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Role of Angioembolization in the Treatment of Medium Sized Renal Masses

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Abstract

Background: Renal cell carcinoma is the most common malignant renal tumors, while Angiomyolipoma (AML) is the most common benign one. It is widely known that surgical procedures such as Partial Nephrectomy (PN) and Radical Nephrectomy (RN), remains the gold standard treatment for them. However the minimally invasive image-guided therapies, such as renal artery embolization are safe and effective therapies pre-operatively and for patients who do not want to undergo traditional surgery.

Aim of Study: To evaluate the role of Renal Artery Embolization (RAE) in treatment of medium size renal tumors either benign Angiomyolipoma (AML) or malignant Renal Cell Carcinoma (RCC) masses.

Methods: Twenty patients were included retrospectively in this study, 11 patients were with RCC and 9 were AML, with a size of 4-7cm as inclusion criteria. Complications and impact of patient's management of RAE (renal artery embolization) were analyzed.

Results: Angioembolization of renal tumors was successful in nearly all cases for AML and in RCC. It achieved adequate results in AML which liable for rupture or in active bleeding. While for RCC it played significant role in pre-operative de-vascularization to facilitate its resection intra operative and aiding as palliative treatment for the RCC.

Conclusion: The RAE is an effective, minimally invasive and well tolerated line of treatment of both AML and RCC either therapeutic pre-operative de-vascularization or palliative treatment with low incidence of minor complications.

Key Words: *RAE (Renal Artery Embolization) – RCC (Renal Cell Carcinoma) – AML (Angiomyolipoma).*

Introduction

RENAL cell carcinoma is the tenth most common adult renal epithelial cancer, accounting for more than 90% of all renal malignancies in men and women, mostly after the age of 64 and rare before the age of 45 [1]. The Angiomyolipoma (AML) is the most common benign renal tumor, that constitutes up to 2% of renal neoplasms [2].

Several treatments plans are existing for management of localized renal masses including local interventional ablation or surgery. Surgical approach including partial nephrectomy more used for small sized tumors and radical nephrectomy for larger ones. However, PN nowadays is preferred for lesions less than 7cm in diameter (medium sized) with other interventional options. So the size of the tumor is highly influencing the treatment options [3,4]. Renal Artery Embolization (RAE) is an effective minimally invasive alternative procedure for the treatment of a variety of conditions. Since the 1970s when RAE was first developed, technical advances and growing experience have expanded the indications to not only include treatment of conditions such as symptomatic hematuria and palliation for metastatic renal cancer, but also pre-operative infarction of renal tumors, treatment of angiomyolipoma, vascular malformations especially for the small and medium sized renal masses [5]. However, RAE is recommended as a first-line therapy for bleeding angiomyolipoma and can be used as a preventative treatment for angiomyolipoma at risk of bleeding [3,7]. The current study aimed to evaluate the role of renal artery embolization in treatment of medium sized renal tumors (4-7cm) either benign; AML or malignant; RCC and additionally the study assessed RAE complication.

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List of Abbreviation:

RAE : Renal Artery Embolization.
AML : Angiomyolipoma.
RCC : Renal Cell Carcinoma.
PN : Partial Nephrectomy.
RN : Radical Nephrectomy.
INR : International Normalized Ratio.
US : Ultrasonography.
MDCT : Multidetector Computed Tomography.
MRI : Magnetic Resonance Imaging.

Patients and Methods

The current study is a retrospective study using secondary data obtained from Urology and Nephrology Center, Mansoura University [8]. The data was obtained from December 2014 to December 2016. Patients were referred from outpatient clinic to Radiology Department. The sample included 20 patients with renal tumors for managing them by renal artery embolization after proper final diagnosis with a size ranging from 4 to 7cm as an inclusion criterion.

These patients were presented with renal masses either benign (renal AML) or malignant (RCC) according to the imaging modalities that were done for them. They underwent embolization of renal artery.

All patients were subjected to clinical assessment such as full history taking, vital signs, anemia, allergy to contrast media. As well as local abdominal examination performed by the colleagues in the Urology Department for abdominal masses. Laboratory investigations were done such as: Complete blood count, renal function tests, serum creatinine, coagulation profile including INR (International Normalized Ratio), prothrombin time and concentration.

Many radiological investigations were fulfilled as abdominal ultrasound (US), Multi-Slice Computed Tomography (MSCT) and/or Magnetic Resonance Imaging (MRI) for assessment the renal tumor, as regards location, size, nature, vascularity of the renal tumor and their relation to surrounding structures.

Patient preparation: Patient should be fasting 8 hours before the procedure. The procedure was explained to the patient or one of his relatives. A written consent was obtained from all patients or their relatives before procedure. Venous access (wide bore cannula) was fixed. Prophylactic antibiotic (ceftriaxone 2gm IV).

Anesthesia: Local anesthesia (5 CC Lidocaine hydrochloride 2% (xylocaine) solution) was infiltrated under skin around the puncture site and superficial to the femoral artery.

