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Transarterial Embolization in the Management of Bleeding From Liver Tumors: Experience of 15 Years

Embolização Transarterial no Controlo de Hemorragia de Tumores Hepáticos: Experiência de 15 Anos

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Abstract

Introduction: Active bleeding of liver nodules is a rare but potentially fatal condition. Transarterial embolization has emerged as an effective approach for the control of active bleeding in this setting.
Objective: To describe the experience of a tertiary hospital with the endovascular management of active bleeding associated with liver nodules, focusing on outcomes.
Methods: A retrospective study of 28 consecutive cases treated with transarterial embolization between January 2009 and December 2024. Demographic variables, tumour diagnosis, clinical data, procedure details and clinical outcome were analysed.
Results: The majority of patients were male (85,7%) with a mean age of 66 years (range: 9 to 94 years). The most frequent diagnosis was hepatocellular carcinoma (n=24), followed by hepatic adenoma (n=2) and hepatic metastasis (n=2). Embolization was performed with polyvinyl alcohol (PVA) particles in 16 cases, microcoils in 2 cases, a combination of PVA particles and microcoils in 9 cases and a combination of PVA particles and cyanoacrylate:lipiodol in 1 case. The technical success rate was 100% and one case of bleeding recurrence was recorded. No complications related to the intervention were recorded. The 30-day mortality was 39% (n=11) and the 12-month mortality was 50% (n=14). All deceased patients had malignant tumours.
Conclusion: Embolization was associated with a high technical success rate and a low rate of hemorrhagic recurrence. The observed mortality occurred in patients with malignant tumors and advanced hepatic dysfunction, suggesting that prognosis may be related to the severity of the underlying disease.

Keywords

Embolization; Liver neoplasms; Hepatocellular carcinoma; Spontaneous bleeding; Interventional radiology; Hemorrhage control.

Resumo

Introdução: A hemorragia ativa de tumores hepáticos é uma situação rara mas potencialmente fatal. A embolização transarterial emergiu como uma abordagem eficaz para o controlo da hemorragia ativa neste contexto.
Objetivo: Descrever a experiência de um hospital terciário na abordagem endovascular de hemorragia ativa associada a tumores hepáticos, com foco no desfecho clínico.
Métodos: Estudo retrospetivo com 28 casos consecutivos tratados por embolização transarterial, entre Janeiro de 2009 e Dezembro de 2024. Foram analisadas variáveis demográficas, diagnóstico dos tumores hepáticos, dados clínicos, detalhes do procedimento e desfecho clínico.
Resultados: A maioria dos doentes era do sexo masculino (85,7%), com idade média de 66 anos (9 a 94 anos). O diagnóstico mais frequente foi de carcinoma hepatocelular (n=24), seguido de adenoma hepático (n=2) e metástase hepática (n=2). A embolização foi realizada com partículas de álcool polivinílico (PVA) em 16 casos, microcoils em 2 casos, associação de partículas e microcoils em 9 casos e combinação de partículas e cianoacrilato:lipiodol em 1 caso. A taxa de sucesso técnico foi de 100% e registou-se um caso de recidiva hemorrágica. Não foram documentadas complicações relacionadas com a intervenção. A mortalidade a 30 dias foi de 39% (n = 11) e a 12 meses de 50% (n = 14). Todos os doentes que faleceram apresentavam tumores malignos.
Conclusão: A embolização associou-se a elevada taxa de sucesso técnico e baixa taxa de recidiva hemorrágica. A mortalidade observada ocorreu em doentes com tumores malignos e disfunção hepática avançada, sugerindo que o prognóstico poderá estar relacionado com a gravidade da doença subjacente.

Palavras-chave

Embolização transarterial; Neoplasias hepáticas; Carcinoma hepatocelular; Hemorragia espontânea; Radiologia de intervenção; Controlo hemorrágico.

Introduction

Active bleeding from liver tumors represents a potentially fatal medical emergency. It can occur in different contexts, most frequently associated with hepatocellular carcinoma (HCC), but also with liver metastases and benign tumors, namely adenomas. Surgical intervention, although effective, carries a significant risk, especially in hemodynamically unstable patients or those with relevant comorbidities.[1,2] Transarterial embolization has emerged as a highly effective minimally invasive alternative for controlling bleeding from liver tumors, with technical success rates of 92-99% and immediate bleeding control in 84-94% of cases, presenting lower hospital mortality and a lower complication rate compared to emergency surgery.[1,3,4,5]

Comparative studies demonstrate that embolization presents significantly lower hospital mortality than emergency surgical resection, with also lower complication rates, maintaining similar results in terms of both hemorrhagic control and 1-year survival.[4] Embolization can also serve as a bridge to elective surgical resection in selected patients.[2,3]

This study aims to describe the experience of the interventional radiology team at a tertiary hospital in the embolization of active bleeding from liver tumors, evaluating case characteristics, techniques used, and clinical outcomes, including hemorrhagic recurrence and mortality.

