Embolotherapy with a Mixture of Lipiodol and Ethanol for Renal Angiomyolipoma: Retrospective Study

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ABSTRACT

Objective: To evaluate the efficacy of embolotherapy with a mixture of lipiodol and absolute ethanol for renal angiomyolipoma.

Patients and Methods: Twelve patients underwent transcatheter embolisation for 13 symptomatic renal angiomyolipomas between November 1997 and May 2005. Of these, 2 patients had tuberous sclerosis with bilateral renal angiomyolipomas. The diagnoses of renal angiomyolipoma were made on the basis of the characteristic computed tomographic findings. The angiomyolipomas were embolised with a 1:3 mixture of lipiodol and absolute ethanol (range, 3 to 10 ml; mean, 4.9 ml). Patients were followed up for 2 months to 7 years. The efficacy of embolotherapy was evaluated in terms of immediate and late complications, symptom-free period, tumour size, and imaging findings.

Results: There was no procedure-related complication and no embolisation-related mortality. During the follow-up period, 9 of the 13 tumours (69%) decreased in size, whereas 3 (23%) of the tumours increased in size. Five of the 12 patients (42%) showed no symptom of recurrence during follow-up. The mean symptom-free period was 35 months. Eleven of the 12 tumours (92%) among the surviving patients showed no evidence of rupture after embolotherapy. One patient required a second embolisation, 1 patient underwent an open nephrectomy 4 years later, and 1 patient subsequently underwent a laparoscopic partial nephrectomy.

Conclusion: Transarterial embolisation with a 1:3 mixture of lipiodol and absolute ethanol is an effective and safe method of treating renal angiomyolipoma; it results in tumour shrinkage and prevention of tumour rupture.

Key Words: Angiomyolipoma/therapy; Embolization, therapeutic; Kidney neoplasms

INTRODUCTION

Renal angiomyolipoma is an uncommon benign hamartomatous tumour that contains variable amounts of abnormal blood vessels, smooth muscle, and fat. These tumours account for 0.3% to 3% of renal masses and 1% of surgically resected tumours. An accurate preoperative diagnosis can be made in almost all instances with the use of computed tomography (CT) and ultrasonography. Angiomyolipomas have a propensity to bleed; size, multifocality, and vascular abnormality are the main risk factors. Among angiomyolipomas that are 4 cm or larger in diameter, 46% to 64% are symptomatic and 50% to 60% bleed spontaneously. During the past 2 decades, significant improvements in technology (e.g., new catheters and embolic materials) and the improving skills of interventional radiologists have meant that selective renal artery embolotherapy, which preserves normal renal parenchyma, has become a widely accepted strategy for managing renal angiomyolipomas. This technique has been used to treat bleeding tumours in the acute setting, as well as in lesions larger than 4 cm prophylactically. Partial or total nephrectomy is usually reserved as the back-up procedure when embolisation fails. Despite the increasing use of this technique as a therapeutic option, there is still a dearth of literature on the efficacy of embolotherapy for the treatment of symptomatic renal angiomyolipoma. This study aimed to evaluate the efficacy of embolisation of renal angiomyolipoma with a 1:3 mixture of lipiodol and absolute ethanol at a local centre.

PATIENTS AND METHODS

From November 1997 to May 2005, twelve patients with renal angiomyolipomas underwent selective...
transcatheter arterial embolisation at the Department of Radiology of the Queen Mary Hospital. Their medical records were extracted and reviewed. The patients comprised 7 men and 5 women whose mean age was 46 years (range, 29 to 75 years). Two patients had tuberous sclerosis with bilateral renal angiomyolipomas. The presenting symptoms were loin pain (n = 6), haematuria (n = 1), spontaneous haemorrhage (n = 4), renal mass (n = 3), and incidental finding on CT or ultrasonography (n = 2). Conventional abdominal CT was performed for all patients as the confirmative diagnostic modality before embolisation. In all cases, the characteristic CT finding of fat attenuation in the tumour supported the initial diagnosis of renal angiomyolipoma.

The embolisations were performed under local anaesthesia by the transfemoral approach. After abdominal aortography was performed, selective renal arteriography was performed with a 4- or 5-French catheter (Figure 1a). A coaxial microcatheter system was used in technically difficult cases. A 1:3 mixture of lipiodol and absolute ethanol was used as the embolic material. The volume of the mixture used ranged from 3 to 10 ml, and the mean volume of the mixture used was 4.9 ml. The mixture was injected slowly until substantial reduction of the tumour circulation was noted. The injection of embolic material was monitored using fluoroscopy to avoid reflux of the agent. The degree of embolisation was assessed by postembolisation arteriography. The end-point was reached when the arterial branches supplying the tumour had been occluded, there was a lack of opacification of the tumour itself, and there was patent blood flow to normal renal parenchyma (Figure 1b). If residual tumour vascularity was observed, an additional application of the ethanol and lipiodol mixture was given until a satisfactory result was achieved. All patients were hospitalised for close monitoring of pain and immediate complications. They were followed up regularly during a mean period of 48 months. Follow-up CT scans of the kidneys were obtained for all patients.