Angiographic Technique:

Interventional procedure including diagnostic angiography by using Toshiba (CAT805B) machine.

Diagnostic and Interventional angiography:

Arterial puncture was obtained through femoral artery. Using the Seldinger's technique, the patient is placed in the supine position. A hollow-core needle is introduced into the artery; a guidewire is inserted through the needle and advanced into the artery. The needle is exchanged for a vascular sheath (5 or 6 French sheath) is used. Subsequent catheter movement and exchange is performed over a guide wire under fluoroscopic guidance. Abdominal aortography was first performed to determine the entire vascular anatomy, exclude main renal artery lesions and be sure of the number of feeding renal arteries. The renal artery was selectively catheterized via cobra catheter (Cordis, USA) (4 or 5 F). Non-ionic contrast media (Omnipaque 350mg/ml) was used in all patients. Manual injection was used in selective angiography (dose of 8-10ml of contrast media in each injection). Diagnostic images were carefully assessed for the presence of vascular pathology and to localize the lesion and the branch of the renal artery supplying the area of the lesion. The catheter was further advanced sub-selectively into the segmental branch of the renal artery feeding the lesion (dose of 4-5ml of contrast media in each injection). Additional oblique and magnification views were used to help in delineation of the exact location of the vascular injury. Post insertion the embolizing material, selective angiography was made while the catheter in main renal artery for assessment of arterial occlusion by manual injection of contrast media (8-10ml of contrast media in each injection) after about 2 minutes from the insertion. After the procedure, the catheter and sheath are removed and compression of the puncture site was performed followed by tight sterile bandage for the puncture site in all patients.

Post embolization follow-up:

In case of embolization of malignant renal masses, the efficacy of pre-operative embolization correlated with operative data (easy resection of the tumor and less bloody operative field). In case of embolization of AML: Follow-up Contrast Enhanced CT (CECT) was done after 2-3 months from embolization to fulfill certain points: Evaluate of the size of the renal mass (AML), evaluate the intra tumoral aneurysm and confirm no recurrence of the bleeding.

Statistical analysis:

All statistical anaylsis was done using SPSS (Statistical Package for the Social Science, version 20). For continuous variables, the mean and SD ratio (descriptive statistics) were calculated. For categorical variables, frequencies with a p-values <0.05 indicated statistical significance.

Results

This study included 20 patients. (12 males and 8 females), their ages ranging from 17 to 75 years (mean ± SD) (47.8±15.5) (Table 1). The 20 patients underwent Angioembolization for their renal masses, 11 patients of them having malignant renal mass (RCC) (55%). While 5 patients of them diagnosed as Tuberous Scleroses (TS) having bilateral AML (25%) and 4 patients of them having solitary AML (20%) (Table 2).

The indications for Angioembolization in 11 patients having malignant renal mass (RCC) as follows: 9 of them as pre-operative total embolization (45%), one patient as a palliative treatment (5%) Fig. (1) and another patient have RCC underwent Angioembolization as a combined treatment after two sessions of RFA Fig. (2) to improve results of RFA (5%) (Table 3).

The indications for Angioembolization in 5 patients diagnosed as TS having bilateral AML as follows: 3 cases to stop bleeding (hematuria) (15%) and 2 cases complicated AML with sub-capsular hematoma (10%) (Table 3). While in the other 4 patients having solitary AML as follows: 1 case complicated with intra lesions aneurysm (5%) and another two cases complicated with perinephric hematoma (10%), one case having multiple intra lesional dilated tortuous vessels (5%) (Table 3).

The embolizing agents used in 20 patients underwent Angioembolization for their renal masses are: 7 cases using alcohol with micro-coils (35%), 6 cases using micro-coils (30%), 5 cases using balloon catheter with alcohol (25%), 1 case using emphosphere particle (5%), 1 case using Gel foam with alcohol (5%) (Table 4).

There are two types of embolization used for treatment of renal masses in 20 patients either Total embolization in 8 patients (40%) selective embolization in 12 patients (60%) (Table 5).

Three patients of 20 patients underwent embolization develops flank pain (15%) and 1 case (5%) develop self-limiting perinephric hematoma, resolving spontaneous (Table 6).

Fig. (1) 75-years old male patient, was presented by accidentally discovered right renal mass.

MRI and MSCT reveals right renal lower pole mass lesion measures (4 X 5cm) with destructive metastatic left iliac soft tissue mass Fig. (1-1).

Patient un fit for surgery and planed for angioembolization of right renal mass as a palliative treatment Fig. (1-2).

1st follow-up MSCT after angioembolization about 1-month duration Fig. (1-3).

2nd follow-up MSCT after 3-month duration Fig. (1-4).

Fig. (2) 54 years old male hepatic patient with liver cirrhosis and right loin pain.

Abdominal US and post contrast MSCT reveals right renal mid zonal soft tissue mass lesion Fig. (2-1).

Follow-up MSCT after 1 month shows residual post ablation enhancement Fig. (2-3).