Materials and Methods

Type of study

Retrospective observational study based on the analysis of clinical data from patients who underwent embolization for active bleeding from liver tumors.

Period of Analysis

January 2009 to December 2024.

Inclusion criteria

- Patients who underwent transarterial embolization of liver tumors between January 2009 and December 2024.
- Embolization performed with the aim of controlling active bleeding associated with a liver tumor.
- Imaging evidence of active bleeding originating from a liver tumor, defined by at least one of the following: endovascular contrast extravasation on Computed Tomography (CT) or angiography; hemoperitoneum associated with a liver tumor with imaging signs compatible with tumor rupture. Compatible clinical context (hemodynamic instability defined by SBP < 90 mmHg and/or need for transfusion support; hemoglobin drop ≥ 2 g/dL).

Exclusion criteria

- Embolization of liver tumors performed for reasons other than acute bleeding control (e.g., preoperative, palliative).
- Hemorrhage following biopsy of liver lesions.

Data collected

- Demographic data: age, sex.
- Diagnosis of liver tumors.
- Clinical data: tumor staging according to the Barcelona Clinic Liver Cancer (BCLC) classification system and stratification of liver disease according to the Model of End Stage Liver Disease (MELD-Na) and Child-Pugh classifications, based on the most recent clinical records and laboratory studies prior to the tumor hemorrhage episode, within a period not exceeding 30 days.
- Procedure: date, embolic materials, and technical details.
- Clinical outcome: technical success, clinical success (hemostasis), hemorrhagic recurrence, complications (available in clinical records), 30-day and 12-month mortality.

Definitions

- Technical success: absence of contrast extravasation foci compatible with active hemorrhage on final angiography.
- Clinical (hemostatic) success: absence of clinically and radiologically documented hemorrhagic recurrence after the procedure, during hospitalization or initial follow-up period.
- Hemorrhagic recurrence: new clinical and imaging evidence of active hemorrhage originating from the embolized tumor. The clinical criteria considered were the reappearance of signs of hemodynamic instability, such as arterial hypotension and the need for additional transfusion support, associated with a drop in hemoglobin greater than 2 g/dL in the first two days after embolization. The imaging criteria considered were the identification of active contrast extravasation on imaging exams (CT and/or angiography) originating from the previously embolized tumor, increased hemoperitoneum volume, or increased hematoma size on serial exams.
- 30-day mortality: death from any cause occurring within the first 30 days after the procedure, analyzed as an independent outcome.
- 12-month mortality: death from any cause occurring within the first 12 months after the procedure, analyzed as an independent outcome.

Statistical analysis

A descriptive analysis of the data was performed. Categorical variables, namely sex, type of liver tumor, material used in embolization, occurrence of hemorrhagic recurrence, and mortality, were presented in absolute and percentage values. Continuous variables, specifically age, were described using mean, median, and age range. The database was analyzed using Microsoft Excel®, and no inferential statistical comparisons were applied due to the limited number of cases (n = 28) and the retrospective and descriptive nature of the study.

Results

3.1 Demographic data

The study included 28 patients, of whom 4 (14.3%) were female and 24 (85.7%) were male. The mean age was 66 years (range: 9 to 94 years).

3.2 Diagnosis of liver tumors

The most frequent liver tumor was HCC, with 24 cases (85.7%). There were also 2 cases (7.1%) of hepatic adenomas and 2 cases (7.1%) of liver metastases.

The benign tumors (adenomas) were diagnosed histologically since both patients underwent elective surgery.

One of the liver metastases was confirmed histologically by biopsy. There were also 13 cases of HCC confirmed histologically. (Table 1)

Table 1 – Demographic characteristics and tumor type of the study population

Variable	Value (n=28	Percentage (%)
Male	24	85.7
Female	4	14.3
Mean age (years)	66	N/A
Age range (years)	9-94	N/A
HCC	24	85.7
Adenoma	2	7.1
Liver metastasis	2	7.1

3.3 Clinical data

Liver function stratification was performed on 24 patients with HCC in the context of chronic liver disease using the MELD-Na and Child-Pugh classifications.

