

# Treatment of angiomyolipoma at a tertiary care centre: the decision between surgery and angioembolization

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## Abstract

**Background:** Angiomyolipoma (AML) is a benign renal neoplasm. First-line therapy includes renal preserving surgery or angioembolization (RAE), both with good outcomes in isolated studies. However, there are no comparative randomized trials and no clinical guidelines to help clinicians decide between these treatment modalities. Our study examines the patterns of AML treatment at a tertiary care centre to evaluate how local urologists have been treating this disease.

**Methods:** This is a retrospective study of all AMLs treated at the Vancouver General Hospital (Vancouver, BC, Canada) over the past 10 years with either RAE or surgical excision. Searches were performed of the radiology and pathology dictation systems, using the following keywords: AML, angiomyolipoma, angioembolization, embolization, surgery, partial nephrectomy and nephrectomy.

**Results:** At our institution, more AMLs were treated by surgery than angioembolization (42 vs. 17 cases). Angioembolization was more often chosen for cases of multifocal AML (35% vs. 7%) and acute hemorrhage (50% vs. 14%). In the angioembolization cases, particles were the embolic agent of choice (used 40% of the time).

**Conclusions:** Angioembolization allows rapid patient stabilization in cases of acute hemorrhage, and provides good renal preservation in cases of multifocal AML. It may also be preferred in large masses when partial nephrectomy is not feasible. Surgery should be performed in cases of diagnostic uncertainty or complex vascular anatomy not amenable to RAE. Prospective randomized studies are needed to compare RAE and surgery to better define their indications in sporadic AML.

## Résumé

**Contexte :** Un angiomyolipome (AML) est une tumeur bénigne du rein. Le traitement de première intention comprend une chirurgie de conservation rénale ou une angioembolisation rénale, qui ont toutes deux donné de bons résultats dans des études isolées. Cependant, aucun essai comparatif randomisé n'a été mené et il n'existe pas de lignes directrices pour aider les cliniciens à choisir entre ces modalités thérapeutiques. Notre étude a examiné les tendances dans le traitement de l'AML à un centre de soins tertiaires pour évaluer comment les urologues y traitent cette maladie.

**Méthodologie :** Il s'agit d'une étude rétrospective de tous les AML traités au Vancouver General Hospital (Vancouver, C.-B., Canada) au cours des 10 dernières années, soit par chirurgie de conservation rénale ou par angioembolisation. Des recherches ont été effectuées dans les systèmes de dictée vocale de radiologie et de pathologie en utilisant les mots-clés anglais suivants : AML, angiomyolipoma, angioembolization, embolization, surgery, partial nephrectomy et nephrectomy.

**Résultats :** Dans notre établissement, plus de cas d'AML ont été traités par chirurgie que par angioembolisation (42 cas contre 17). L'angioembolisation a été plus souvent choisie dans les cas d'AML multifocal (35 % contre 7 %) et d'hémorragie aiguë (50 % contre 14 %). Dans les cas traités par angioembolisation, les particules ont été l'agent embolique privilégié (utilisées dans 40 % des cas).

**Conclusions :** L'angioembolisation permet de stabiliser rapidement l'état du patient en cas d'hémorragie aiguë, et offre une bonne conservation rénale en cas d'AML multifocale. Elle peut aussi être préférable en présence de larges masses quand la néphrectomie partielle n'est pas possible. La chirurgie doit être réalisée en cas d'incertitude diagnostique ou d'anatomie vasculaire complexe ne se prêtant pas à l'angioembolisation rénale. Des études prospectives randomisées sont nécessaires pour comparer l'angioembolisation rénale et la chirurgie afin de mieux définir leurs indications dans les formes sporadiques d'AML.