Second session of RFA was done for the residual enhancing tumor tissues 1 month later Fig. (2-4).

Follow-up MSCT after 2nd session of RFA 1 month later shows marked residual enhancement Fig. (2-5).

The patient planned for angioembolization for this right renal mass lesion Fig. (2-6).

Third session of RFA was done at the 2nd day after Angioembolization Fig. (2-7).

Follow-up MSCT was done after third session of RFA Fig. (2-8).

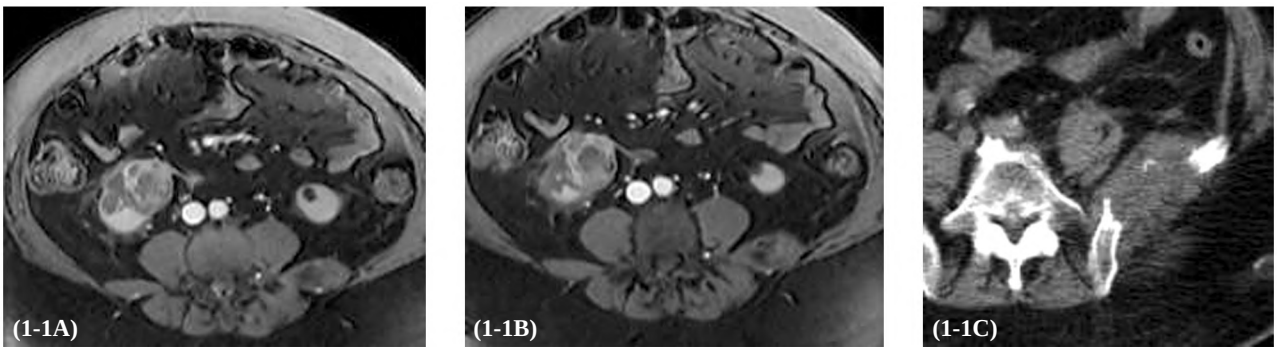

Fig. (1-1): A, B: Post contrast Axial MRI images shows ill-defined enhanced lower pole right renal mass (6 X 7cm) with infiltration the perinephric fat plans, C: Axial CT image of the pelvis shows destructive left iliac metastatic soft tissue mass lesion.