The mean MELD-Na score was 16.6 ± 6.6, with slightly higher values detected in the subgroup of HCC patients who died within the first 30 days (18.22 ± 8.6) and 12 months (19.5 ± 7.5). On the other hand, the mean MELD-Na score

was lower in patients who did not die during the first 12 months (13.5 ± 5.1).
The Child-Pugh classification was A in 5 cases (20.8%), B in 16 (66.7%) and C in 3 cases (12.5%). In the subgroup of patients who died within the first 30 days, there was a predominance of patients with more severe liver dysfunction (Child-Pugh B and C), as can be seen in Table 2.
Regarding tumor staging according to the BCLC classification, 3 patients (12.5%) had stage A, 6 patients (25%) had stage B, 9 patients (37.5%) had stage C and 6 (25%) had stage D. The most advanced stages predominated in the subgroups of patients who died within the first 30 days and at 12 months, as shown in Table 2.

3.5.3 Complications
The angiography reports did not describe any complications associated with the interventions. Furthermore, an analysis of the patients' clinical records revealed that no complications related to the puncture were recorded during hospitalization; the analytical control with liver function tests did not reveal any alterations that would suggest hepatic ischemia; there were no clinical records referring to alterations that could be related to complications of the procedure.

3.5.4 Mortality (30 days and 12 months)
- 30-day mortality: 11 patients (39%) died within the first 30 days after embolization, 9 of whom had HCC.

Table 2 – Clinical data of patients with HCC and chronic liver disease

Group	M E L D - N a (mean ± DP)	Child-Pugh A [n.(%)]	Child-Pugh B [n,(%)]	Child-Pugh C [n,(%)]	BCLC A [n,(%)]	BCLC B [n,(%)]	BCLC C [n,(%)]	BCLC D [n,(%)]
Total (n=24)	16,6±6,6	5 (20,8%)	16 (66,7%)	3 (12,5%)	3 (12,5%)	6 (25%)	9 (37,5%)	6 25%)
30-day mortality (n=9)	18,22±8,6	1 (11%)	6 (66,7%)	2 (22,2%)	0 (0%)	2 (22%)	2 (22%)	5 (56%)
12-month mortality (n=12)	19,5±7,5	1 (8,3%)	9 (75%)	2 (16,7%)	0 (0%)	3 (25%)	4 (33,3%)	5 (41,7%)
12-month survival (n=12)	15,5±5,1	4 (33%)	7 (58,3%)	1 (8%)	3 (25%)	3 (25%)	5 (41,7%)	1 (8,3%)

BCLC: Barcelona Clinic Liver Cancer

3.4 Embolization Procedure (Tabela 3)
The embolization methods used were as follows:
- Polyvinyl alcohol (PVA) particles: 16 cases (57%)
- PVA particles and Microcoils: 9 cases (32%)
- Microcoils: 2 cases (7%)
- PVA particles and cyanoacrylate:lipiodol: 1 case (4%)

The dilution ratio of CA:Lipiodol was 2:1.

Table 3 – Embolic agents used

Embolic agent	Cases (n=28)	Percentage (%)
PVA Particles (isolated)	16	57
PVA Particles + Microcoils (combined)	9	32
Microcoils (isolated)	2	7
PVA Particles + CA:Lipiodol	1	4

3.5 Clinical Outcome (Tabela 4)

3.5.1 Technical and clinical success (hemostasis)
In the present study, the technical success rate was 100% and the clinical success rate was 96%, as there was one case of hemorrhagic recurrence during hospitalization.

3.5.2 Hemorrhagic recurrence
There was only one case of hemorrhagic recurrence, corresponding to one of the cases of hemorrhage originating from a liver metastasis, in the context of massive hepatic metastasis of a primary neoplasm of the head of the pancreas. Initial laboratory evaluation demonstrated severe anemia (4.3 g/dL) and an International Normalized Ratio (INR) of 1.39. Embolization was performed with PVA particles and microcoils. The evolution was unfavorable, with no transfusion yield, and a repeat angio-CT scan showed persistent contrast extravasation originating from the embolized lesion and an increase in hemoperitoneum volume. The multidisciplinary team decided not to repeat the embolization due to the patient's critical condition, who ultimately died after 24 hours.

- 12-month mortality: 14 patients (50%) died within 12 months after the procedure.
- All patients who died had malignant tumors: 12 cases of HCC and 2 cases of liver metastasis.

