Original Article

Role of 64 slice multidetector computed tomography and angiography to establish relationship between tumor size, aneurysm formation and spontaneous rupture of renal angiomyolipomas: Single center experience

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Abstract

Objective: To evaluate the role of computed tomography (CT) angiography using 64 slice multidetector CT scan to establish relationships among tumor size, aneurysm formation, and spontaneous rupture of renal angiomyolipomas (AML).

Materials and Methods: Total 27 patients were diagnosed as having renal angiomyolipoma (AML) at institute of kidney disease and research center from June 2008 to June 2015. All patients with renal AML underwent contrast-enhanced CT (CECT) with CT angiography with 64 slice multidetector CT scan.

Kidneys were divided into two groups; unruptured and ruptured AML based on CT findings. The single largest lesion in each kidney was evaluated for tumor size on CECT. CT angiography images were evaluated for size of an aneurysm if present; in each group. Tumor and aneurysm sizes were compared, and multiple regression analysis was performed to identify factors affecting the rupture.

Results: Total 34 kidneys were found to be affected by AML. Out of which 6 AML were ruptured and remaining 28 were unruptured. If tumor size of 4 cm or larger is used as predictor of rupture; sensitivity 20%, specificity 89%, positive predictive value 83.3%, and negative predictive value 28.5%; and If aneurysm size >5 mm is used as predictor of rupture; sensitivity 75%, specificity 90%, positive predictive value 50%, and negative predictive value 96.4% was found.

Conclusion: Tumor size, aneurysm size and tumor multiplicity cannot use as a predictor of spontaneous rupture of the tumor.

Key Words: Angiomyolipoma, computed tomography angiography, intratumoral aneurysm, rupture

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INTRODUCTION

Angiomyolipoma (AML) of the kidney is a benign neoplasm consisting of thick walled aneurysmal vessels, smooth muscles, and varying levels of mature adipose tissue. It has an incidence of about 0.3–3%.[1] Two types are described: Isolated AML and AML that is associated with tuberous sclerosis. Isolated AML occur sporadically, account for 80% of AML.[2] Nearly, 20–30% AML is seen in patient with tuberous sclerosis.[3] About 50% of patient with tuberous sclerosis complex develops AML. Dysmorphic blood vessels in the AML often form aneurysms, which may rupture and result in renal hemorrhage.[4] AML is the most common renal neoplasm associated with spontaneous renal hemorrhage.

Till date, a line of treatment of AML is based on tumor size, presence or absence of rupture, associated factors, and clinical features at the time of presentation. A study was done using a parameter of tumor size on computed tomography (CT) study and aneurysm size on conventional angiography to predict rupture of the tumor.[5] Simultaneous embolization of AML can be carried out during conventional angiography if needed; however, this advantage is overshadowed by the risk involved in any invasive procedure.[6]

Hence, this study was undertaken to predict rupture of AML based on tumor size and aneurysm size measured using noninvasive technique - 64 slice CT scan and CT angiography; which is well-tolerated by patients and required less contrast medium compared to digital subtraction angiography.

MATERIALS AND METHODS

Total 27 patients were diagnosed as having renal AML at institute of kidney disease and research center from June 2008 to June 2015. In all patients, the diagnosis of AML was made with unenhanced and enhanced CT on the basis of the presence of lipomatous components in the tumor because when evidence of fat depicted on CT histological proof is not necessary to diagnose AML.[7] All patients underwent CT examination on Somatom sensation 64 slices multidetector CT scan from siemens after informed consent within 1st week after ultrasonographic detection of suspected AML. Plain CT sections of abdomen were taken at 1 mm interval followed by contrast study. Nonionic contrast iomeron (iomeprol - 350 mg/ml) or omnipaque (iohexol - 350 mg/ml) was injected at rate of 3.5 ml/s at dose of 1–1.5 ml/kg by using mechanical injector followed by 20 ml of saline. Angiographic phase was obtained by bolus tracking technique. Scan parameters were: 110 kVp, 120 mAs, pitch 1.2, and rotation time 0.5 s. Nephrographic phase was obtained at 90 s delay. 0.6 mm reconstructions of images were done.