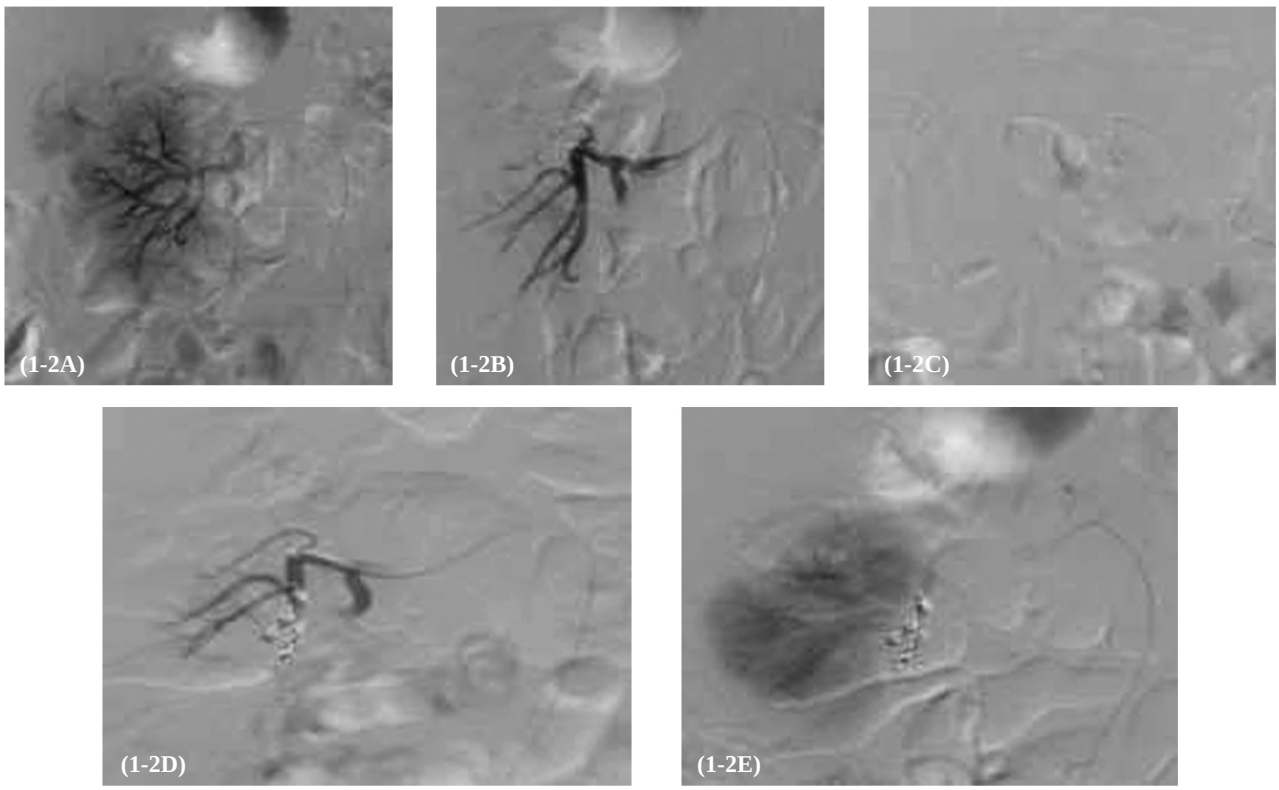

Fig. (1-2): Right renal DSA: (A) Shows right renal A with 2 main divisions, two inter lobar branches from the distal segmental A are seen related to lower polar renal mass. (B) Selective catheterization of the feeding artery to lower polar mass using micro catheter. (C) Selective embolization was done using two micro coils. (D, E) Post embolization angiogram showno further opacification of the tumor with preservation remaining right renal vasculature.

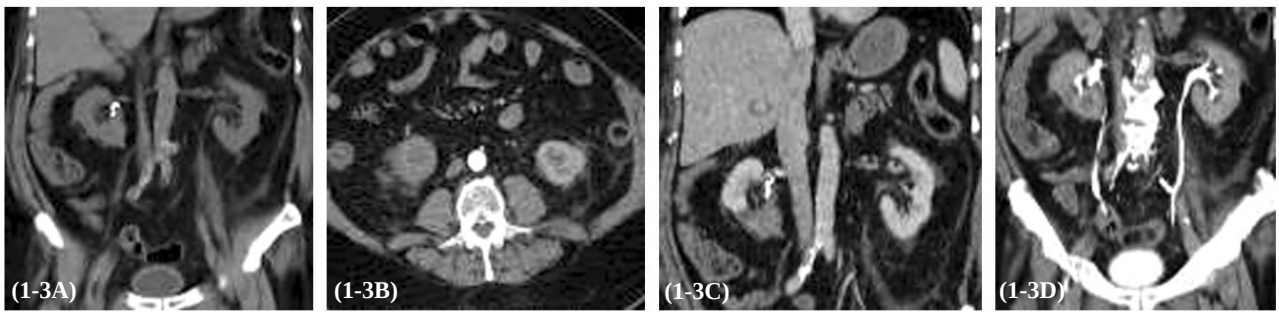

Fig. (1-3): (A) Coronal Non enhanced CT images, (B, C, D) Post contrast CT axial arterial phase, coronal venous phase and coronal excretory phase respectively shows right renal lower polar mass show little enhancement with stranding and thickening perinephric fat and small perinephric hematoma, two micro coils at right renal pelvic region.

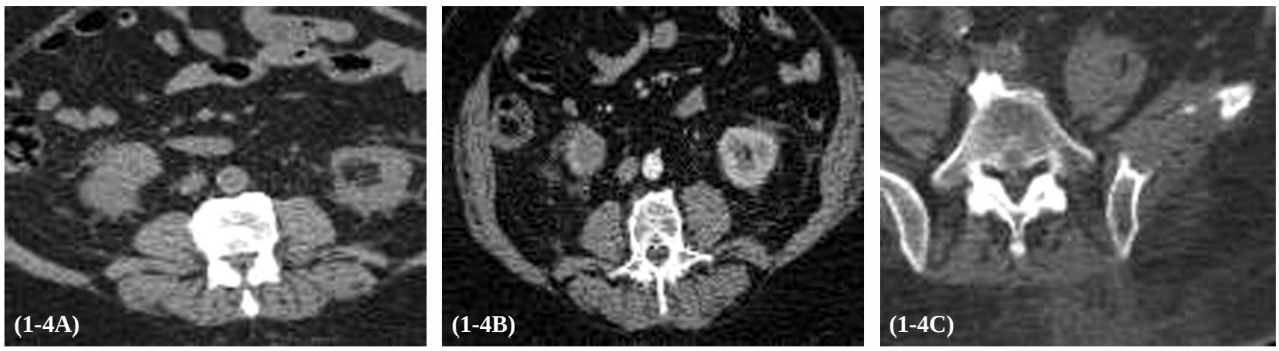

Fig. (1-4): (A) Axial non enhanced CT images, (B) Post contrast axial CT images, shows Right renal lower polar mass show no significant enhancement with resolving the peri nephric hematoma, (C) Axial CT images of iliac bones: Nearly the same size of left iliac destructive soft tissue mass lesion.