The pre-embolisation and follow-up tumour sizes were measured using the contrast-enhanced CT scans. Areas of angiomyolipomas were calculated with the following formula:

\[ \text{Area} = \frac{\pi}{4} \times \text{long-axis length} \times \text{short-axis length} \]

Long- and short-axis lengths were measured from axial images that were obtained at the middle of the mass. To evaluate changes of tumour dimension after embolisation, the area of a lesion on the initial scan was compared with that in a follow-up scan. The percentage change in size was calculated with the following formula:

\[ \text{Percentage change} = \frac{\text{initial area} - \text{follow-up area}}{\text{initial area}} \times 100 \]

All patients were followed up regularly from 2 months to 7 years (mean, 48 months) with regard to status of subjective symptoms and immediate and late complications. The efficacy of embolotherapy was evaluated by immediate and late complications, the length of the symptom-free period, and tumour size in follow-up CT scans.

**RESULTS**

The embolisation procedure was technically successful for all 12 patients. No major procedure-related complications were noted. Six patients experienced mild

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**Figure 1.** (a) Pre-embolisation renal arteriogram showing a vascular angiomyolipoma at the upper pole of the right kidney. (b) Postembolisation arteriogram showing occlusion of the arterial branches supplying the tumour, lack of opacification of the tumour itself, and patent blood flow to normal renal parenchyma; lipiodol staining is visible inside the tumour mass.
postembolisation syndrome — namely, fever, aggravated flank pain, nausea, vomiting, and headache — which subsided with conservative treatment. No patient developed severe late complications. In the follow-up period, 9 of the 13 tumours (69%) decreased in size (Figure 2) and 3 tumours (23%) increased in size.

Five of the 12 patients (42%) showed no symptom of recurrence during follow-up. Symptoms recurred in 7 patients (58%). The recurrent symptom was most commonly loin pain and the time of recurrence of symptoms was between 12 and 28 months. The mean symptom-free period for the whole group of patients was 35 months.

Patient 4 underwent open nephrectomy 4 years later because the tumour had further increased in size and the patient experienced severe symptoms. One patient (patient 7) required a second embolisation. One patient defaulted follow-up. Patient 6, who had tuberous sclerosis, died 2 months after the embolisation because of disseminated malignancy. Eleven of the 12 tumours (92%) among the surviving patients showed no evidence of rupture after embolotherapy.

Patient 10 presented with a rapidly dropping haematocrit value and hypovolaemic shock 3 days after the embolisation. Urgent CT revealed a left perinephric haematoma. Postembolisation renal angiography did not reveal any residual tumour vessel or active contrast extravasation. The patient was admitted to the intensive care unit and was discharged uneventfully 2 weeks later.

Revascularisation and increase in size of the tumour was noted in the follow-up CT scan in patient 12, who had undergone a total embolisation of the left mid-pole angiomyolipoma. He underwent laparoscopic left partial nephrectomy 1 year later.

When total embolisation was achieved, 8 of 10 tumours decreased in size. Clinical and radiological follow-up results of the embolisations are summarised in Table 1.

**DISCUSSION**

Renal angiomyolipomas are generally benign, although an uncommon subtype (epithelioid angiomyolipoma) may behave more aggressively than others. Malignant transformation does not occur except in rare cases. Tuberous sclerosis–associated angiomyolipoma tends to be larger, more numerous, and more likely to cause spontaneous haemorrhage than the sporadic disease. Tumours that bleed also tend to be larger. CT or magnetic resonance imaging is usually sufficient for diagnosis. Biopsy is rarely needed. Primary indications for intervention include symptoms such as pain or bleeding. Prophylactic intervention is justifiable for large tumours.

