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Factors associated with in-hospital mortality following transcatheter arterial embolization for tumor hemorrhage in patients with cancer

Factores asociados con la mortalidad intrahospitalaria tras embolización arterial transcatéter en pacientes oncológicos con hemorragia tumoral

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ABSTRACT

Introduction: Bleeding in cancer patients is a common and potentially serious complication associated with high morbidity and mortality. Transcatheter arterial embolization has emerged as an effective therapeutic strategy for controlling bleeding, especially in patients with advanced disease or limited treatment options. **Materials and methods:** A retrospective, observational, analytical cohort study was conducted in cancer patients with tumor hemorrhage treated with transcatheter arterial embolization using coils at SOLCA Guayaquil between March and November 2025. Clinical, procedure-related, and outcome variables were collected, including technical success, immediate control of bleeding, rebleeding, re-embolization, and mortality. A descriptive and comparative analysis was performed using Fisher's exact test and the Mann–Whitney U test. **Results:** Twenty-six patients were included; the median age was 58 years, and 61.5% were female. Technical success was 100%, with immediate control of bleeding in 69.2% of cases. Rebleeding occurred in 30.8%, and 15.4% required re-embolization. In-hospital mortality was 38.5%, and 30-day mortality was 42.3%. Higher in-hospital mortality was observed among patients with hematologic malignancies, those requiring vasopressors, those without immediate bleeding control, and those with rebleeding. **Conclusions:** Patients presenting with shock on admission had a higher mortality rate, although this difference did not reach statistical significance. In contrast, tumor type was significantly associated with in-hospital mortality, with higher mortality observed among patients with hematologic malignancies.

Keywords: Therapeutic embolization; hemorrhage; neoplasms; interventional radiology; mortality.

RESUMEN

Introducción: El sangrado en pacientes oncológicos es una complicación frecuente y potencialmente grave, asociada a alta morbilidad y mortalidad. La embolización arterial transcatéter ha emergido como una estrategia terapéutica eficaz para el control del sangrado, sobre todo en pacientes con enfermedad avanzada o con opciones terapéuticas limitadas. **Materiales y métodos:** Se realizó un estudio observacional, analítico y de cohorte retrospectiva en pacientes oncológicos con hemorragia tumoral tratados mediante embolización arterial transcatéter con coils en SOLCA Guayaquil, entre marzo y noviembre de 2025. Se recolectaron variables clínicas, relacionadas con el procedimiento y de desenlace, entre ellas el éxito técnico, el control inmediato del sangrado, el resangrado, la reembolización y la mortalidad. Se realizó un análisis descriptivo y comparativo mediante la prueba exacta de Fisher y la prueba U de Mann-Whitney. **Resultados:** Se incluyeron 26 pacientes, la mediana de edad fue de 58 años y el 61,5 % correspondió al sexo femenino. El éxito técnico fue del 100%, con control inmediato del sangrado en el 69,2 %. El 30,8 % presentó resangrado y el 15,4 % requirió reembolización. La mortalidad intrahospitalaria fue del 38,5 % y la mortalidad a 30 días, del 42,3 %. Se observó mayor mortalidad intrahospitalaria en los pacientes con neoplasias hematológicas, aquellos que requirieron vasopresores, aquellos sin control inmediato del sangrado y aquellos que presentaron resangrado. **Conclusiones:** Los pacientes con choque al ingreso presentaron una mayor proporción de mortalidad, aunque esta diferencia no alcanzó significancia estadística. En contraste, el tipo de tumor se asoció significativamente con la mortalidad intrahospitalaria, observándose una mayor mortalidad en los pacientes con neoplasias hematológicas.

Palabras clave: embolización terapéutica; hemorragia; neoplasias; radiología intervencionista; mortalidad.

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1. Introduction

Bleeding is a common and clinically significant complication in patients with cancer, with an estimated incidence of approximately 10% over the course of the disease. Its clinical presentation is heterogeneous, ranging from mild bleeding episodes to potentially life-threatening major hemorrhage, with significant implications for hemodynamic stability, transfusion requirements, and the continuation of oncologic treatment [1]. In addition, hemorrhagic events are associated with poorer prognosis, impaired quality of life, and interruption of antineoplastic therapies, all of which contribute to increased morbidity and mortality in this population [2].

Tumor invasion, ulceration, and erosion of vascular structures may lead to persistent or recurrent hemorrhagic events, potentially resulting in hemodynamic instability, delays in the continuation of oncologic treatment, and an increased risk of mortality [3]. However, the etiology of bleeding in patients with cancer is multifactorial. In addition to tumor progression, bleeding may be related to diagnostic or therapeutic interventions, including invasive procedures, radiotherapy, and systemic therapies. Concomitant conditions such as thrombocytopenia, hepatic dysfunction, and anticoagulant use may also contribute to bleeding, particularly in patients with hematologic malignancies and advanced disease [1].