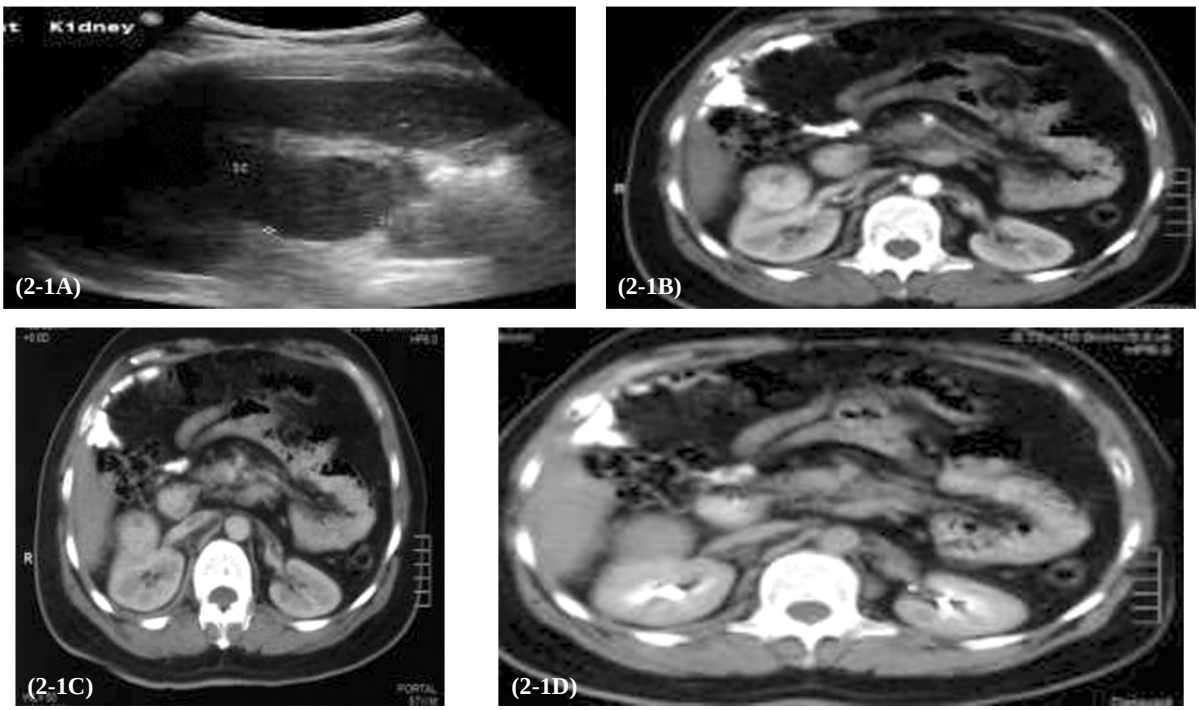

Fig. (2-1): A: Abdominal US shows echogenic soft tissue mass lesion involving middle zone of right kidney. B, C, D: Axial contrast enhanced CT images (arterial, nephrographic and excretory phase respectively) shows right renal middle zone anterior cortical enhanced soft tissue mass lesion measures 4 X 4.5cm, planed for RFA (Radio Frequency Ablation) because his co morbidity (hepatic cirrhosis).

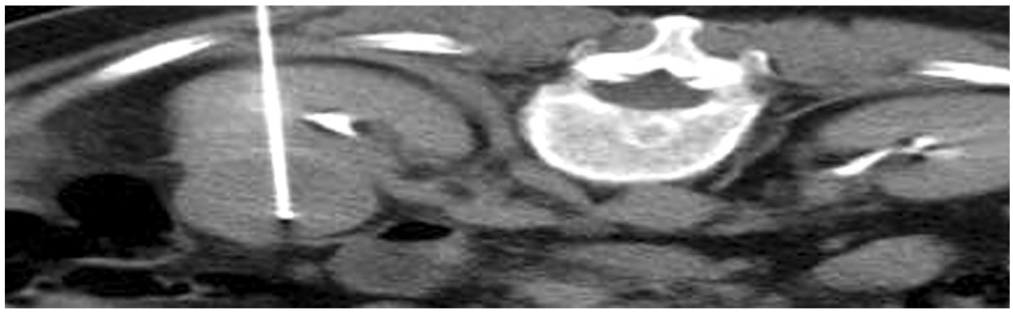

Fig. (2-2): Patient in a prone position and axial CT scan at delayed phase obtained shows RF needle electrode within the tumor.