## Introduction

Angiomyolipoma (AML) is a benign renal neoplasm composed of fat, vascular and smooth muscle elements. The indications for treatment, though somewhat controversial, relate to the inherent risk of spontaneous hemorrhage and include bleeding, pain, large tumour size (often quoted as >4 cm), females of childbearing age and inadequate emergency or follow-up care. Since so many AMLs are small and asymptomatic, over 50% of cases are managed by observation alone.<sup>1</sup>

Fortunately, modern imaging techniques allow for high accuracy of AML diagnosis. Almost all renal masses containing macroscopic fat are AMLs.<sup>2</sup> Fat-containing renal cell carcinomas (RCCs) are so rare, they are only described in case reports. Moreover, all of these lesions contained calcifications,<sup>3-7</sup> a finding extremely rare in AMLs.<sup>2</sup> Thus, a renal

mass with fat and no calcium is almost certainly AML and, in the absence of other concerning features, can be treated as a benign lesion with angioembolization and simple enucleation. The diagnostic dilemma is the 5% of AMLs that do not contain fat. These lesions are typically identified as RCC and these patients proceed to the appropriate surgical management. Newer imaging techniques, particularly in magnetic resonance imaging, may provide better capability to diagnosis fat-poor AMLs in the future.<sup>2</sup>

The 2 mainstays of treatment for AML are surgery and renal angioembolization (RAE). Other management strategies include surveillance, total nephrectomy and investigational medical management, such as hormonal therapy or use of mammalian target of rapamycin (mTOR) inhibitors, such as sirolimus.<sup>8</sup> The optimal modality of treatment is still unclear. There are no prospective or randomized studies comparing RAE and surgery, and no treatment guidelines. Instead, urologists must consider several factors including treatment efficacy and morbidity, patient renal function, individual tumour characteristics, operative time and patient/surgeon preference.

As expected, recurrence rates after surgery are extremely rare.<sup>9-11</sup> However, in a review of 14 series, RAE required repeat procedures in 14% of cases after a median follow-up of 23 months; these were usually for recurrent symptoms or bleeding.<sup>1</sup> On follow-up imaging after RAE, the decrease in tumour size is variable, but typically averages only 50% to 60%.<sup>12</sup> Although complete eradication is expected after surgery, the risk of bleeding and neoplastic progression remains after RAE, due to the persistence of the disease that is common after treatment.<sup>12</sup>

Renal angioembolization offers the least invasive treatment option. Hospital stay is typically less than 24 hours compared to at least 2 days for surgery.<sup>9</sup> Blood loss associated with RAE is negligible. The most familiar complication is the postembolization syndrome, characterized by symptoms of pain, fever and nausea, reported in up to 85% of cases;<sup>1,13,14</sup> the severity of these symptoms may be proportional to the size of the infarct.<sup>14</sup> Complications from surgery, including hemorrhage, urinary leak/fistula, tend to be more significant but are also rare. Overall, there is a 12% rate of complication for partial nephrectomy, including a 5% risk of urinary fistula.<sup>9</sup>

Unfortunately, there are no randomized studies comparing renal function after partial nephrectomy and RAE, although case series have demonstrated the preservation of renal function with both treatments with median follow-up as long as 8 years.<sup>9,11,12,15,16</sup>

The characteristics of an AML are also likely to influence the decision between surgery and RAE. Some authors suggest that larger AMLs are more often amenable to RAE than partial nephrectomy.<sup>15</sup> Cases presenting with acute hemorrhage are best managed with RAE as it allows more rapid

**Table 1. Case characteristics of angiomyolipoma treated at Vancouver General Hospital (1999-2009)**

	Embolization	Surgery
No. patients	17	42
No. procedures	22	42
Age, mean (SD)	47	53
Female (%)	65	79
Multifocal AMLs (%)	35	7
Acute hemorrhage (%)	50	14
Require repeat procedure	5	0

SD: standard deviation; AMLs: angiomyolipomas.

stabilization and avoids total nephrectomy in the emergent scenario.<sup>17,18</sup> Difficult tumour locations (i.e., hilar) can influence the choice of treatment, and in some cases necessitate nephrectomy. Angiomyolipomas can also be mistaken for RCC on imaging, particularly in tumours with low fat content.<sup>19</sup> These suspicious tumours should undergo surgery for definitive diagnosis and management.