The pathophysiology of cancer-related bleeding involves an interplay between local and systemic mechanisms. Tumor invasion of vascular structures, erosion of the vessel wall, extrinsic vascular compression, and the development of abnormal neovascularization may promote hemorrhage. Tumor necrosis, whether spontaneous or induced by oncologic treatment, may further increase the risk of bleeding. These mechanisms are compounded by treatment-related factors, including surgery, biopsies, ablative procedures, radiotherapy, and the use of antiangiogenic agents or anticoagulants, as well as common hematologic abnormalities such as thrombocytopenia and cancer-associated coagulopathies [4].

Consequently, the management of bleeding in patients with cancer represents a clinical challenge, particularly in those with advanced disease, multiple lines of therapy, or significant comorbidities. Although medical therapy, radiotherapy, and surgery remain important therapeutic options, their use may be limited by the patient's clinical condition, the location of the bleeding, or the extent of disease. In this setting, transcatheter arterial embolization has become an effective, minimally invasive alternative for controlling persistent or refractory hemorrhage, particularly when other therapeutic modalities have failed or are not feasible [5].

Transcatheter arterial embolization is an angiography-guided diagnostic and therapeutic procedure that enables identification and occlusion of the vessel responsible for bleeding. It may be performed selectively when there is angiographic evidence of active bleeding or empirically based on clinical, endoscopic, or computed tomography findings, making it particularly useful in patients with advanced disease, failure of conventional hemostatic measures, or hemodynamic instability [3].

Several case series have reported high technical and clinical success rates, with a favorable safety profile and a low incidence of major complications, even among patients with multiple comorbidities or receiving antithrombotic therapy. The ability to perform the procedure under local anesthesia and as part of a multidisciplinary approach has contributed to its increasing incorporation into the management of cancer-related bleeding [6].

Despite these encouraging results, the available evidence remains heterogeneous. Previous studies have reported substantial variability in clinical success, rebleeding, and mortality rates, likely related to tumor type, disease extent, baseline clinical status, and the presence of prognostic factors such as shock, tumor burden, and associated comorbidities. Accordingly, further evidence is needed to better characterize clinical outcomes and prognostic factors in patients with cancer undergoing embolization for tumor-related hemorrhage [7].

Accordingly, this study aimed to describe clinical outcomes and identify factors associated with in-hospital mortality among patients with cancer and tumor-related hemorrhage treated with transcatheter arterial embolization using coils.

2. Materials and methods

An observational, analytical, retrospective cohort study was conducted based on a review of the medical records of patients with cancer and tumor-related hemorrhage treated with transcatheter arterial embolization at SOLCA Guayaquil between March and November 2025.

Adult patients with a diagnosis of cancer who presented with bleeding attributable to the underlying malignancy and underwent embolization during the study period were included. Patients with incomplete data for the main study variables or in whom the tumor-related origin of bleeding could not be confirmed were excluded. Given the retrospective study design, no formal sample size calculation was performed. All patients who met the eligibility criteria during the specified study period were included, yielding a final sample of 26 patients.

Demographic, clinical, procedure-related, and outcome variables were collected based on their clinical relevance. Clinical variables included tumor type, presence of metastatic disease, performance status according to the Eastern Cooperative Oncology Group (ECOG) scale, presence of shock on admission, pre-embolization hemoglobin levels, transfusion requirements, and vasopressor use before embolization.

Procedure-related variables included technical success, intraprocedural complications, and immediate bleeding control. Follow-up variables included post-embolization rebleeding, need for repeat embolization, vasopressor use after the procedure, length of hospital stay, and length of stay in the critical care unit. Outcome variables included in-hospital mortality and 30-day mortality.

Technical success was defined as successful angiographic occlusion of the vessel responsible for bleeding or the absence of contrast extravasation at the end of the procedure. Immediate bleeding control was defined as the absence of clinical recurrence during the immediate post-embolization period.

Embolization procedures were performed by the interventional radiology team under angiographic guidance, with identification of the vascular territory responsible for the hemorrhage followed by selective or superselective catheterization of the target vessel. Coils were used as the embolic agent in all procedures. Coil size and deployment site were individualized according to vessel caliber, vascular anatomy, and the angiographic characteristics of the bleeding, at the discretion of the interventional radiologist.

Statistical analysis included descriptive statistics, with absolute and relative frequencies for categorical variables and measures of central tendency and dispersion for continuous variables. Continuous variables were summarized using the mean and standard deviation or the median and interquartile range, as appropriate according to their distribution. For comparative analyses, categorical variables were assessed using Fisher's exact test, whereas continuous variables were analyzed using the Mann–Whitney U test.

Covariates were selected based on their clinical relevance and included tumor type, presence of shock on admission, bleeding control, transfusion requirements, and vasopressor use. Given the small sample size and the limited number of events (in-hospital deaths), multivariable models were not performed to avoid overfitting and unstable estimates. Therefore, the analysis was limited to descriptive statistics and bivariate analyses.