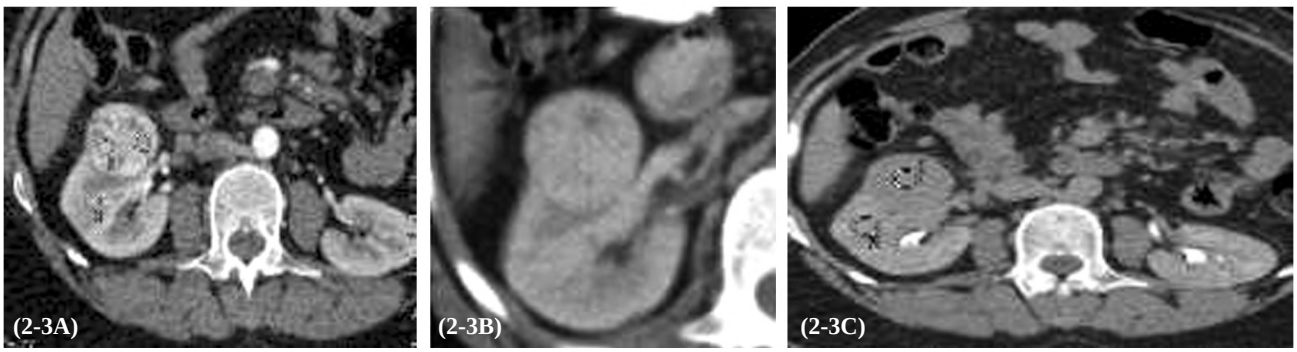

Fig. (2-3): A, B, C: (Arterial, nephrographic and excretory phases) post contrast enhanced axial CT images obtained 1 month after 1 st RF ablation session show residual enhancing tumor tissues of previously ablated renal mass.

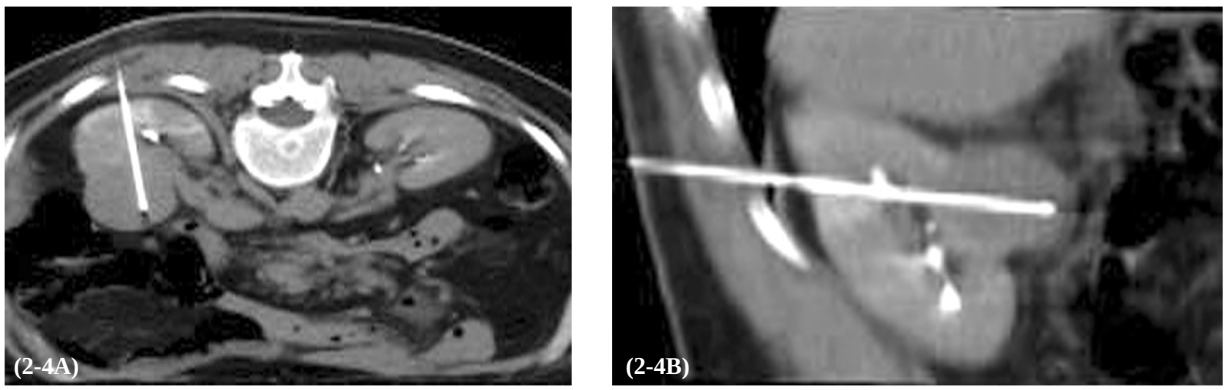

Fig. (2-4): 2nd RFA session: Patient in a prone position and axil, sagittal CT images obtained at delayed phase shows RF needle electrode within the tumor.

Fig. (2-5): A, B, C: (Non contrast, Arterialand nephrographic phases) axial CT images obtained 1 month after 2 nd RF ablation session show marked residual enhancing tumor tissues of previously ablated renal mass.

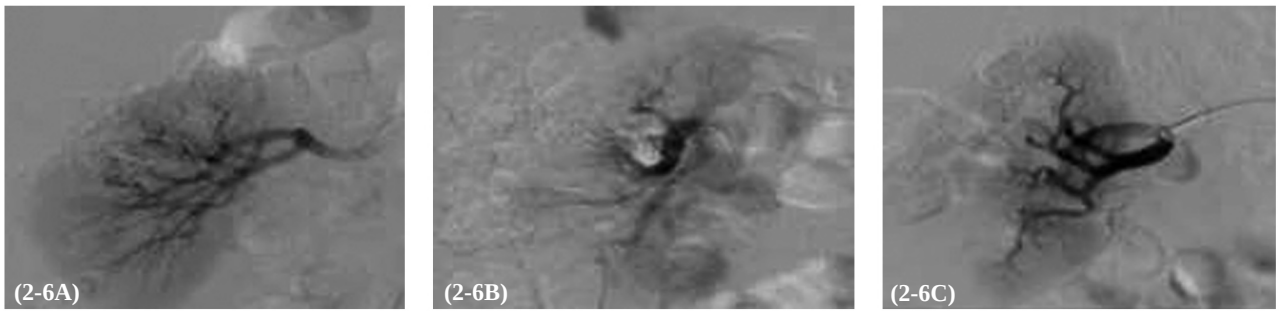

Fig. (2-6): Selective right renal DSA: (A) Shows highly vascular renal mid zone lesion (arrow). (B, C) Post selective embolization (was done by alcohol) angiography shows successful renal tumor embolization.

Fig. (2-7): 3rd RFA session: Patient in a prone position and axial non contrast CT images obtained shows RF needle electrode within the tumor.

