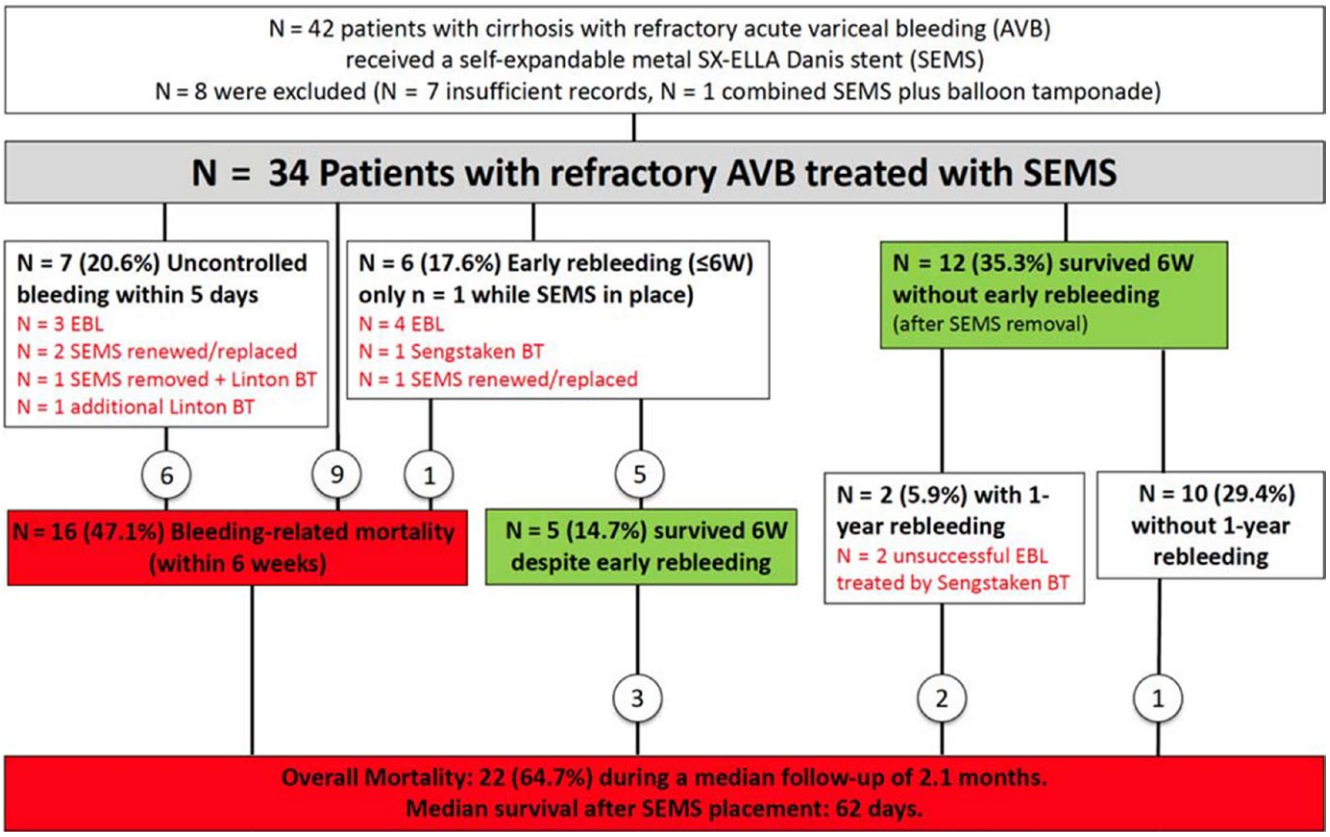

FIGURE 1 Study flow chart. Among 42 patients screened, 8 patients were excluded because of insufficient records and one patient received combined SEMS plus balloon tamponade. Finally, 34 patients with refractory variceal bleeding were included. These patients were divided into respective groups of uncontrolled bleeding within 5 days, early rebleeding within 6 weeks and survivors without early rebleeding within 6 weeks. Death during follow-up is marked with a black circle. Abbreviations: EBL, endoscopic band ligation; SEMS, self-expanding SX-ELLA Danis metal stent; BT, balloon tamponade; 6 W, 6 weeks

2.2 | Statistics

All calculations were performed using GraphPad Prism 6 (GraphPad Software, La Jolla, CA). Continuous variables were described as mean ± standard deviation (SD) or median (interquartile range [IQR]), while categorical variables were reported as numbers (n) and proportions (%) of patients.