Missing data were handled using complete-case analysis without imputation. A P value < 0.05 was considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics, version 26 (IBM Corp., Armonk, NY, USA).

Given the retrospective design, potential selection and information biases inherent to medical record review were acknowledged. To minimize these biases, study variables were predefined and data were collected systematically.

The study was approved by the Ethics Committee of Universidad de Especialidades Espíritu Santo. Confidentiality and anonymization of all data were ensured throughout the study in accordance with the ethical principles of the Declaration of Helsinki and applicable national regulations governing research involving human participants.

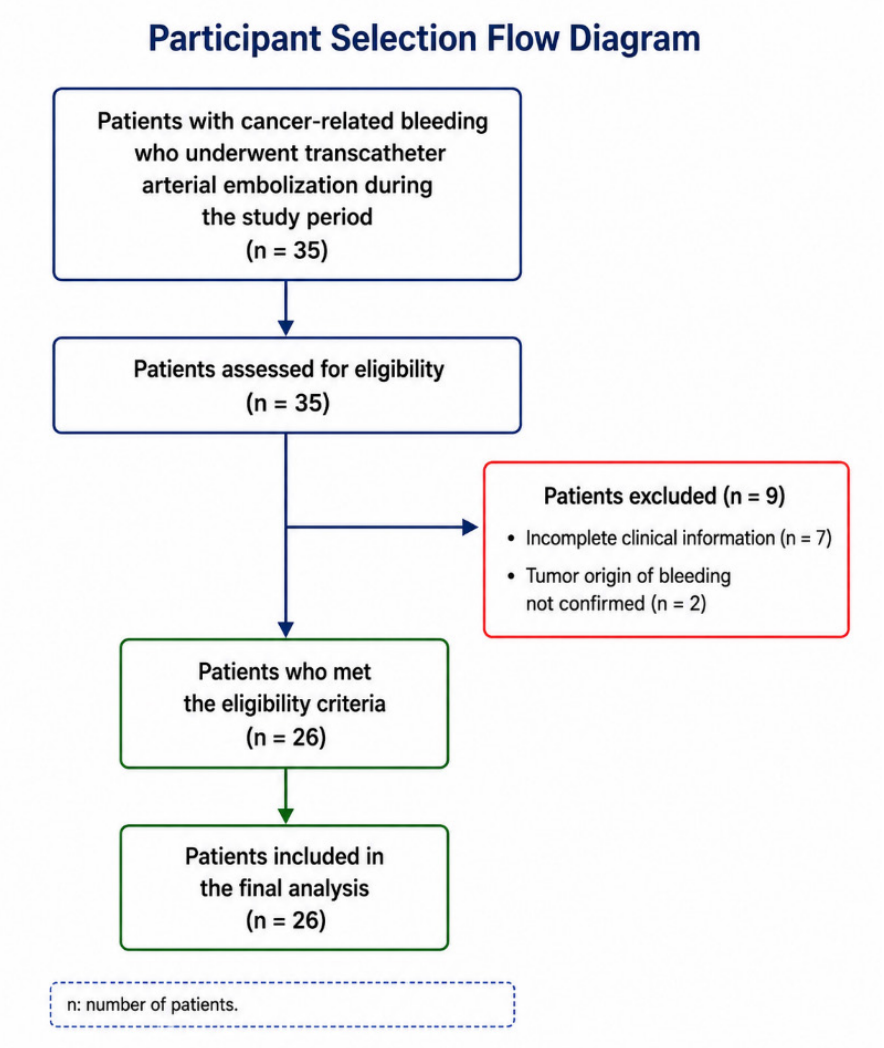
3. Results

A total of 26 patients with cancer who presented with tumor-related hemorrhage and underwent transcatheter arterial embolization were included. No missing data were identified for the main variables analyzed. The patient identification, screening, eligibility, and inclusion process is presented in Figure 1.

Figure 2 summarizes the demographic and clinical characteristics of the cohort, as well as the main outcomes following transcatheter arterial embolization. Female patients with solid tumors predominated in the cohort. Regarding pre-embolization performance status, 23 patients (88.5%) had an ECOG score of 1 and 3 (11.5%) had an ECOG score of 2. The procedure achieved a technical success rate of 100%, with immediate bleeding control in approximately seven out of ten patients and no intraprocedural complications.

