



## Research Progress Report: Predictors and management of post-banding ulcer bleeding in cirrhosis

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### Summary / Brief outline of topic

The aim of my PhD project is to investigate the incidence, mortality, and predictors of post-banding ulcer bleeding (PBUB) in patients with cirrhosis undergoing endoscopic band ligation (EBL), and to improve risk stratification after EBL. PBUB is an uncommon but serious complication associated with relevant morbidity and mortality. My research program includes: (1) a systematic review with meta-analysis, (2) a retrospective cohort study from the University Hospital of Bern, and (3) development and external validation of a prognostic model for PBUB. The long-term objective is to support earlier identification of high-risk patients and improve prevention and management strategies.

### Activities

During the last year, I focused on the completion of the retrospective cohort study and on the development of the prognostic model for PBUB. The main activities were:

- Consolidation of the results from the previously completed systematic review and meta-analysis;
- Completion and publication of the retrospective Bern cohort study on PBUB incidence, outcomes, and predictors;
- Development and internal validation of six survival-type prediction models for PBUB;
- Preparation of two independent external validation cohorts from the Medical University of Vienna and São João University Hospital, Oporto;
- Coordination with collaborators, statistician, and institutional legal teams regarding variable harmonization and data transfer agreements;
- Preparation of the manuscript on model development and external validation.



## Results

### Study 1: Systematic review and meta-analysis

The systematic review and meta-analysis included 18 studies and 9,043 patients with cirrhosis. The pooled incidence of PBUB was 5.5% (95% CI, 4.3–7.1%), the mean time to PBUB occurrence was 11 days, and pooled mortality was 22.3% (95% CI, 14.1–33.6%). Urgent EBL and higher MELD score emerged as major predictors.

### Study 2: Retrospective cohort study at the University Hospital of Bern

This study has now been completed and published in *Alimentary Pharmacology & Therapeutics*. The cohort included 206 patients and 630 EBL procedures performed between 1 January 2018 and 31 December 2022. We observed 43 PBUB events in 36 patients. PBUB incidence was 17.5% per patient and 6.8% per EBL procedure. Median time from EBL to PBUB was 12 days (IQR 6–19). In multivariable analysis, urgent EBL and higher creatinine were independently associated with PBUB. PBUB was also associated with worse outcomes, including higher in-hospital mortality and reduced overall survival.

### Study 3: Model development and external validation

Using the Bern cohort as the derivation dataset, we developed and internally validated six survival-type prediction models for PBUB. The primary prediction horizon was 28 days after index EBL, with additional horizons at 7, 14, 21, and 90 days. Internal validation was performed with 1,000 patient-level bootstrap resamples and the .632 bootstrap rule. The best-performing model was XGBoost (AFT), with a C-index of 77.7%, followed by Survival Forest (75.9%) and XGBoost PH (74.1%). Across models, creatinine and urgent EBL were the most stable predictors. Two independent external validation cohorts have now been assembled in Vienna and Oporto, and validation analyses are ongoing.

## Discussion

The work completed this year confirms and extends the findings from the earlier phases of the project. The Bern retrospective cohort validated the main predictors suggested by the meta-analysis, particularly the importance of urgent EBL and impaired renal function. These same variables also emerged as the most stable predictors in the prognostic models, supporting their clinical relevance.



The main advance this year is therefore the transition from risk factor identification to individualized risk prediction. The main current challenge is external validation, harmonization of variables and management of missing data across cohorts. However, with two independent external cohorts now available, robust validation is feasible.

## **Achievements (Grants / Prizes / Publications)**

### Publications

de Brito Nunes M, Knecht M, Wiest R, Bosch J, Berzigotti A. Predictors and management of post-banding ulcer bleeding in cirrhosis: A systematic review and meta-analysis. *Liver Int.* 2023;43:1644–1653.

de Brito Nunes M, Knecht M, Schropp J, Wiest R, Bosch J, Berzigotti A. Post-Banding Ulcer Bleeding After Endoscopic Ligation: Incidence, Risk Factors and Outcomes in Patients With Cirrhosis. *Aliment Pharmacol Ther.* Epub 2025 Dec 10.

### Grant

Grant from the Burgergemeinde Bern.

### Scientific dissemination

- Poster presentation: Predictors and Management of post-banding ulcer bleeding in Cirrhosis: a systematic review and meta-analysis; EASL congress 2023, Vienna, Austria;
- Oral presentation: Predictors of post-banding ulcer bleeding in patients with cirrhosis: Insights from a Large Swiss Tertiary Center; 16<sup>th</sup> Graduated school of health sciences symposium, November 2024, Bern;
- Oral presentation (Pecha Kucha): Predictors of post-banding ulcer bleeding in patients with cirrhosis at a large tertiary center in Switzerland: a retrospective study; Junior research; Day of BioMedical Research, November 2024, Bern;
- Poster presentation: Post-Banding Ulcer Bleeding After Endoscopic Ligation: Risk Factors, and Outcomes in Patients with Cirrhosis, EASL congress 2025, Amsterdam;
- Oral presentation: Post-Banding Ulcer Bleeding After Endoscopic Ligation: Incidence, Risk Factors, and Outcomes in Patients with Cirrhosis, 25 annual meeting (September 2025), SASL/SGG meeting, Interlaken.



## Outlook / Next steps

The next steps are:

- to complete external validation of the PBUB prediction models in the Vienna and Oporto cohorts;
- to finalize and submit the manuscript on model development and external validation;
- to integrate these results into the PhD thesis manuscript and defense preparation;
- to continue the next planned project on viscoelastic coagulation tests as a tool for PBUB prediction and management algorithm development.