Evaluation

Diagnosis of rupture of the tumor was based on CT findings. Perirenal or subcapsular hematoma indicated rupture of tumor. Patients were divided into two groups – ruptured AML and unruptured AML. Further evaluation was done by measuring size of tumor and the size of the largest aneurysm in each kidney.

When a patient was found to have multiple tumors in one kidney, the single largest lesion in each kidney was evaluated. If an aneurysm was not detected on CT angiographic study aneurysm size was considered to be 0 mm. Tumor and aneurysm sizes were compared between the two groups by calculating sensitivity, specificity, positive and negative predictive values for the prediction of rupture. Multiple regression analysis was performed to identify factors linked with AML rupture. Tumor and aneurysm sizes, tumor multiplicity were chosen as variables. Independent *t*-test and Mann–Whitney test have been used to calculate the statically significant value. $P < 0.05$ was considered to represent a statistically significant difference.

RESULTS

Of the 27 patients with AML, 22 were females while five were males (male:female; 1:4.4). The age range was 12–67 years with a mean age of 37.2 years.

Total 34 kidneys were diagnosed as having renal AML based on CT findings. Twenty patients had single kidney affected. Seven patients had multiple bilateral lesions and associated with tuberous sclerosis complex. More than one tumor in single kidney found in 19 kidneys including patients with tuberous sclerosis. Subcapsular and perirenal hematoma indicative of tumor rupture was found in six patients. None of our patients had bilateral ruptured tumor [Figures 1 and 2].

Tumor size

- Nine tumors out of 34 kidneys were of <4 cm in size
- Out of 6 ruptured AML; 5 were >4 cm and 1 was <4 cm in size
- Out of 28 un-ruptured tumors; 20 were >4 cm and 8 were <4 cm in size [Figure 3].

Presence and size of an intratumoral aneurysm

- An aneurysm was observed in 10 out of 34 kidneys on CT angiographic study. The size of smallest and largest aneurysm was 3 mm and 54 mm respectively
- Out of 6 ruptured AML; 3 had an aneurysm >5 mm in size; and 3 had an aneurysm <5 mm in size
- In un-ruptured group; one patient had an aneurysm of 13 mm (>5 mm) in size. Twenty seven patient had aneurysm <5 mm in size [Figure 4].

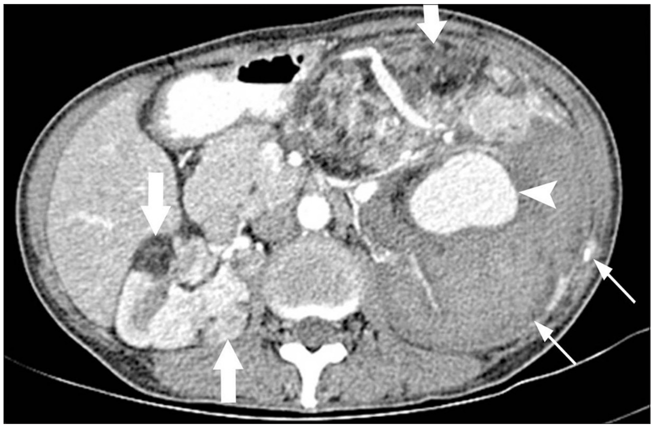

Figure 1: Ruptured angiomyolipoma in 43 years old female with tuberous sclerosis - image shows multiple angiomyolipomas (thick arrows) in both kidneys. A large aneurysm (arrowhead) is seen in ruptured tumor of left kidney with perirenal hematoma (thin arrows)

Figure 2: Ruptured angiomyolipoma in 50 years old female - image shows ruptured angiomyolipoma (thick arrow) in right kidney, perirenal hematoma (thin arrow), and small intratumoralaneurysm (arrowhead)