2.3 | Ethics

This study was conducted in accordance with the Declaration of Helsinki and was approved by the ethics committees of the Medical University of Vienna (EK#2097/2016) and the Krankenanstaltenverbund Wien (KAV) (MA-15, EK#16-218-VK).

3 | RESULTS

3.1 | Patient characteristics

A total of 42 patients were treated with SEMS during the study period. Eight patients were excluded because of insufficient data or additional treatment with balloon tamponade. Finally, 34 patients with a mean age of 55.5 years were included in this study. The majority of patients were male (82.4%). Alcoholic liver disease was the most common aetiology of cirrhosis (47.1%). Six patients (17.6%) had hepatocellular carcinoma and four (11.8%) patients had portal vein thrombosis at time of SEMS implantation. None of the patients with portal vein thrombosis received anticoagulation at baseline or during the first 6 weeks of the study. The majority of patients had large varices (67.6%). Most patients had Child-Pugh B cirrhosis (29.4%) and the median MELD was 18 (interquartile range, IQR 10) points (Table 1).

Most patients had a prior history of variceal bleeding (52.9%). More than a half of them (55.6%) had previously been treated with a combination of NSBBs and EBL.

3.2 | Overall bleeding control

Among the 34 patients included in this study, 12 (35.3%) patients had treatment failure as defined by an unsuccessful EBL prior to SEMS implantation. SEMS controlled acute bleeding in 27 (79.4%) of patients. A total of 13 patients died with the SEMS in situ. After successful stent removal (n = 20 patients), bleeding reoccurred in n = 7 (35%) patients. Ten (29.4%) patients did not experience any