Table 4 – Analysis of clinical outcome

Results	Value (n=28)	Percentage (%)
Technical success	28	100
Clinical success (hemostasis)	27	96
Complications	0	0
Hemorrhagic recurrence	1	4
30-day mortality	11	39
12-month mortality	14	50

Discussion

4.1 Interpretation of Results
The results demonstrated a high technical success rate (100%) and a low rate of hemorrhagic recurrence in this series (4%). Only one case of hemorrhagic recurrence was documented, corresponding to a low recurrence rate in this series, suggesting sustained hemostatic efficacy.
No immediate or inpatient complications were documented in the records analyzed. This observation should be interpreted in light of the retrospective nature of the study and its dependence on the quality of the clinical record.
Although embolization has been associated with a high rate of technical and clinical success (hemostasis), overall mortality remains high.
The 30-day mortality rate (39%) was observed predominantly in patients with malignant neoplasms and advanced chronic liver disease. These data suggest a possible association between clinical severity at admission and early mortality, although it is not possible to determine the relative weight of each factor in this descriptive design.

All these patients presented with malignant neoplasms, mostly HCC (9 patients) in the context of chronic liver disease. Of the 9 patients with HCC, 8 (88%) had Child-Pugh B or C. The single case of Child-Pugh A corresponded to a patient with several comorbidities and low functional reserve. Regarding BCLC stage, 7 patients had stage C or D and 2 patients had stage B, with no cases in stage A. The two cases in stage B corresponded to elderly patients (82 and 94 years old) with low functional reserve.

The 12-month mortality rate was 50% (14 patients) and includes the 11 deaths that occurred within 30 days. All deaths occurred in patients with malignant tumors (HCC and metastases). The 3 patients who died after the first 30 days had Child-Pugh B, 2 (66.7%) had stage C HCC, and 1 (33.3%) had stage B BCLC. These data demonstrate a high technical success rate and a low rate of hemorrhagic recurrence in this series. However, it is not possible to assess the impact of embolization on the natural course of chronic liver disease or oncological pathology.

In the present cohort, mortality occurred in patients with advanced tumor stage (BCLC B, C, or D) and significant liver dysfunction (Child-Pugh B or C). These findings are consistent with factors described in the literature as associated with a worse prognosis, although the present study does not allow for the establishment of formal causal relationships.[5,6,7,8]

Although the specific cause of each death was not individualized due to the nature of the study, data suggest a possible association between clinical severity at admission and early mortality, but it is not possible to determine the relative weight of each factor in this descriptive design.

The mean MELD-Na value observed in the sample (16.6 ± 6.6) may not fully reflect the clinical severity associated with the acute episode of tumor rupture, since this index predominantly reflects baseline liver function before the hemorrhagic event. Nevertheless, it was found that patients who died had higher mean MELD-Na values than survivors.

4.2 Comparison with Literature

The low rate of hemorrhagic recurrence (1 case) is relevant information, as it suggests that the intervention was highly effective in controlling bleeding, in line with what has been reported in other studies.[3,9,10,11,12]

The absence of documented complications, as recorded in the procedure reports and inpatient clinical records, is an important finding and is consistent with the literature, which suggests that immediate complications associated with embolization of liver tumors are rare.[10,12,13,14]

Literature on hepatic embolization for the control of active bleeding in patients with malignant liver tumors indicates 30-day mortality rates ranging from 20% to 40%, depending on clinical characteristics and the technique used. 12-month mortality tends to be even higher, particularly in patients with advanced HCC, which is consistent with the results of the present study.[5,6,7,8]

4.3 Study Limitations

As mentioned earlier, the study has some limitations. The sample size is insufficient (28 cases) to obtain statistical significance from the results. Studies with a larger number of cases could provide a more robust analysis of the impact of embolization on different types of liver tumors with active bleeding.

The retrospective nature of the study is also a significant limitation, as it may lead to selection bias and incomplete data. In addition, the lack of information on minor complications and the absence of long-term follow-up of liver function tests, due to the fact that many patients are referred to and followed up at other hospitals, make it difficult to fully assess the long-term efficacy and safety of embolization. This dispersion and fragmentation of clinical data also made it impossible to determine the direct cause of death in all cases, limiting the clear distinction between mortality resulting from refractory hemorrhagic shock, acute liver failure, or progression of the underlying oncological pathology.

It is considered relevant to conduct prospective studies with more detailed post-procedure follow-up to assess complications and late effects of this technique.