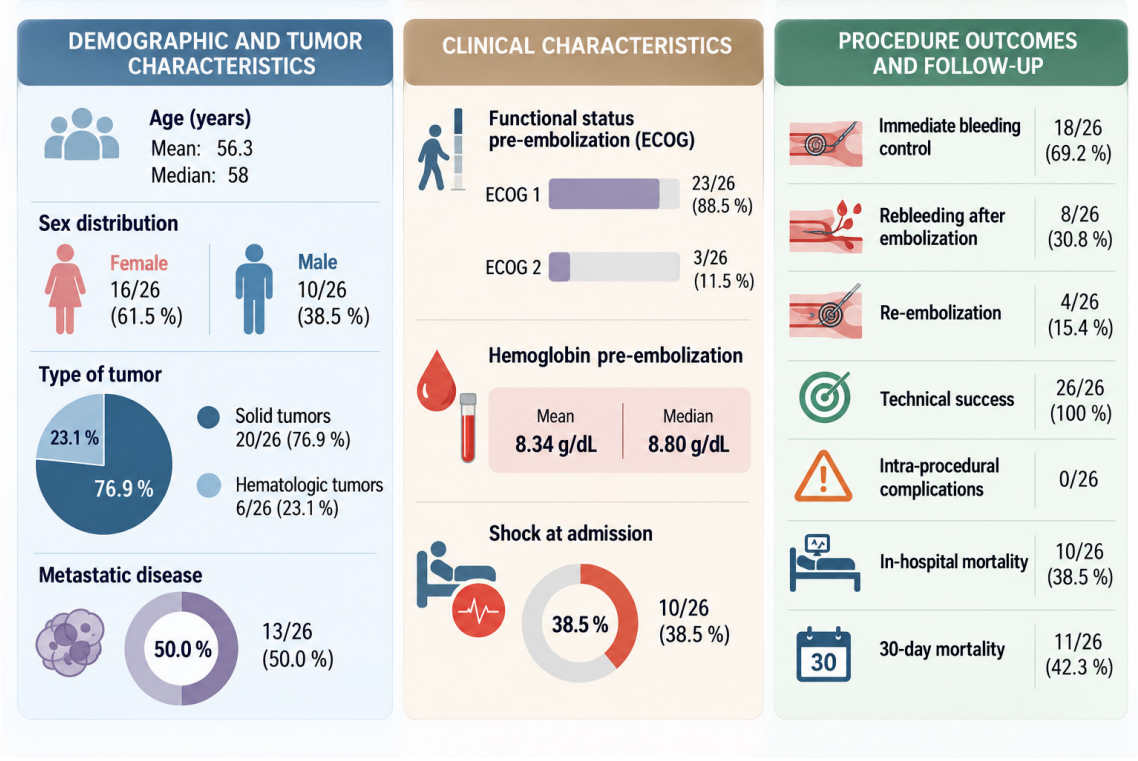
Figure 3 shows the association between different clinical variables and in-hospital mortality. A higher frequency of mortality was observed among patients with hematologic malignancies, those who required vasopressors before embolization, and those in whom immediate bleeding control was not achieved.

Figure 1. Flow diagram of the participant selection process and exclusions leading to the final study cohort (n = 26).



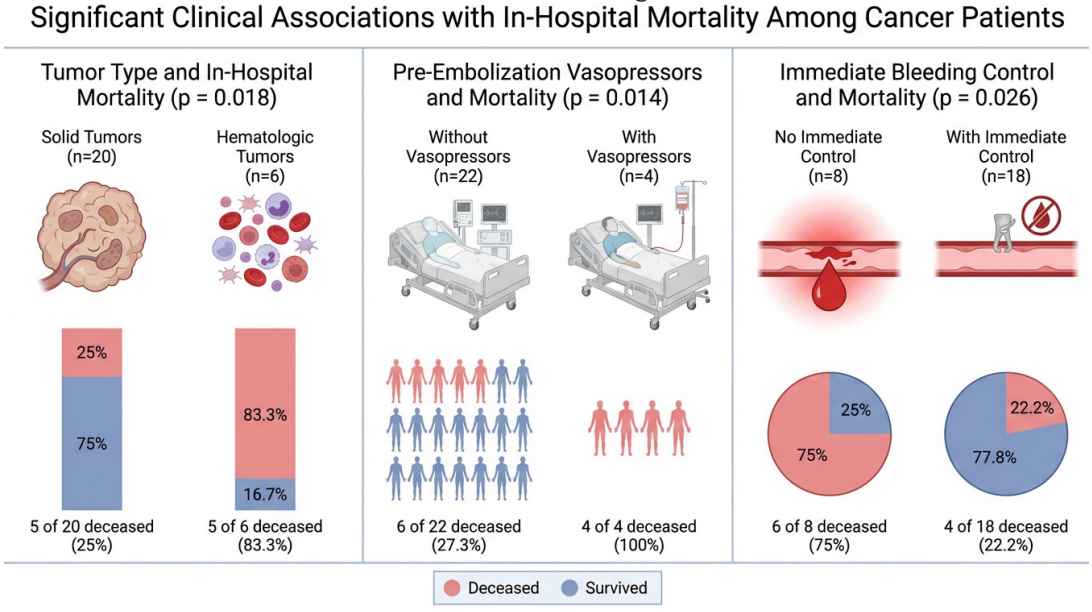
Source: Prepared by the authors based on the study data.