Embolotherapy has been gaining popularity during the past 2 decades in the management of symptomatic angiomyolipomas for 3 reasons: tumours are benign, patient symptoms are usually the result of bleeding, and selective embolisation preserves some normal renal parenchyma. A variety of embolic agents, such as absorbable gelatin sponge, absolute alcohol, iodised oil, polyvinyl alcohol particles, and metal coils, have been used for embolisation of renal angiomyolipomas. The Queen Mary Hospital uses an ethanol-lipoiodol (Guerbet) mixture as the embolic agent for the embolisation of renal angiomyolipoma. Absolute ethanol is well known

![Figure 2. Axial computed tomograms of the kidneys of patient 3: (a) plain axial image showing a typical fat-containing angiomyolipoma at the middle pole of the right kidney and a hyperdense haematoma (arrow); and (b) image after transcatheter embolisation showing obvious interval reduction in tumour size.](image-url)
to be an effective embolic agent. It provides permanent occlusion at the arteriolar and capillary level distal to the level of collateral inflow and necrosis of the tumour tissue. Owing to the radiolucency of ethanol, however, its flow cannot be observed on a fluoroscopic monitor. The major risk with the use of ethanol is non-target embolisation resulting from reflux out of the tumour-feeding vessel. The radio-opacity of lipiodol serves both as a radio-opaque marker and as an embolic agent, and it can be used to delineate the tumour without diluting the alcohol concentration. Use of lipiodol also eliminates the need for a balloon catheter during embolisation. Zerhouni et al and Alder et al reported aneurysmal ruptures during embolisation with an occlusion balloon that could have been attributable to increased intravascular pressure generated by the forceful injection of ethanol into a closed system, or to erosion of the thin aneurysm wall by the caustic alcohol.

Embolotherapy has long been recognised as an effective treatment option for renal angiomyolipomas. Owing to the low incidence of renal angiomyolipomas, the long-term results of embolisation have been reviewed only to a limited extent. Kothary et al reported a 31.6% recurrence rate of angiomyolipoma in their series of 30 lesions in 19 patients who were followed up for a mean of 51.5 months. Lee et al, in their series of 15 patients with 21 tumours, reported recurrent symptoms or haemorrhage in 4 tumours and revascularisation on follow-up imaging in 1 tumour. Soulen et al reported long-term results including more than 90% effectiveness after studying a series of 5 cases and reviewing 21 patients previously described in the literature.

This study evaluated the effectiveness of embolisation during long-term follow-up (mean, 48 months) and also assessed the efficacy of embolotherapy in preventing tumour rupture. In this series, when total embolisation was achieved, 8 of 10 tumours decreased in size. The partially embolised angiomyolipoma also reduced in size, although the patient was followed up for only 2 months and defaulted. In the series studied by Lee et al, 12 of 21 tumours (57%) decreased in size and 8 (38%) of the tumours were static in size.

The percentage decrease in angiomyolipoma size is variable. Because angiomyolipomas are composed of varying amounts of smooth muscle, adipose, and vascular tissue, effects of embolisation vary. The adipose tissue, owing to its hypovascularity, is probably resistant to embolisation; hence, the volume of adipose tissue is not much affected after embolotherapy. On the contrary, the angiomyogenic components seem to respond well to embolisation, as demonstrated by markedly decreased or absent enhancement on follow-up imaging. For the prevention of tumour rupture,
the method works well: 11 of 12 tumours did not rupture during the follow-up period. Although 1 patient developed a perinephric haematoma 3 days after the embolisation, postembolisation renal arteriography did not reveal any residual tumour vessel or active contrast extravasation. It was thought that there might have been an anomalous supply from the inferior phrenic vessel that accounted for the tumour rupture.

Han et al. reported that in 13 of 14 patients, clinical symptoms disappeared during the 7 to 72 months of follow-up. In a series reported by Mourikis et al., 2 of 5 patients had recurrent symptoms. In this series, 5 of 12 patients (42%) remained asymptomatic during a mean of 48 months of follow-up and a mean symptom-free period of 35 months. The difference in outcomes may be partly accountable by different embolic agents used, differences in the follow-up duration, and differences in the initial tumour sizes in these studies.

In the outcome analysis of 42 cases of renal angiomyolipomas conducted by Kennelly et al., 8 of 42 renal angiomyolipomas required surgical intervention — either partial or total nephrectomy. Steiner et al. reported that 54% of angiomyolipomas larger than 4 cm required surgical intervention in their series of 24 patients with 28 tumours. In this study, 2 patients ultimately underwent a laparoscopic partial and an open radical nephrectomy, because the tumours had significantly increased in size and symptoms recurred. A re-embolisation was not performed in these patients because surgical intervention was recommended. In the authors’ opinion, a repeat embolisation could have conferred adequate control over recurrent symptoms, as reported by Mourikis et al.

**CONCLUSION**

Transarterial embolisation with a 1:3 mixture of lipiodol and absolute ethanol is an effective and safe method of treating renal angiomyolipoma. Satisfactory results can be achieved in terms of tumour shrinkage and prevention of tumour rupture.

**REFERENCES**