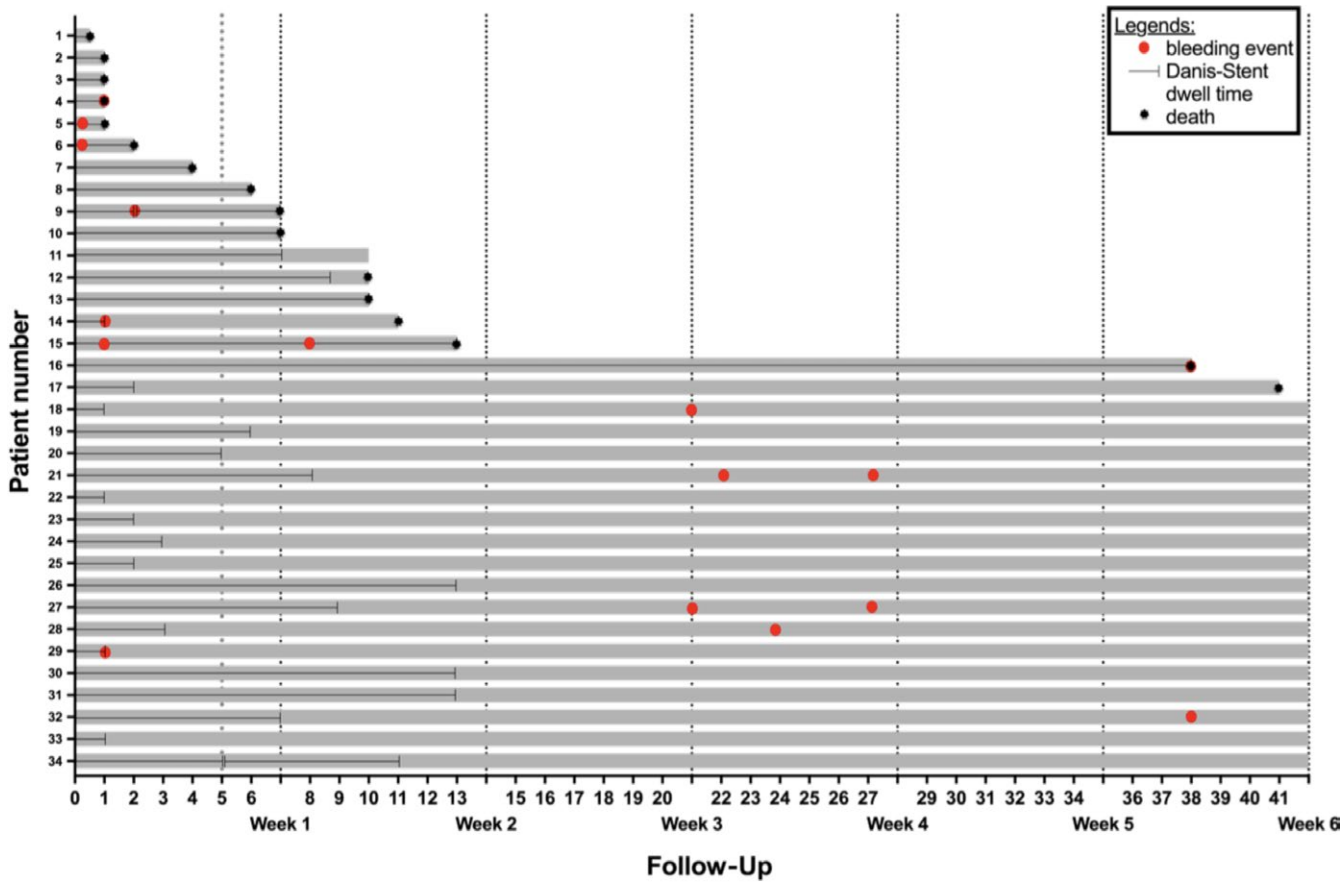

FIGURE 2 Patients' course after self-expanding SX-ELLA Danis metal stent. Bleeding events were highlighted with red dots, deaths with black stars and the stent dwell time was marked with a black line

rebleeding within 6 weeks after SEMS removal (Table 2, Figures 1-3).

3.3 | Uncontrolled bleeding, further procedures and outcome

In the remaining seven (20.6%) patients who experienced failure-to-control bleeding within five days, three patients had subsequent EBL, while in two patients the stent had to be replaced, one patient received a Linton BT after removing SEMS and one patient additionally received a Linton BT. Among these patients, six had bleeding-related mortality, and only one patient achieved a successful long-term bleeding control (Figures 1,2).

3.4 | Early rebleeding, further procedures and outcome

Early rebleeding within 6 weeks was observed in six patients (17.6%). Four patients of them underwent EBL, one received a subsequent SEMS, and one patient was treated with a Sengstaken tube. Five patients survived at least six weeks after the first SEMS implantation. However, three of them died during follow-up. One patient died within six weeks (Figures 1,2).

3.5 | Rebleeding during follow-up, further procedures and outcome

A total of 12 patients (35.3%) survived 6 weeks without early rebleeding. Only two (5.9%) patients showed rebleeding after the first 6 weeks of follow-up. These two patients were treated with