Figure 2. Clinical outcomes of embolization in 26 patients: demographic characteristics, tumor types, post-embolization procedures, and follow-up.



Source: Prepared by the authors based on the study data.

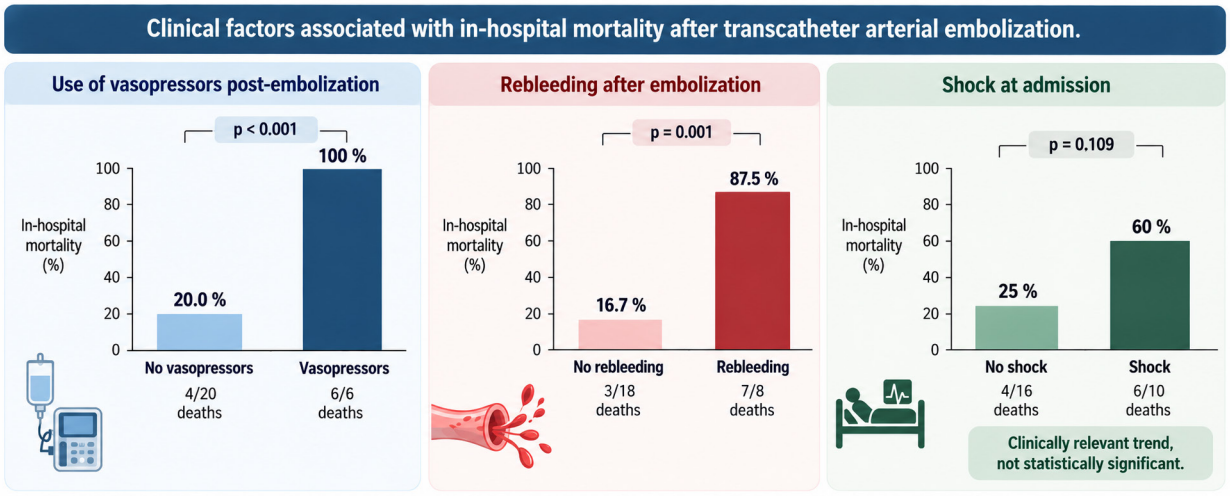
Figure 3. Clinical variables associated with in-hospital mortality in patients with cancer and tumor-related hemorrhage.



Source: Prepared by the authors based on the study data.

In the postprocedural period, mortality was higher among patients who presented rebleeding (87.5% vs. 16.7%; p = 0.001) and among those who required vasopressors after embolization (100% vs. 20.0%; p < 0.001). Although the difference did not reach statistical significance, patients presenting with shock on admission had a higher proportion of in-hospital mortality than those without shock (60% vs. 25%; p = 0.109) (See Figure 4).

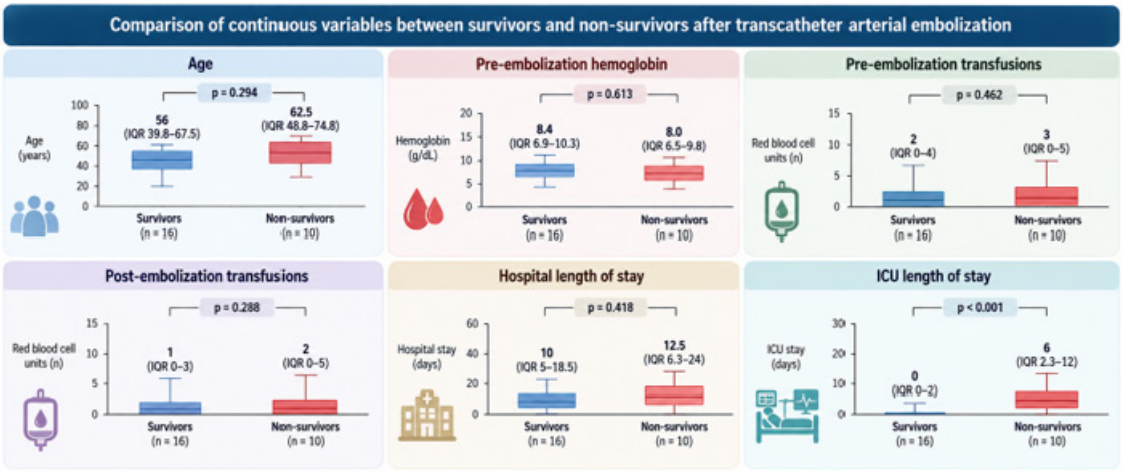
Figure 4. Post-Procedural factors associated with mortality following embolization.



Source: Prepared by the authors based on the study data.