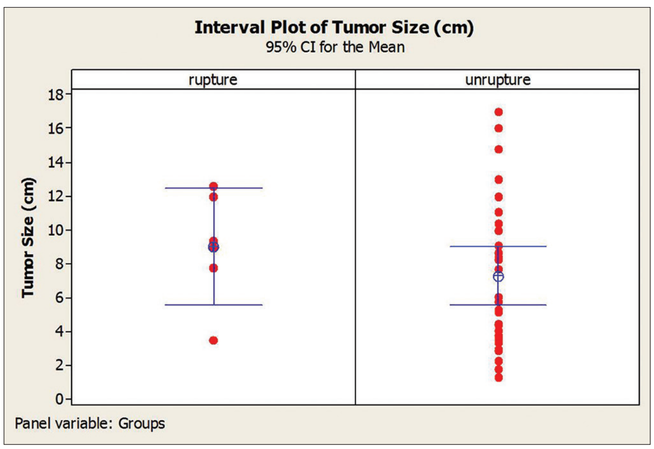

Figure 3: The chart shows mean tumor size in ruptured and unruptured group

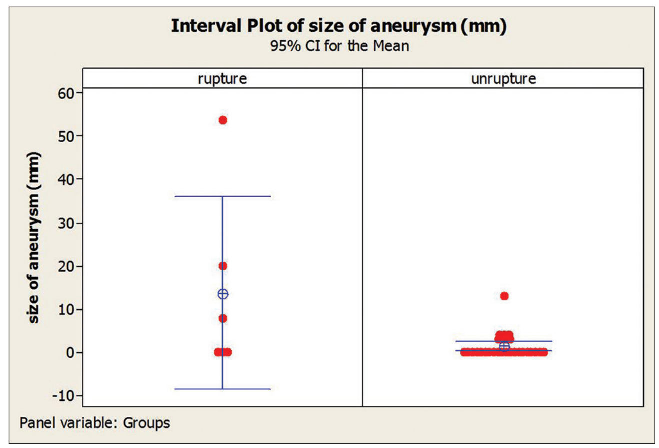

Figure 4: The chart shows mean aneurysm size in ruptured group than un-ruptured group

If we use tumor size >4 cm and aneurysm size >5 mm; sensitivity, specificity, positive and negative predictive value for prediction of rupture were shown in Table 1. Results of multiple regression analysis were shown in Table 2. Mean ± standard deviation of tumor and aneurysm size are shown in Table 3. We found that tumor size, aneurysm size and tumor multiplicity were not significantly linked to rupture ($P > 0.05$).

DISCUSSION

AML is a benign tumor requiring treatment only if it is symptomatic or prone to hemorrhage. Multiple studies have demonstrated that the frequency of symptoms and risk of hemorrhage is directly proportionate to the size of the tumor; larger the tumor, the greater is the risk of bleeding,[8,9] but there is debate regarding the size criteria for treatment of patients with asymptomatic AML. Some clinician treat asymptomatic tumors of >8 cm[10] whereas some consider >4 cm as the threat of bleeding.[8] Our institute accepts 4 cm as cutoff size for treatment. With the rapidly increasing knowledge being gained on the mammalian target of rapamycin (mTOR) pathway in relation to tuberous scleoris complex, the future use of mTOR inhibitors are likely to become well established in our institute.

Most of the patients with small tumors (<4 cm) that tend to be asymptomatic are managed conservatively, with annual CTs.[10] If the lesion is <4 cm the risk of bleeding is 13%, but tumor size of >4 cm carries 51% risk of rupture.[8] According to Meiri *et al.* if tumor size >4 cm used as a predictor of rupture sensitivity and negative predictive value is 57% and specificity and positive predictive value 80%.[11] Similarly, in our study, one of the ruptured tumors was <4 cm and 20 un-ruptured tumors were >4 cm and asymptomatic, hence if tumor size of 4 cm or larger is used as predictor of rupture, sensitivity and specificity are 20% and 89%, respectively, predictive value of positive test is 83.3%, predictive value of negative test is 28.4% was found. In another study, 3 out of 11 lesions (27%) which had spontaneous renal bleeding secondary to AML; the tumor measured 2.5–4 cm in size.[12]