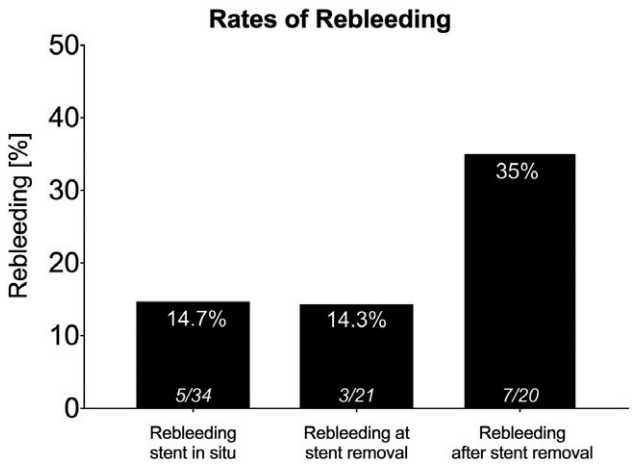

FIGURE 3 Rebleeding while stent in situ, rebleeding at stent removal and rebleeding after successful stent removal

TABLE 3 Treatment-related adverse events after SEMS placement

All (n)	34
Stent dislocation, n (%)	13 (38.2)
Ulcers/necrosis of the oesophageal mucosa, n (%)	4 (11.8)

n, total numbers.

a Sengstaken tube and died during follow-up. Furthermore, 10 patients (29.4%) had no rebleeding event within 1 year. One of them died during follow-up (Figure 1).

3.6 | Bleeding-related mortality

Overall, 22 (64.7%) patients died during follow-up with a median survival of 2.1 (17.7) months after SEMS placement. Seven (20.6%) patients died owing to uncontrolled bleeding within 5 days and nine (26.6%) patients had bleeding-related mortality. Causes of death within one year were liver failure (n = 3), cardiovascular disease (n = 1) and consequences of further rebleeding (n = 1) after 6 weeks (Table 2).

3.7 | Rebleeding and death with SEMS in situ

In 5 of 34 (14.7%) patients, a rebleeding event was reported while the stent was in situ and 13 patients (38.2%) died while the stent was in situ (Figure 3, Table 2).

3.8 | Outcome after SEMS removal

Bleeding control was achieved in 58.8% (20/34) after SEMS removal. However, rebleeding at stent removal occurred in 14.3%. The rebleeding rate after successful stent removal was 35% and bleeding-related death was reported in four (11.8%) patients. One death (2.9%) occurred owing to uncontrolled bleeding after SEMS removal (Figure 3, Table 2, Table S1).

Next, we compared the characteristics of patients with (n = 7, 20.6%) and without (n = 10, 29.4%) early rebleeding after SEMS removal (Table S1). We found no statistically significant differences between these subgroups; however, there was a trends towards a lower prevalence of hepatocellular carcinoma (HCC, 0% vs 28.6%, $P = 0.072$) in patients without early rebleeding after SEMS removal.

3.9 | Adverse Events

Median SEMS dwell time was 5 (IQR, 6.3) days. However, 20 patients who survived 14 days or more had median dwell time of five (IQR, 6.8) days. The most common adverse events were stent dislocations (n = 13; 38.2%), while ulcers/necrosis of the oesophageal mucosa was observed in four (11.8%) patients (Table 2, Table 3).

3.10 | TIPS implantation

Notably, no "early" or "rescue" TIPS placements were performed in our cohort, but four patients received an elective TIPS during follow-up.

Among all included patients, 18 (52.9%) potentially met the early TIPS criteria with 29.4% of patients having Child-Pugh B and 23.5% of patients having a Child-Pugh C with scores of 10-13. However, many patients had relative contraindications for TIPS, such as HCC (n = 6; 17.6%) and portal vein thrombosis (PVT, n = 4; 11.8%).

4 | DISCUSSION

Current guidelines recommend either balloon tamponade (BT) or self-expandable metal stent (SEMS) for treatment of refractory and/or endoscopically uncontrolled variceal bleeding.[6,7] However, the evidence supporting the use of SEMS is still limited. In this retrospective multicentre observational study, we assessed the safety and efficacy of the SX-ELLA analyzed from data of four Austrian tertiary care hospitals.