Patients who died had a longer median intensive care unit stay than survivors (6 vs. 0 days; p < 0.001). No statistically significant differences were observed between survivors and patients who died in age (56 vs. 62.5 years; p = 0.294), pre-embolization hemoglobin levels (8.4 vs. 8.0 g/dL; p = 0.613), pre-embolization transfusion requirements (2 vs. 3 units; p = 0.462), post-embolization transfusion requirements (1 vs. 2 units; p = 0.288), or total hospital stay (10 vs. 12.5 days; p = 0.418).

Figure 5. Comparison of Continuous Variables Between Survivors and Non-Survivors Following Transcatheter Arterial Embolization



Source: Prepared by the authors based on the study data.

Regarding continuous variables, ICU length of stay was significantly longer among patients who died than among survivors (median: 6 vs. 0 days; p < 0.001). No statistically significant differences were observed between the two groups in age, pre-embolization hemoglobin levels, pre- and post-embolization transfusion requirements, or hospital length of stay (Figure 5).

4. Discussion

Tumor-related hemorrhage represents a clinically significant complication in patients with cancer, particularly in those with advanced disease. In our cohort, a substantial proportion of patients had metastatic disease and severe clinical conditions at admission, including shock, reflecting the complexity of this population and consistent with findings reported in the literature. In this context, transcatheter arterial embolization has emerged as an effective therapeutic option for the management of tumor-related hemorrhage.

In our series, technical success was achieved in 100% of patients, with immediate bleeding control in 69.2%, findings consistent with those reported in the literature. Previous studies, such as that by Park et al., have reported technical and clinical success rates of 85% and 65%, respectively [8]. Similarly, other series involving urologic malignancies have reported comparable outcomes, with high rates of technical and clinical success even in clinically complex patients [9].

Available evidence indicates that transcatheter arterial embolization has a favorable safety profile, with a low incidence of major complications and generally mild and self-limiting adverse events. No intraprocedural complications were recorded in our cohort, a finding consistent with previous reports. Taken together, these findings support the safety of embolization as a therapeutic option for patients at high surgical risk or with complex clinical conditions [6].

Several studies have shown that clinical success following embolization is associated with improved short-term survival, suggesting that it may represent an important prognostic indicator in patients with tumor-related hemorrhage. Consistent with these findings, our results underscore the relevance of achieving early and effective bleeding control as a determinant of clinical outcomes.

Similarly, Ushimaru et al. [2] compared radiotherapy and transcatheter arterial embolization in patients with advanced gastric cancer and reported a higher rate of immediate hemostatic success with radiotherapy (94.7% vs. 66.7%), although no significant differences in overall survival were observed [2]. These findings suggest that, regardless of the therapeutic modality used, timely control of hemorrhage represents one of the major determinants of prognosis in patients with tumor-related bleeding [2].

Consistent with the above, the absence of immediate bleeding control in our cohort was associated with higher in-hospital mortality, suggesting that the early clinical response to the procedure may be related to subsequent prognosis, particularly in patients with advanced disease and hemodynamic compromise [1].

The biological heterogeneity of tumors may influence the response to conventional therapeutic strategies, reinforcing the need for individualized approaches [10]. In this context, transcatheter arterial embolization represents an alternative within the comprehensive management of patients with cancer, particularly when other therapeutic options are limited [11].

However, the clinical benefit of embolization should not be assessed solely on the basis of immediate hemostasis, but also on its ability to provide sustained bleeding control during follow-up. In patients with advanced cancer, persistent or recurrent bleeding may once again compromise clinical stability and prevent continuation of antineoplastic treatment. Therefore, the durability of bleeding control represents a key component of the clinical effectiveness of embolization and an important objective during follow-up [12].

Regarding postprocedural outcomes, rebleeding remains one of the main limitations of arterial embolization, even when adequate initial bleeding control is achieved. Previous studies have reported rebleeding rates of approximately 30–33% during follow-up despite high rates of technical and clinical success [5]. In our cohort, the rebleeding rate was 30.8%, consistent with previous reports and indicating that initial bleeding control does not necessarily ensure sustained hemostasis.

Furthermore, several studies have identified factors associated with recurrent bleeding and the need for reintervention, including tumor characteristics, persistent residual vascularization, and post-embolization tumor volume [13]. In our cohort, 15.4% of patients required repeat embolization, indicating that, in some cases, the initial procedure may not be sufficient to achieve definitive bleeding control. These findings underscore the need for close follow-up and clinical and imaging reassessment when recurrence is suspected.

The rebleeding observed in our cohort may be explained, at least in part, by the biological and vascular complexity of advanced malignancies. The presence of multiple feeding vessels, collateral circulation, and anatomical variations associated with tumor growth may hinder the identification and complete occlusion of all bleeding sources. Recurrent bleeding may also be influenced by tumor progression and previous oncologic treatments, including chemotherapy- or radiotherapy-induced necrosis and ulceration. These mechanisms highlight the multifactorial nature of rebleeding and may explain its occurrence despite adequate initial technical success [14].