Table 1: Sensitivity, specificity, positive and negative predictive value for prediction of rupture

Predictor of rupture	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Tumor size >4 cm	20	89	83.3	28.5
Aneurysm size >5 mm	75	90	50	96.4

Table 2: Results of multiple regression analysis

Independant variables	Coefficient	Std. error	Exp (B)	*P*-value	95% CI	
					Lower	Upper
Aneurysm size (mm)	-0.21	0.12	0.81	0.07	0.65	1.01
Tumor size (cm)	0.06	0.14	1.06	0.67	0.81	1.40
Tumor Multiplicity	1.98	1.51	7.21	0.19	0.37	139.79

Table 3: Mean±SD of aneuryms and tumor size

	Rupture (*n*=6)	Unrupture (*n*=28)	*P*
Aneurysm size (mm)	13.67±21.26	1.32±2.75	0.21 (NS)
Tumor size (cm)	9.05±3.28	7.29±4.42	0.37 (NS)

SD: Standard deviation, NS: Not significant

Hence, size of tumor should not be considered as a good predictor for rupture.

Intralesional aneurysms are described as a vascular cause of hemorrhagic complication in AML.[13,14] Albi *et al.* documented that an intralesional aneurysm on CT scan can predict a greater possibility of tumor rupture.[15] In a meta-analysis of 739 cases of AML; selective angiography demonstrated aneurysms in the interlobar or interlobular arteries in 71.4% of cases.[16] In our study, aneurysms were detected in 29.4% of AML patients by CT angiography. Yamakado *et al.* used CT image to measure size of tumor and conventional angiography to measure size of an aneurysm.[5] In that study, conventional angiography was done to all patients with AML for the purpose of plan of treatment and to differentiate it from renal cell carcinoma. However, with advent of multislice multidetector CT scan and advanced MRI, there is no role of angiography in the diagnosis of renal cell carcinoma over CT – so doing angiography in such patients is of no meaning nowadays. In our institute, protocol of renal conservation for renal AML patients is followed; using a strategy of observation for small (<4 cm) asymptomatic tumors, partial nephrectomy for moderate size tumors and selective arterial embolization is only reserved for large tumors which are not amenable to partial nephrectomy hence conventional angiography has limited role. Another aspect is conventional angiography may demonstrate smaller aneurysm than its actual size due to partial thrombosis, in our study use of CT angiography to measure size of an aneurysm has overcome this limitation. Incidentally, we did not find any thrombosed aneurysm in our study patients.

The smallest aneurysm found in our study was 3 mm in diameter; we found two patients with a large aneurysm with a ruptured tumor in our study. Yamakadok *et al.* observed that there were significant differences in mean aneurysm size (13.3 mm ± 6.2 vs. 2.4 mm ± 2.9, $P < 0.02$) between the ruptured and unruptured tumor groups.[5] Accordingly to them when aneurysm size of 5 mm or larger was used as predictors of rupture, sensitivity and specificity was 100% and 86%, respectively. We found no significant difference in mean aneurysm size between ruptured and unruptured group ($P > 0.05$). The results of multiple regression analysis also support this finding.

It is known that patient with tuberous sclerosis were more frequently symptomatic and required surgery.[1] Renal AML associated with tuberous sclerosis grow fast and have an increased risk of spontaneous hemorrhage.[17] More likely they are multiple and bilateral.[18] These data suggest that multifocality should also be considered as a factor linked to rupture. However, we found 19 kidneys had more than one tumor out of theses only 5 (26.31%) were ruptured. Hence, in accordance with Yamakado *et al.*[5] our study also suggests that tumor multiplicity is not a good predictor of rupture of tumor.