We found a high percentage of successful bleeding control within five days (82.4%) and one-third had successful bleeding control without bleeding events during follow-up. A recent meta-analyses of 12 studies comprising a total of 155 patients reported a promising clinical success rate of 96% within 24 hours using SEMS for refractory variceal bleeding.[29] However, in three of the included studies, haemostasis within 24 hours was only achieved with lower rate ranging from 78% to 89%.[23,30,31] Another meta-analyses comprising n = 134 showed failure-to-control bleeding rate of 14.2%.[32]

Rebleeding after stent removal represents a serious clinical problem and significantly impacts on long-term outcome. In our study, 29.4% patients had rebleeding after stent removal—including three patients with immediate rebleeding. In the previously mentioned meta-analysis, the rate of rebleeding rate after stent removal was 11% (6 out of 54 patients).[32]

Bleeding-related mortality was as high as 47.1% (n = 16/34) of patients in our study, including 20.6% (n = 7/34) who deceased owing to uncontrolled bleeding. A systematic meta-analysis of 13 studies of patients with variceal bleeding described mortality related to variceal bleeding at 6.7% and 30-day mortality at 34.2%.[32] One possible explanation for this discrepancy with our results is the selection of patients with "true" refractory bleeding in our study, since all patients underwent pretreatment with vasoactive drugs and (attempted) band ligation. If this first-line therapy failed, SEMS implantation was performed as a rescue therapy. While there are no large studies that compare SEMS with BT regarding rebleeding and mortality, a prospective Spanish multicentre trial compared SEMS with BT in a series of cirrhotic patients with variceal bleeding.[25] This study showed a superior safety profile with a lower rate of adverse events and

higher efficacy in controlling bleeding with SEMS as compared to BT. However, the use of SEMS did not result in an improved survival.[25]

In our study, SEMS showed a favourable safety profile when compared to previous studies on BT. Only 11.8% of patients had ulcer and/or necrosis after SEMS implantation, but stent dislocations were found in n = 13 (38.2%) patients. Interestingly, other complications, such as stent migration, pulmonary aspiration and aspiration pneumonia were not observed. Previous studies found stent migrations in 20% to 63.3% of patients[21,22,30,31,33,34] and recorded mucosal ulcerations in 2.9% to 18.2% [21-23,31,34] of patients.

A median SEMS dwell time of three (IQR, 6.3) days was observed in our study, although the manufacturer states that the SEMS can remain in situ for up to 7 days.[20] However, after excluding the seven (20.6%) patients who died within the first 5 days with the stent in situ, the other 27 (79.4%) patients had a median dwell time of five (IQR, 7) days. In addition, 9/24 (37.5%) of patients with the SEMS in place for ≤7 days had the SEMS removed owing to stent dislocation. Moreover, it seems that in a "real life" scenario, when the device is used the first or second time only, the individual decision was to remove the stent early. Therefore, these individual decisions might have had a significant impact on the dwell time.

The most important limitation of our study is its uncontrolled, retrospective design. Therefore, clinical visits during and after gastroscopy sessions did not follow a regular schedule. In most previous studies comparing SEMS with BT, patients were not randomly allocated, but SEMS was retrospectively compared to a historical group of patients who received BT. Notably, variceal bleeding was endoscopically treated by sclerotherapy in most patients of these studies, thus, not representing a valid historical control group.[7,16,32,35] In our study, a retrospective comparison with BT was not possible owing to the unavailability of electronical data of BT.

Apparently, patients with early rebleeding despite SEMS had a very poor prognosis: Nearly half of the patients (47.1%) died within 6 weeks owing to bleeding-related complications. Interestingly, not a single patient in our study underwent early TIPS or orthotopic liver transplantation (OLT) after SEMS. The exact reasons why TIPS was not performed were not systematically documented. However, some patients presented with relative contraindications for TIPS, such as HCC (17.6%) and PVT (11.8%).

Three out of four centres were not able to offer TIPS implantation without transferring the patient to other centres. Furthermore, some patients were managed in intensive care units mainly run by anaesthesiologists or other specialities. These physicians are often not aware of the recommendations regarding the use of early TIPS—especially when bleeding is controlled by the SEMS.

