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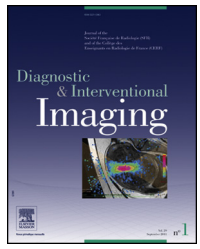

ORIGINAL ARTICLE /*Genito-urinary imaging*

Tumor necrosis after preventive embolization of large renal angiomyolipomas

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KEYWORDS
Angiomyolipoma;
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Abstract
Objectives: The purpose of this study was to retrospectively evaluate tumor necrosis following preventive embolization in patients with renal angiomyolipoma (RAML) at high risk of bleeding.
Patients and methods: Arterial embolization was performed in 24 patients (22 women, 2 men; mean age, 43 ± 13 years) with a total of 30 RAMLs (mean volume, 137 cm^3 ± 163) between 1996 and 2012. Two sub-groups of patients were identified and further compared based on the presence or not of necrosis following arterial embolization.
Results: The technical and clinical success rates of arterial embolization of RAMLs were 97% and 87%, respectively. The mean initial volume of RAMLs differed between the two sub-groups with 331 cm^3 in the group with tumor necrosis and 88 cm^3 in the group without tumor necrosis ($P = 0.0047$). High-fat content RAMLs were predominantly observed in the necrosis group and the mean volume reduction observed for high-fat RAMLs was 65% whereas it was 36% for low-fat content RAMLs. The six patients who developed RAML necrosis had arterial embolization using microspheres (one patient with microspheres alone and five with a combination of microspheres and metallic coils). All necrotic RAMLs displayed arterial dysplasia.
Conclusion: The risk of tumor necrosis is higher for larger RAMLs. The role of distal arterial embolization with microspheres in tumor necrosis in RAML is suggested by the results of our study but could not be definitely demonstrated statistically due to the limited sample size.

Abbreviations: RAML, renal angiomyolipoma; TSC, tuberous sclerosis complex; MRI, magnetic resonance imaging.

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Introduction

Renal angiomyolipomas (RAMLs) are hypervascular benign tumors that convey a risk for hemorrhagic complications. They occur sporadically in 80% of patients or for the remaining in patients with tuberous sclerosis complex (TSC, 20%). In most cases, AMLs show tissue heterogeneity (vascular, adipose and muscle tissue) [1—7]. This category of lesion is rare, representing 1% of renal tumors, with an incidence ranging from 0.07 to 0.3% [8,9].

The treatment of acute bleeding due to rupture of RAML is well established depending on the patient's hemodynamic status. Arterial embolization is currently used as the favored method [10—12].

However, no clear consensus has been reached on when and how to apply preventive treatment. The use of therapeutic arterial embolization is debated, depending on the risk of hemorrhage using criteria described in previous reports: tumor size > 4 cm, aneurysm > 4—5 mm, history of minor RAML bleeding [6,11,13]. When preventive treatment is indicated, surgery can be a valid approach if embolization fails or in some specific cases (isolated RAML, RAML with a large exorenal component, foreseeable difficulties in post-embolization follow-up) [14,15].

Several studies have demonstrated the technical and clinical efficiency of hemostatic and preventive arterial embolization [16—18]. Complications occurring after preventive arterial embolization, such as tumor necrosis, are generally rare [10].

The purpose of the present study was to describe the clinical, biological and imaging features of the main complication (i.e., tumor necrosis, as defined by lipid necrosis of the entire RAML) and to assess the risk factors involved in its occurrence.

Patients and methods

This retrospective single-center study covered a period of 16 years (from 1996 to 2012) and included 33 patients who underwent RAML embolization because of a potential risk of hemorrhagic complications (tumor size > 4 cm, aneurysm > 4—5 mm, history of minor AML bleeding). Only patients fulfilling the inclusion criteria for preventive arterial embolization were included; nine patients were excluded following emergency arterial embolization due to active bleeding with hemorrhagic shock.

Two patient sub-groups were identified following data collection based on the presence or not of post-embolization necrosis (Table 1). Creatinine clearance levels were evaluated prior to arterial embolization.

Imaging findings

Diagnosis of RAML was based on the presence of intratumoral macroscopic fat with a spontaneous attenuation value of less than −20 HU on computed tomography (CT).

The fatty component was considered to be predominant if an attenuation value < −20 HU was found in more than 50% of the tumor volume with only attenuation values < −20 HU. This 50% threshold was proposed by Planché et al. [19].

Clinical, biological and radiological follow-up was performed either by abdominal CT scans, or by a combination of CT scans and renal MR imaging examinations. Follow-up visits were scheduled six months after arterial embolization and then every two years. Patients in the necrosis group were monitored more regularly during the first year after embolization.

Selective embolization

Renal angiograms were first obtained via a puncture of the femoral artery using a 4- or 5-Fr introducer sheath. The aim was to achieve selective catheterization in order to preserve the maximum volume of the normal renal parenchyma.

Embolic agents consisted of microspheres, coils or a combination of metallic coils and microspheres.

Post-embolization assessment

The success of arterial embolization was assessed immediately using angiography and considered successful if the tumor vascular network, intratumoral aneurysms and arterial dysplasia were no longer visible.

Table 1 Descriptive statistics and RAML characteristics of the study population.

Population	Overall population	Patients without necrosis	Patients with necrosis
Number of patients (*n* [%])	24	18 (75)	6 (25)
Mean age (years)	43 ± 13	45 ± 15	41.5 ± 9.6
Male (*n* [%])	2 (8)	2 (11)	0 (0)
Female (*n* [%])	22 (92)	16 (89)	6 (100)
Sporadic RAML (*n* [%])	15 (63)	11 (61)	4 (67)
Congenital TSC lesions (*n* [%])	9 (37)	7 (39)	2 (33)
Number of RAMLs (*n* [%])	30	24 (80)	6 (20)
Mean initial volume of RAML (cm^3)	137 ± 163	88 ± 94	331 ± 240
Mean aneurysm size (mm)	4.7 ± 5.8	9.1 ± 6.1	2.1 ± 2.5
Presence of arterial dysplasia (*n* [%])	25 (83)	19 (79) (median 5)	6 (100) (median 25)
Number of predominantly fatty RAMLs > 50% (%)	24 (80)	18 (75) (median 6)	6 (100) (median 24)
Number of RAMLs with aneurysm (%)	14 (47)	11 (46) (median 16)	3 (50) (median 14)