4.4 Clinical Implications

Embolization was associated with a high technical success rate and a low rate of hemorrhagic recurrence in this cohort. High mortality, especially in the short term (30 days), occurred in patients with advanced-stage malignant tumors and impaired liver function.

The observed results, consistent with the literature, support the use of embolization as a relevant therapeutic option in the control of hepatic tumor hemorrhage, particularly in hemodynamically unstable patients, thus avoiding the increased risk associated with surgical intervention.

However, the main clinical implication lies in the interpretation of the observed mortality. In this series, deaths occurred exclusively in patients with malignant tumors, suggesting that the underlying pathology may have a decisive influence on the prognosis.

Thus, after hemostasis is achieved, it is imperative that the patient receives rigorous clinical follow-up within a multidisciplinary team. The focus should be on the oncological assessment and liver function of the patient, with a view to managing and planning definitive or palliative therapies directed at the underlying disease, without which the prognosis remains guarded.

Conclusion

Arterial embolization was associated with a high technical success rate and a low rate of hemorrhagic recurrence in this cohort of 28 patients. The observed mortality occurred predominantly in patients with malignant tumors and advanced liver dysfunction, suggesting that the prognosis may be related to the severity of the underlying disease. Larger studies and inferential analysis are needed to clarify formal prognostic associations.

Case Report

We present an illustrative case of a patient who presented to the Emergency Department of our center with acute abdominal pain and syncope.
Tomografia Computorizada sem administração de contraste revelou hemoperitoneu peri-hepático (estrela em A). Após a administração de contraste endovenoso observou-se um fígado dismórfico com uma massa hipervascular com um foco de extravasamento de contraste na fase arterial (seta na imagem B), com aumento progressivo na fase portal (seta na imagem C), traduzindo hemorragia ativa. (Fig. 1)

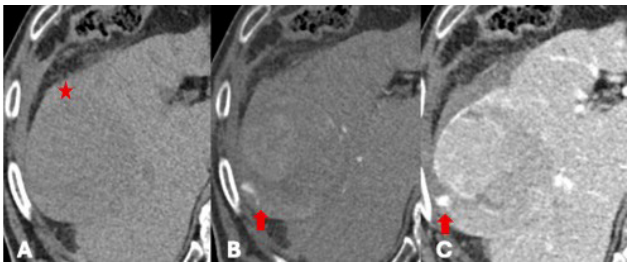

Figure 1 – Computed tomography scan before (A) and after intravenous administration of iodinated contrast in arterial (B) and portal venous (C) opacification phases.

Initial angiography revealed a hypervascular hepatic mass (red circle) with a focus of contrast extravasation (arrow). (Fig. 3) Transarterial embolization was performed.
Final angiography showed no extravasation or tumor vascularization. (Fig. 3)

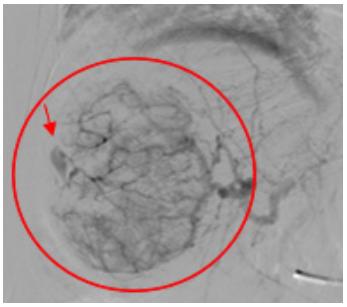

Figure 2 – Digital subtraction angiography image

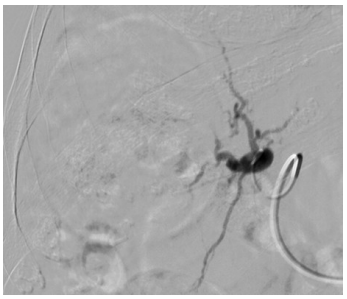

Figure 3 – Digital subtraction angiography image at the end of the procedure.

Ethical Disclosure / Divulgações Éticas
Conflicts of interest: The authors have no conflicts of interest to declare.
Conflitos de interesse: Os autores declaram não possuir conflitos de interesse.
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Suporte financeiro: O presente trabalho não foi suportado por nenhum subsídio ou bolsa.
Confidentiality of data: The authors declare that they have followed the protocols of their work center on the publication of data from patients.
Confidencialidade dos dados: Os autores declaram ter seguido os protocolos do seu centro de trabalho acerca da publicação dos dados de doentes.
Protection of human and animal subjects: The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).
Protecção de pessoas e animais: Os autores declaram que os procedimentos seguidos estavam de acordo com os regulamentos estabelecidos pelos responsáveis da Comissão de Investigação Clínica e Ética e de acordo com a Declaração de Helsínquia da Associação Médica Mundial.

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