We conclude from our data that physicians should be better informed about the early TIPS strategy. We believe that this is a critical issue owing to the promising results of early TIPS implantation with a number needed to treat four patients for preventing mortality within one year.[36]

Thus, we strongly support a subsequent TIPS implantation strategy for patients at high risk of treatment failure after initial pharmacological and endoscopic treatment,[6,7] especially after the need for SEMS to control bleeding.

The lack of systematic use of TIPS was not only observed in our study. A recent real-life study clearly demonstrated that among the one-third of patients who fulfil the criteria for early TIPS, only 7% had finally received early TIPS implantation.[11]

In conclusion, the use of SEMS controlled refractory VB in most patients without significant safety concerns. However, almost half of patients experienced bleeding-related mortality within 6 weeks—probably as an early TIPS strategy after SEMS placement was not followed. Late rebleeding after SEMS removal was uncommon, but the long-term outcome remained poor. While SEMS can be sufficiently used to control refractory variceal bleeding, future studies should evaluate if long-term outcome is improved when the early TIPS strategy has been better implemented after SEMS placement.

ACKNOWLEDGEMENTS

Proof reading by Johanna Zimmerer, Benjamin Zwirzitz and Max Dabomber Schneider

CONFLICT OF INTEREST

NP received travel support from Abbvie and MSD. MM has served as a speaker and/or consultant and/or advisory board member for AbbVie, Bristol-Myers Squibb, Gilead, Janssen and W. L. Gore & Associates and has received a research award from Medis. MG has served as speaker and consultant for AbbVie, Gilead, BMS and MSD and has received grants from AbbVie, Gilead and MSD. MT received advisory board fees from Albireo, Gilead, Janssen, MSD, Falk, Novartis and Intercept and research grants from Albireo, Gilead, MSD, Takeda, Falk, Intercept and Phenex. TR received travel support from Boehringer-Ingelheim, WL Gore, Gilead, Roche and MSD; grant support from Abbvie, Boehringer-Ingelheim, Gilead, WL Gore, Phenex Pharmaceuticals and Philipps; served on advisory boards for Abbvie, Bayer, Boehringer-Ingelheim, Gilead and MSD; and received lecture fees from Boehringer-Ingelheim, Gore, MSD and Roche. The other authors declared that they have no conflict of interest.

AUTHORS' CONTRIBUTIONS

NP, MM, TR: conceived and designed the study; acquired the data; analyzed and interpreted the data; drafted the manuscript; critically revised the manuscript for important intellectual content. BS, KK, WD, AM, LK: acquired the data. IG, EF, LU, CI: critically revised the manuscript for important intellectual content. FR, TP, MG, CM, MT: acquired the data; critically revised the manuscript for important intellectual content, analyzed and interpreted the data.