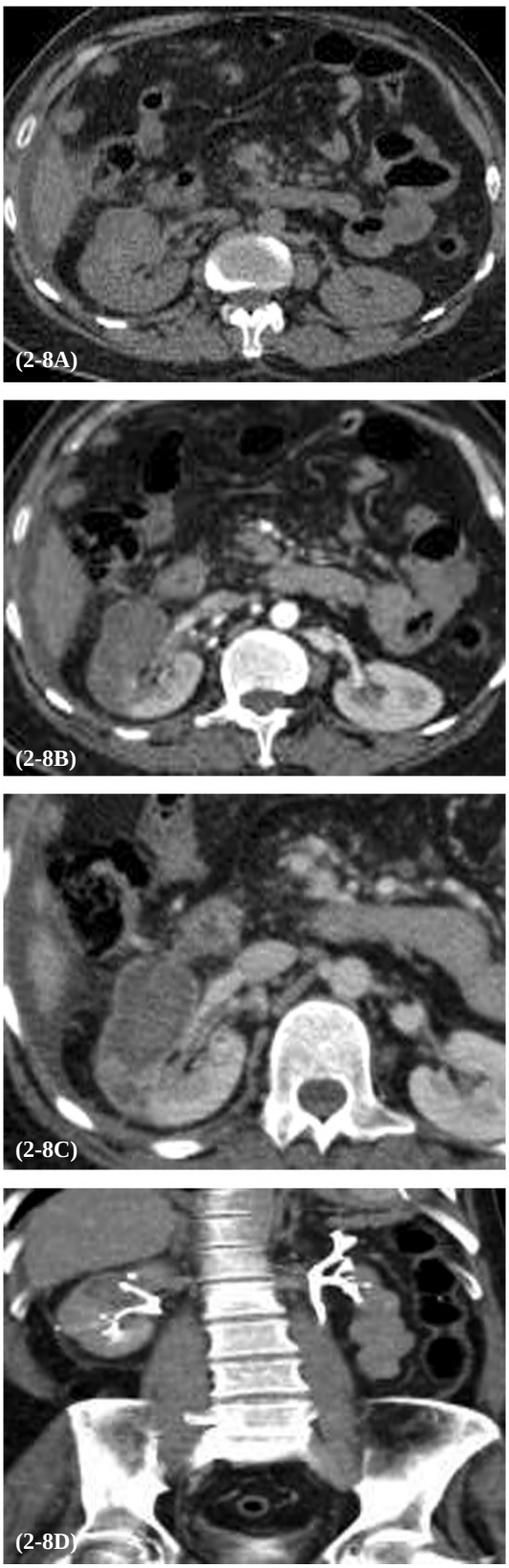

Fig. (2-8): A, B, C: (Non contrast, Arterialand nephrographic phases) axial CT images, D: Excretory phase coronal CT image, are obtained 1 month after 3 rd RF ablation session show reduced size of ablated right renal mid zone mass lesion, stranding perinephric fat and no residual enhancing tumor tissues.

Table (1): Age and sex distribution among the 20 patients in our study.

	Total
Sex, n (%):	20
Male	12 (60.0%)
Female	8 (40%)
Age (years):	
Range	17-75y
Mean ± SD	47.8± 15.5

Table (2): Type of renal masses in 20 patients underwent Angioembolization.

Type of patient	No.	%
Malignant renal mass (RCC)	11	55.0
T.S	5	25.0
Solitary AML	4	20.0
Total	20	100%

Table (3): Indications of angioembolization.

Indications	No.	%
TS:	5	25.0
Stop bleeding (hematuria)	3	15.0
Complicated AML with sub capsular hematoma	2	10.0
AML:	4	20.0
Complicated with intra lesional aneurism	1	5.0
Complicated with perinephric hematoma	2	10.0
Intra lesional dilated tortuous vessels	1	5.0
RCC:	11	55.0
Pre-operative total embolization	9	45.0
Palliative treatment	1	5.0
Combined with RFA	1	5.0
Total	20	100%

Table (4): Type of embolizing agents were used in Angioembolization of renal masses.

Type of embolizing Agent		
Alcohol + microcoils	7	35.0
Microcoils	6	30.0
Balloon catheter + Alcohol	5	25.0
Emphosphere particle	1	5.0
Gel foam + alcohol	1	5.0
Total	20	100%

Table (5): Type of embolization in management of renal masses.

Type of embolization	No.	%
Total	8	40.0
Selective	12	60.0
Total	20	100%

Table (6): Complications of Angioembolization.

Complications	No. of patients	%
Perinephric hematoma	1	5.0
Flank pain	3	15.0
Total	4	20%

Discussion

The initial indications for Renal Artery Embolization (RAE) since 1970 were limited to symptomatic hematuria and palliation of metastatic renal cancer, but with the technical advances and growing experience the indications broadened. The current study agreed with Li et al., as regards the indications for RAE in the treatment of renal masses which include: Pre-operative embolization before nephrectomy for primary kidney tumor (RCC); palliation for advanced stage RCC; treatment for angiomyolipoma; and as an adjunctive therapy in RCC ablation [6].

The Renal Artery Embolization (RAE) has been used in treatment of multiple issues related to RCC, including pre-operative blood supply occlusion to minimize the intraoperative bleeding and as salvage therapy of metastatic tumors. The Super-selective RAE helps to control hemorrhage after renal surgery and this procedure considered as a minimally invasive and effective in managing bleeding complications [9]. Additionally, the preoperative embolization of RCC associated with improved mortality rates when compared with surgical treatment alone [4].