Since there are no randomized trials or guidelines to support the use of surgery or embolization, we reviewed our own experience to evaluate how these decisions have been made over the past 10 years.

## Methods

This is a retrospective study of all AMLs treated with either RAE or surgery at the Vancouver General Hospital (Vancouver, BC, Canada) over the past 10 years. Subjects were identified by searching the local "Sunset" databases, comprehensive dictation records of all AMLs treated by RAE and all AML-pathology specimens removed surgically.

The Sunset Radiology Intranet Database was searched with the following keywords: AML, angiomyolipoma, TSC (tuberous sclerosis complex), tuberous sclerosis, angioembolization and embolization. The RAE dictated reports were evaluated for patient characteristics, embolic agent used, features of the AML tumour (i.e., size, location) and the treatment indication.

The Sunset Pathology Intranet Database was then searched for following keywords: AML, angiomyolipoma, TSC, tuberous sclerosis, nephrectomy and partial nephrectomy. Pathology reports were evaluated for tumour characteristics, unique pathology (no fat, cystic, epithelioid) and patient characteristics. Patient charts were reviewed

**Table 2. Characteristics of angiomyolipoma surgical specimens**

% Radical nephrectomy	60% (25/42)
% Partial nephrectomy	40% (17/42)
Mean AML size (cm)	5.85
Median AML size (cm)	4.00

AML: angiomyolipomas.

for patient characteristics, imaging features (size, location), and the indication for treatment. We excluded all autopsy specimens and patients in whom the AML was not the primary indication for treatment (i.e., patients with coexistent malignancies, trauma nephrectomies).

Results

We report on a total of 59 patients who underwent treatment for AML with RAE or surgery. Both treatment groups displayed the classic over-representation of middle-aged females between 24 and 76 years old. Three patients with multifocal AML underwent multiple RAE procedures to treat different tumours at different times. One RAE patient required a repeat procedure for persistent bleeding. One RAE case was unsuccessful due to the inability to accurately map the tumour because of insufficient vascular aneurysm formation.

Surgical management included 25 (60%) undergoing radical nephrectomy and 17 (40%) undergoing partial nephrectomy. During this time period, all partial procedures were performed through an open procedure, while most complete resections were performed by laparoscopy. No surgical cases required re-operation for any reason. No urinary leakage was reported postoperatively.

At our institution, more AMLs were treated by surgery than RAE (42 vs. 17 cases). Renal angioembolization was more often chosen for cases of multifocal AML (35% vs. 7%) and acute hemorrhage (50% vs. 14%). For RAE cases, particles (most commonly polyvinyl alcohol) were used in 40% of cases, making them the agent of choice, followed by coils (25%), multiple agents (20%) and alcohol (15%) (Table 3).

Within the surgical population, more AMLs were removed via radical nephrectomy than partial nephrectomy (60% vs. 40%). The mean AML size was 5.85 cm (standard deviation 4.4, range 1-15 cm), and the median size was 4 cm (Table 2).

Discussion

Renal angioembolization and surgery are both efficacious treatments for AML. In past series, surgery has been more prevalent,<sup>1,20,21</sup> although there is a trend towards using more angioembolization at our centre and at other centres around the world.<sup>20</sup> This trend most likely reflects improved angiography techniques and the desire to maintain maximal renal function. No study clearly demonstrates the superiority of one embolic agent. The agents appear to have similar rates of success, complications and postinfarction syndrome.<sup>22</sup> With new materials, such as acrylic embospheres and hep-aspheres continuously, emerging the preferred agents are likely to change over time.<sup>23</sup>