ORCID

Nikolaus Pfisterer http://orcid.org/0000-0003-1336-7250

Florian Riedl http://orcid.org/0000-0001-5772-1886

Michael Gschwantler http://orcid.org/0000-0002-2523-1708

Mattias Mandorfer http://orcid.org/0000-0003-2330-0017

Thomas Reiberger http://orcid.org/0000-0002-4590-3583

REFERENCES

1. Jairath V, Rehal S, Logan R, et al. Acute variceal haemorrhage in the United Kingdom: patient characteristics, management and outcomes in a nationwide audit. *Dig Liver Dis*. 2014;46(5):419-426.
2. García-Pagán JC, Reverter E, Abraldes JG, Bosch J. Acute variceal bleeding. *Semin Respir Crit Care Med*. 2012;33(1):46-54.
3. D'Amico G, De, . Franchis R, Cooperative Study Group. Upper digestive bleeding in cirrhosis. Post-therapeutic outcome and prognostic indicators. *Hepatology*. 2003;38(3):599-612.
4. D'Amico G, Pagliaro L, Bosch J. The treatment of portal hypertension: a meta-analytic review. *Hepatology*. 1995;22(1):332–354.
5. D'Amico G, Criscuoli V, Fili D, Mocciaro F, Pagliaro L. Meta-analysis of trials for variceal bleeding. *Hepatology*. 2002;36(4):1023–1024.
6. Reiberger T, Püspök A, Schoder M, et al. Austrian consensus guidelines on the management and treatment of portal hypertension (Billroth III). *Wien Klin Wochenschr*. 2017;129(S3):135–158.
7. de Franchis R, Faculty B. Expanding consensus in portal hypertension: Report of the Baveno VI Consensus Workshop: Stratifying risk and individualizing care for portal hypertension. *J Hepatol*. 2015;63(3):743–752.
8. D'Amico M, Berzigotti A, Garcia-Pagan JC. Refractory acute variceal bleeding: what to do next? *Clin Liver Dis*. 2010;14(2):297–305.
9. Karsan HA, Morton SC, Shekelle PG, et al. Combination endoscopic band ligation and sclerotherapy compared with endoscopic band ligation alone for the secondary prophylaxis of esophageal variceal hemorrhage: a meta-analysis. *Dig Dis Sci*. 2005;50(2):399–406.
10. García-Pagán JC, Caca K, Bureau C, et al. Early Use of TIPS in Patients with Cirrhosis and Variceal Bleeding. *N Engl J Med*. 2010;362(25):2370–2379.
11. Thabut D, Pauwels A, Carbonell N, et al. Cirrhotic patients with portal hypertension-related bleeding and an indication for early-TIPS: a large multicentre audit with real-life results. *J Hepatol*. 2017;68(1):73–81.
12. Garcia-Pagán JC, Di Pascoli M, Caca K, et al. Use of early-TIPS for high-risk variceal bleeding: Results of a post-RCT surveillance study. *J Hepatol*. 2013;58(1):45–50.
13. Terés J, Cecilia A, Bordas JM, Rimola A, Bru C, Rodés J. Esophageal tamponade for bleeding varices. Controlled trial between the Sengstaken-Blakemore tube and the Linton-Nachlas tube. *Gastroenterology*. 1978;75(4):566–569.
14. Fort E, Sautereau D, Silvain C, Ingrand P, Pillegand B, Beauchant M. A randomized trial of terlipressin plus nitroglycerin vs. balloon tamponade in the control of acute variceal hemorrhage. *Hepatology*. 1990;11(4):678–681.
15. Pinto-Marques P, Romãozinho JM, Ferreira M, Amaro P, Freitas D. Esophageal perforation–associated risk with balloon tamponade after endoscopic therapy. Myth or reality? *Hepatogastroenterology*. 2006;53(70), 536–539.
16. Avgerinos A, Armonis A. Balloon tamponade technique and efficacy in variceal haemorrhage. *Scand J Gastroenterol Suppl*. 1994;207:11–16.
17. Jaramillo JL, de laMata M, Miño G, Costán G, Gómez-Camacho F. Somatostatin versus Sengstaken balloon tamponade for primary haemostasia of bleeding esophageal varices. A randomized pilot study. *J Hepatol*. 1991;12(1):100–105.
18. García-Compeán D, Blanc P, Bories JM, et al. Treatment of active gastroesophageal variceal bleeding with terlipressin or hemostatic balloon in patients with cirrhosis. A randomized controlled trial. *Arch Med Res*. 1997;28(2):241–245.
19. de Franchis R. Evolving consensus in portal hypertension. Report of the Baveno IV consensus workshop on methodology of diagnosis and therapy in portal hypertension. *J Hepatol*. 2005;43(1):167–176.