In case of treatment of AML with RAE the indications: Include those which present with hemorrhage and hemodynamic instability, as well as those which are found to be more than 4cm [10].

11 patients having malignant renal mass (RCC) in our study underwent Angioembolization, 9 of them underwent pre-operative total embolization (45%). The study agreed with a study was done by Muller and Rouvière [7] as Angioembolization facilitated subsequent surgery in large locally advanced renal tumors. Li et al., [6] reported the benefits of RAE in the 15 pre-operative setting include a decrease in peri-operative blood loss, creation of a tissue plane of edema facilitating dissection, and reduction in tumor bulk including extent of vascular thrombus, when present.

Li et al., [6] reported that the RAE is well tolerated with few complications, particularly if the time interval from embolization to surgery is reduced to less than 48 hours, while other authors [5] reported the recommended delay between RAE and surgery is 24-72 hours. In the current study, the 11 patients with RCC in the current study underwent total nephrectomy at the same day of Angioembolization.

One patient in the current study have RCC underwent Angioembolization as a combined treatment after two sessions of Radio Frequency Ablation (RFA) to improve results of RFA (5%). Many studies used RAE as add-on tool to percutaneous RFA as feasible, safe, and very effective tool, it also revealed a disease-free interval and cancer-specific survival close to that of partial and/or radical nephrectomy especially in early cancer [11].

There are various embolic agents had been used for pre-operative RAE of locally advanced tumors, but microparticles and coils seem particularly well-suited for this indication. Proximal vascular plugs are also a common treatment choice, but attention must be paid to ensure a residual stump of the proximal artery remains to allow for surgical clamping [7]. In the current study 7 cases used alcohol with micro-coils (35%), 6 cases using micro-coils (30%), 5 cases using balloon catheter with alcohol (25%), 1 case using emphosphere particle (5%), 1 case using Gel foam with alcohol (5%).

The choice of embolization agent for AML is controversial. Common agents include ethanol, PVA, and Embospheres [6]. The utility of coils remains unclear with some authors advocating their use, and others suggesting that their use promotes collateral formation around the level of occlusion. Using PVA and coils may prevent intra-procedural aneurysm rupture rate [12-13].

As for the AML our study was in agreement with many studies regards the indications for RAE include symptomatic AMLs such as those with active hemorrhage, flank pain, hematuria, or mass effect. AMLs larger than 4cm associated with symptoms (80-90%) and spontaneous hemorrhage (50-60%). AMLs more than 4 cm are at high risk of further growth as well. So RAE is well established as the first-line therapy for the treatment of AML [6-10].

The large AMLs (those sized 10cm or greater) are considered more resistant to RAE as they had high rate of recurrence and difficulty to embolize [14].

The post RAE complications in our study among the 20 patients are three patients develops flank pain (15%) and one patient develop self-liming perinephric hematoma, resolving spontaneous (5%)

this may have attributed to avoid delay of operation time in pre-operative cases.

Controversy surrounds the optimal timing of resection; some authors suggest a delay of 24 to 48 hours after embolization, which allows edema to develop facilitating surgical dissection, while other authors have suggested that there should be as minimal delay as possible to prevent collateral vessel formation **[15]**.

Post embolization syndrome is the most common complication, occurring in up to 64% of patients in one series. Most cases are self-limited and successfully medically treated. Major reported complications are limited to abscess formation, coagulative necrosis and all of them are successfully treated without long-term adverse squeal. Multiple retrospective series have been published since 2000 that provide long-term follow-up confirming safety and long-term efficacy of RAE for AML with recurrence rates ranging from 0 to 37%. The majority of recurrences are successfully managed with repeating the RAE **[6]**.

Conclusions:

RAE is an effective, minimally invasive and well tolerated line of treatment of both AML and RCC with limited complications rate.

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دور إنصمام الشريان الكلوى فى علاج أورام الكلى المتوسطة الحجم

إن الهدف من البحث: تقييم دور إنصمام الشريان الكلوى (فى علاج أورام الكلى المتوسطة الحجم (٤–٧سم) سواء كان ورم شحمى عضلى وعائى حميد (AML) أو سرطان الخلايا الكلوية الخبيثة.

طريقة البحث: أدرجت الدراسة ٢٠ مريضاً بأثر رجعى، ١١ مريضاً كانوا يعانوا من أورام خبيثة وتم تقييم جميع المرضى بالكامل قبل التعرض للإنضمام لتقييم حجم الورم، التمديد. وتم تقييم المضاعفات المصاحبة فى حالة ورم شحمى عضلى وعائى حميد (AML) تم تحليل مضاعفات (RAE) وتأثير إدارة المريض كذلك.

نتائج البحث: إن إستخدام الصمام الشريان الكلوى كانت ناجحة فى جميع الحالات تقريباً فى حالات الأورام.