Transcatheter arterial embolization also has a role within the multidisciplinary management of tumor-related hemorrhage, particularly in patients at high surgical risk or with limited therapeutic alternatives [15].

Nevertheless, recurrent hemorrhage remains one of the major challenges following embolization. Initial technical success does not always translate into sustained clinical control because of factors such as the complexity of tumor vascularization, disease progression, and the effects of previous oncologic treatments, highlighting the need for close surveillance and follow-up [16].

Although transcatheter arterial embolization can provide adequate initial control of tumor-related hemorrhage, subsequent clinical outcomes do not depend exclusively on the technical success of the procedure. Our findings, consistent with the literature, suggest that survival may also be related to progression of the underlying malignancy and the patient's baseline clinical condition at the time of bleeding. In this context, embolization should primarily be regarded as a tool for clinical stabilization, as technical success alone does not necessarily modify the prognosis of patients with cancer.

Recurrent hemorrhage remains a challenge following embolization and may occur despite adequate technical success. Therefore, close surveillance and early reassessment are essential, particularly in patients with advanced disease and a high risk of rebleeding [17].

Overall, our findings show a high rate of technical success and initial bleeding control in a substantial proportion of patients undergoing transcatheter arterial embolization, even in a population with considerable clinical complexity. However, the frequency of rebleeding and the need for reintervention indicate that initial procedural success does not always translate into sustained clinical benefit. Prognosis appears to be related both to the early response to bleeding control and to baseline clinical and oncologic severity, underscoring the importance of appropriate risk stratification and close follow-up.

Future prospective, multicenter studies with larger sample sizes are needed to validate these findings and more accurately determine the factors associated with mortality and rebleeding in patients with cancer undergoing transcatheter arterial embolization. Multivariable analyses will also be important to assess the influence of clinical, tumor-related, and procedure-related variables on outcomes and to identify predictive factors that may help select patients most likely to achieve sustained clinical benefit.

5. Conclusions

Transcatheter arterial embolization represents an effective strategy for controlling tumor-related hemorrhage in patients with cancer, achieving a high technical success rate and adequate initial bleeding control, even among patients with advanced disease and substantial clinical complexity. However, rebleeding remains an important limitation and was associated with higher mortality, highlighting the importance of close follow-up after the procedure.

Our findings indicate that the prognosis of patients with tumor-related hemorrhage depends not only on the technical success of embolization but also on baseline clinical severity and the early response to treatment. In this context, early and sustained bleeding control represents a key therapeutic goal for optimizing clinical outcomes. These results characterize the clinical outcomes observed following transcatheter arterial embolization in patients with cancer and tumor-related hemorrhage and highlight the influence of baseline clinical status and bleeding control on subsequent outcomes.

6. Abbreviations

CEISH-UEES: Comité de Ética para Investigación en Seres Humanos - Universidad de Especialidades Espíritu Santo

ECOG: Eastern Cooperative Oncology Group

IQR: Interquartile range

SOLCA: Sociedad de Lucha Contra el Cáncer

SPSS: Statistical Package for the Social Sciences

7. Administrative information

7.1 Author contributions

Sandra Auqui Valarezo: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Visualization, Project Administration, Writing – Original Draft, Writing – Review & Editing.

Pablo Bravo Sánchez: Methodology, Investigation, Data Curation, Formal Analysis, Visualization, Writing – Review & Editing.

Josefina Vivar Maldonado: Investigation, Validation, Supervision, Writing – Review & Editing.

7.2 Conflict of interest statement

The authors declare that they have no conflicts of interest related to the conduct or publication of this study.

7.3 Funding

This study received no external funding.

7.4 Disclaimer

The authors are responsible for the content and opinions expressed in this manuscript, which do not necessarily reflect the official position of their affiliated institutions.

7.5 Ethical considerations

The study was approved by the Human Research Ethics Committee of Universidad de Especialidades Espíritu Santo (CEISH-UEES), under approval code C-UEES-25-54.

8. References

1. Minici R, Guzzardi G, Venturini M, Fontana F, Coppola A, Spinetta M, et al. Transcatheter arterial embolization (TAE) of cancer-related bleeding. Medicina (Kaunas) [Internet]. 2023;59(7):1323. https://doi.org/10.3390/medicina59071323
2. Ushimaru Y, Kawabata R, Nishikawa K, Takeoka T, Ikeda H, Kimura Y, et al. The effectiveness of radiotherapy and transarterial embolization for advanced gastric cancer bleeding. BMC Gastroenterol [Internet]. 2025;25(1):608. https://doi.org/10.1186/s12876-025-04177-3
3. Hall T, Temperley HC, Mac Curtain BM, O'Sullivan NJ, Quirke N, McEniff N, et al. Transcatheter arterial embolisation (TAE) to treat acute upper gastrointestinal bleeding secondary to gastric cancer: A systematic review and meta-analysis. Surgeon [Internet]. 2024;22(6):e213-20. https://doi.org/10.1016/j.surge.2024.09.009
4. Chen Y, Yang Y, Xu W-J, Xin Y-J, Wang Y-N, Zhou X, et al. Clinical application of interventional embolization in tumor-associated hemorrhage. Ann Transl Med [Internet]. 2020;8(6):394. https://doi.org/10.21037/atm.2020.03.69