20. SX-ELLA Stent Danis - ELLA-CS, s.r.o. https://www.ellacs.eu/danis-procedure-pack.html. Published 2018. Accessed January 4, 2018.
21. Zehetner J, Shamiyeh A, Wayand W, Hubmann R. Results of a new method to stop acute bleeding from esophageal varices: implantation of a self-expanding stent. *Surg Endosc*. 2008;22(10):2149–2152.
22. Hubmann R, Bodlaj G, Czompo M, et al. The use of self-expanding metal stents to treat acute esophageal variceal bleeding. *Endoscopy*. 2006;38(9):896–901.
23. Wright G, Lewis H, Hogan B, Burroughs A, Patch D, O'Beirne J. A self-expanding metal stent for complicated variceal hemorrhage: experience at a single center. *Gastrointest Endosc*. 2010;71(1):71–78.
24. Dechêne A, El Fouly AH, Bechmann LP, et al. Acute management of refractory variceal bleeding in liver cirrhosis by self-expanding metal stents. *Digestion*. 2012;85(3):185–191.
25. Escorsell À, Pavel O, Cárdenas A, et al. Esophageal balloon tamponade versus esophageal stent in controlling acute refractory variceal bleeding: a multicenter randomized, controlled trial. *Hepatology*. 2016;63(6):1957–1967.
26. Escorsell A, Bosch J. Self-expandable metal stents in the treatment of acute esophageal variceal bleeding. *Gastroenterol Res Pract*. 2011;2011:910986.
27. Child CG, Turcotte JG. Surgery and portal hypertension. *Major Probl Clin Surg*. 1964;1:1–85.
28. de Franchis R, Faculty BV. Revising consensus in portal hypertension: Report of the Baveno V consensus workshop on methodology of diagnosis and therapy in portal hypertension. *J Hepatol*. 2010;53(4):762–768.
29. McCarty TR, Njei B. Self-expanding metal stents for acute refractory esophageal variceal bleeding: A systematic review and meta-analysis. *Dig Endosc*. 2016;28(5):539–547.
30. Fierz FC, Kistler W, Stenz V, Gubler C. Treatment of esophageal variceal hemorrhage with self-expanding metal stents as a rescue maneuver in a swiss multicentric cohort. *Case Rep Gastroenterol*. 2013;7(1):97–105.
31. Zakaria MS, Hamza IM, Mohey MA, Hubamnn RG. The first Egyptian experience using new self-expandable metal stents in acute esophageal variceal bleeding: pilot study. *Saudi J Gastroenterol*. 2013;19(4):177–181.
32. Marot A, Trépo E, Doerig C, Moreno C, Moradpour D, Deltenre P. Systematic review with meta-analysis: self-expanding metal stents in patients with cirrhosis and severe or refractory oesophageal variceal bleeding. *Aliment Pharmacol Ther*. 2015;42(11–12):1250–1260.
33. Holster IL, Kuipers EJ, van Buuren HR, Spaander M, Tjwa E. Self-expandable metal stents as definitive treatment for esophageal variceal bleeding. *Endoscopy*. 2013;45(6):485–488.
34. Müller M, Seufferlein T, Perkhofer L, Wagner M, Kleger A. Self-Expandable Metal Stents for Persisting Esophageal Variceal Bleeding after Band Ligation or Injection-Therapy: A Retrospective Study. *PLoS One*. 2015;10(6):e0126525.
35. Garcia-Tsao G, Sanyal AJ, Grace ND, Carey W. Practice Guidelines Committee of the American Association for the Study of Liver Diseases, Practice Parameters Committee of the American College of Gastroenterology. Prevention and management of gastroesophageal varices and variceal hemorrhage in cirrhosis. *Hepatology*. 2007;46(3):922–938.

36. Al S, Sawas T, Sadat B, et al. TIPS versus endoscopic therapy for secondary prophylaxis after management of acute esophageal variceal bleeding in cirrhotic patients: a meta-analysis of randomized controlled trials. *J Gastroenterol Hepatol*. 2016;31(9):1519–1526.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: Pfisterer N, Riedl F, Pachofszky T, et al. Outcomes after placement of a SX-ELLA oesophageal stent for refractory variceal bleeding—A national multicentre study. *Liver Int*. 2019;39:290–298. https://doi.org/10.1111/liv.13971