Vallejo *et al.* also observed that patient age and sex, and lesion multiplicity and size were not found to be predictors of spontaneous rupture.[19]

Limitation of our study is small sample size due to lower incidence of tumor.

CONCLUSION

We observed no significant relationships among size of tumor, tumor multiplicity, and size of an aneurysm measured on CT angiography and incidence of spontaneous rupture.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Steiner MS, Goldman SM, Fishman EK, Marshall FF. The natural history of renal angiomyolipoma. J Urol 1993;150:1782-6.
2. Yiu WC, Chu SM, Collins RJ, Tam PC, Chan FL, Ooi GC. Aggressive renal angiomyolipoma: Radiological and pathological correlation. J Hong Kong Coll Radiol 2002;5:240-2.

3. Blute ML, Malek RS, Segura JW. Angiomyolipoma: Clinical metamorphosis and concepts for management. J Urol 1988;139:20-4.
4. Shepherd CW, Gomez MR, Lie JT, Crowson CS. Causes of death in patients with tuberous sclerosis. Mayo Clin Proc 1991;66:792-6.
5. Yamakado K, Tanaka N, Nakagawa T, Kobayashi S, Yanagawa M, Takeda K. Renal angiomyolipoma: Relationships between tumor size, aneurysm formation, and rupture. Radiology 2002;225:78-82.
6. Hessel SJ, Adams DF, Abrams HL. Complications of angiography. Radiology 1981;138:273-81.
7. Bosniak MA, Megibow AJ, Hulnick DH, Horii S, Raghavendra BN. CT diagnosis of renal angiomyolipoma: The importance of detecting small amounts of fat. AJR Am J Roentgenol 1988;151:497-501.
8. Oesterling JE, Fishman EK, Goldman SM, Marshall FF. The management of renal angiomyolipoma. J Urol 1986;135:1121-4.
9. Tsai HN, Chou YH, Shen JT, Huang SP, Wu WJ, Wang CJ, *et al.* The management strategy of renal angiomyolipoma. Kaohsiung J Med Sci 2002;18:340-6.
10. Dickinson M, Ruckle H, Beaghler M, Hadley HR. Renal angiomyolipoma: Optimal treatment based on size and symptoms. Clin Nephrol 1998;49:281-6.
11. Meiri H, Soejima K, Tokuda Y, Miyazaki K, Nakamura K, Kuratomo K, *et al.* The management selection of renal angiomyolipoma. Nihon Hinyokika Gakkai Zasshi 1996;87:1151-7.
12. Prando A. Radiological classification of renal angiomyolipomas based on 127 tumors. Int Braz J Urol 2003;29:208-15.
13. Adler J, Greweldinger J, Litzky G. "Macro" aneurysm in renal angiomyolipoma: Two cases, with therapeutic embolization in one patient. Urol Radiol 1984;6:201-3.
14. Heckl W, Osterhage HR, Frohmüller HG. Diagnosis and treatment of renal angiomyolipoma (based on 15 cases). Urol Int 1987;42:201-6.
15. Albi G, del Campo L, Tagarro D. Wünderlich's syndrome: Causes, diagnosis and radiological management. Clin Radiol 2002;57:840-5.
16. Arima K, Kise H, Yamashita A, Yanagawa M, Tochigi H, Kawamura J, *et al.* Renal angiomyolipoma: Diagnosis and treatment. Hinyokika Kiyo 1995;41:737-43.
17. Nelson CP, Sanda MG. Contemporary diagnosis and management of renal angiomyolipoma. J Urol 2002;168 (4 Pt 1):1315-25.
18. van Baal JG, Smits NJ, Keeman JN, Lindhout D, Verhoef S. The evolution of renal angiomyolipomas in patients with tuberous sclerosis. J Urol 1994;152:35-8.
19. Vallejo BJ, Herrera TE, Domenech CA, Lafuente PM, de Ramírez TI, Robles MJ. Renal angiomyolipoma: Presentation, treatment and results of 20 cases. Actas Urol Esp 2008;32:307-15.