5. Chen C, Kim PH, Shin JH, Yoon KW, Chung MS, Li H-L, et al. Transcatheter arterial embolization for intractable, nontraumatic bladder hemorrhage in cancer patients: A single-center experience and systematic review. Jpn J Radiol [Internet]. 2021;39(3):273-82. https://doi.org/10.1007/s11604-020-01051-y

6. Kozyrakis D, Konstantinopoulos V, Papaspyridakos P, Zarkadas A, Bozios D, Karmogiannis A, et al. Prostate artery embolization as an effective treatment for clinically significant prostate cancer-related hemorrhage: A case report. Exp Ther Med [Internet]. 2025;29(2):26. https://doi.org/10.3892/etm.2024.12776

7. Gong T, Tsauo J, Ding M, Jin L, Duan F, Yu Y, et al. Transcatheter arterial embolization for cancer-related non-variceal upper gastrointestinal bleeding: A multicenter retrospective study of 107 patients. Diagn Interv Imaging [Internet]. 2023;104(2):60-6. https://doi.org/10.1016/j.diii.2022.07.006

8. Park S, Shin JH, Gwon D-I, Kim HJ, Sung K-B, Yoon H-K, et al. Transcatheter arterial embolization for gastrointestinal bleeding associated with gastric carcinoma: Prognostic factors predicting successful hemostasis and survival. J Vasc Interv Radiol [Internet]. 2017;28(7):1012-21. https://doi.org/10.1016/j.jvir.2017.03.017

9. Kim MS, Hong HP, Kang KA, Lee YR, Joo KJ, Cho Y-S, et al. Superselective vesical artery embolization for intractable bladder hemorrhage related to pelvic malignancy. Acta Radiol [Internet]. 2021;62(9):1229-37. https://doi.org/10.1177/0284185120952781

10. Yung KS, Chung PM, Wong SC, Kwok HM, Ng FH, Lam SY, et al. Transcatheter arterial embolization of vesical arteries for intractable hematuria: Effectiveness and safety in 36 patients. J Vasc Interv Radiol [Internet]. 2025;36(7):1153-1159. https://doi.org/10.1016/j.jvir.2025.03.015

11. Le Tat T, Jost R, Kuoch V, Carlier R-Y, El Hajjam M, Zhou J. Arterial embolization for massive bleeding from a locally advanced breast tumor. Radiol Case Rep [Internet]. 2024;19(11):4698-701. https://doi.org/10.1016/j.radcr.2024.07.050

12. He D, Shao L, Xie Y, Zhao X, Zhang Z, Xu R, et al. Transcatheter arterial embolization with N-butyl cyanoacrylate versus gelatin sponge particles for gastric cancer-related upper gastrointestinal bleeding: A comparison of efficacy and safety. J Gastrointest Oncol [Internet]. 2026;17(2):50. https://doi.org/10.21037/jgo-2025-1-1083

13. Rinka K, Kioka K, Amano Y, Nakai T, Kawasaki Y, Kawada N. Three effective cases of transcatheter arterial embolization after atezolizumab and bevacizumab treatment for hepatocellular carcinoma: A case report. J Med Case Rep [Internet]. 2025;19(1):38. https://doi.org/10.1186/s13256-025-05040-5

14. Yang X-J, Wu Y-J, Wang J-Z, Zheng Y-L, Cheng G-Y, Cui Y-H, et al. Preprocedural computed tomography angiography-guided transcatheter arterial embolization for managing esophageal cancer bleeding: A case series study. Front Oncol [Internet]. 2025;15(1598271):1598271. https://doi.org/10.3389/fonc.2025.1598271

15. Ramakrishnan A, Reilly D, Sayre J, Asachi P, Khabaz K, Quirk M, et al. Predictors of hemorrhage and re-intervention in renal angiomyolipoma following transcatheter arterial embolization. J Clin Med [Internet]. 2025;14(19):6990. https://doi.org/10.3390/jcm14196990

16. Okano H, Nakatsuka A, Ogura M, Mukai K, Nishimura A, Asakawa K, et al. Bleeding from a ruptured, extraluminally growing gastric gastrointestinal stromal tumor treated by transcatheter arterial embolization: A case report. Cureus [Internet]. 2024;16(1):e52394. https://doi.org/10.7759/cureus.52394

17. Choi J, Shin JH, Chu HH. Transcatheter arterial embolization for palliation of uterine body cancer bleeding. J Korean Soc Radiol [Internet]. 2023;84(3):606-14. https://doi.org/10.3348/jksr.2022.0067