The advantage of a surgical approach includes com-

Table 3. Embolic agents used for renal angioembolization

Embolization agent	Frequency utilized (%)
Particles	40
Coils	25
Alcohol	15
Combination of agents	20

plete resection of the disease and pathologic analysis of the specimen to confirm the diagnosis. Where imaging strongly supports a diagnosis of AML, surgical treatment with simple enucleation is feasible and may reduce nephron loss. Angiomyolipoma is surrounded by a distinct pseudocapsule that permits enucleation through an avascular plane. One study reported 34 cases of successful enucleation for AML, although 3 cases required some sharp dissection due to difficulty in identifying the correct plane of enucleation. There was no evidence of recurrence after a median follow-up of 56 months, and no cases of urine leak as entry into the collecting system was largely avoided.<sup>24</sup>

The advantages of RAE include preservation of renal function, minimal invasiveness of the procedure and rapid stabilization in cases of acute hemmhorage. Patients with AMLs that are fed by a distinct arterial branch are optimal candidates for RAE, as multiple branches are more technically difficult and increase the risk of embolizing normal renal tissue.<sup>24</sup> Apart from this, there are no specific radiologic features that strongly support the use of RAE over surgery. Tumours with complex vascular anatomy or close proximity to the hilum may require discussion between the urologist and interventional radiologist to determine the optimal approach.

Five of the 11 surgical cases that had complete data underwent surgery for suspicion of malignancy. These were all relatively small neoplasms, averaging 3 to 4 cm in size, with no fatty component. Although it seems as if there are many misdiagnoses on imaging, it is a relatively small number considering the 10 years of renal mass presentations at a tertiary care centre. In fact, large series have shown that 5% of all AMLs do not contain fat.<sup>2</sup> The remaining 6 AMLs underwent surgery for reasons including large tumours (total nephrectomy), failure of RAE and surgeon/patient preference.

Interestingly, more patients underwent radical nephrectomy than partial nephrectomy. This is far more than we would expect for a benign neoplasm, given the morbidity from potential renal insufficiency. In fact, there are very limited indications for nephrectomy for AML. These include AMLs that have replaced most renal parenchyma, cases with a strong suspicion of malignancy or cases in which renal-preserving treatment is not technically possible. The latter 2 indications for nephrectomy should be relatively rare. For instance, AMLs that are confused with RCCs are usually small lesions, as they are more likely to have minimal fat on

imaging. These tumours are more likely amenable to a partial nephrectomy, thus avoiding radical nephrectomy. Secondly, AMLs not amenable to partial nephrectomy should first be considered for RAE. Total nephrectomy should only be considered if both options have been exhausted.

The disproportionately high number of surgical cases compared to RAE cases in this study partly reflects the retrospective nature of the study and the inherent selection bias. The surgical cohort was recruited based on postoperative AML pathology (several of whom had surgery for preoperative concerns of malignancy). Thus, many of these patients were not presenting for management of AML, but rather for management of a suspected malignancy, resulting in an overestimation of the role of surgery for AML.

There are no guidelines regarding follow-up after AML treatment. Our centre does not have a standardized protocol, but most practitioners obtain a single computed tomography (CT) scan or ultrasound 6 months after treatment. The RAE cases performed for acute hemorrhage have a follow-up CT scan within 24 to 48 hours, but subsequent follow-up is variable. Angiomyolipomas undergoing RAE may require more long-term follow-up as they typically diminish in size, but do not disappear.<sup>12</sup>

Ideally, prospective studies comparing angiography and partial nephrectomy would help to better define the specific roles of surgery and RAE. Series with longer follow-up would also help assess rates of recurrence and re-treatment, as the current case series in the literature have follow-ups of less than 10 years.

## Conclusion

Angioembolization allows rapid patient stabilization in cases of acute hemorrhage and good renal preservation in cases of multifocal AML. Renal angioembolization may also be preferred in masses >15 cm if partial nephrectomy is not feasible. Surgery should be performed in cases of diagnostic uncertainty. The less invasive nature of angioembolization has been a primary driving force of its increasing usage over the past 10 years, but the role of surgery is undeniable, if as yet not fully defined. Prospective randomized studies are needed to compare angioembolization and surgery to better define their indications in sporadic AML.

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