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Transarterial embolization of renal tumors improves surgical outcomes: A case series

Henry A. Reinhart^a, Melhem Ghaleb^b, Brian R. Davis^{a,*}^a Texas Tech University Health Sciences Center, Paul L. Foster School of Medicine, Department of Surgery, 4800 Alberta Avenue, El Paso, TX 79905, United States^b Texas Tech University Health Sciences Center, Paul L. Foster School of Medicine, Department of Radiology, 5001 El Paso Drive, El Paso, TX 79905, United States

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ABSTRACT

INTRODUCTION: Operative treatment of renal tumors can be associated with a high rate of perioperative morbidity related to hemorrhage and injury to adjacent anatomical structures. This morbidity of solid organ surgery is especially prevalent when the lesion involves chronic inflammation or a desmoplastic reaction from a rapidly growing tumor. No consensus on the use of transarterial embolization has been fashioned as the number of prospective studies is small. This study proposes to examine the beneficial effects of selective transarterial embolization of the kidney prior to surgical resection.

PRESENTATION OF CASE: A retrospective case matched review was performed of consecutive nephroureterectomies evaluating outcomes of patients receiving transarterial embolization versus those patients who received no embolization. The records were obtained from University Medical Center of El Paso for the time period of 05/2011–12/2014. Data examined included patient demographics, operative blood loss, operative time, transfusion requirements, and pathology. Previous studies have shown that preoperative embolization of renal tumors resulted in a decreased need for blood transfusion.

CONCLUSION: Our review showed transarterial embolization had a decrease in blood loss and required no transfusions. It also facilitated a larger and more advanced tumor resection. Our series of patients tolerated transarterial embolization well and had good surgical outcomes. Transarterial embolization of kidneys prior to radical nephroureterectomy results in a safe and uncomplicated operative course with less perioperative morbidity when compared to resection alone.

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1. Introduction

Transarterial embolization (TAE) is a technique that is increasingly being used to augment surgical options for an increasing number of pathologies [1]. Renal cell cancer (RCC) is the 10th leading cause of cancer death in adult males in the United States. It has also been increasing in incidence on a global scale [2,3]. The increase is likely due to the use of CT imaging for other conditions enhancing detection of incidentally found renal tumors. While the incidence of RCC is increasing, the amount of patients presenting with metastatic disease is alarmingly high at 20–30% [3].

Renal artery embolization was originally used to treat unresectable renal cancers that were symptomatic but is now being increasingly used to augment surgical resection [4,5]. Surgeons

began to use renal embolization in the 1970s [6] since resection of renal tumors can be associated with a high rate of perioperative morbidity related to hemorrhage. No consensus on the use of TAE has been fashioned as the number of prospective studies is small. Due to the lack of consensus on preoperative TAE with resection versus surgery alone we elected to investigate the differences between the two modalities at our institution.

2. Presentation of case

A retrospective case matched control review was performed of consecutive nephroureterectomy patients from the years of 2011 through 2014. The records for this study were obtained from the University Medical Center of El Paso. Patients who received TAE along with surgery were compared to those patients who underwent radical nephrectomy alone. ICD-9 codes were then used to look through the patient database to find the applicable subjects. Codes included 55.39, 55.89, 59.0, 59.00, 59.02, 59.03, 59.09, 59.1, 59.11, 59.12, 59.19, 59.29, 59.91, 59.92, 00.25, 88.45, 88.51, and 38.86. Data examined included patient demographics, operative blood loss, operative time, transfusion requirements, length of stay,

Abbreviations: TAE, transarterial embolization; RCC, renal cell cancer; CT, computed tomography; ICD9 codes, International Classification of Disease; TNM, T = tumor, N = nodes, M = metastasis: classification of malignant tumors.

* Corresponding author.

E-mail addresses: henry.reinhart@ttuhsc.edu (H.A. Reinhart), Melhem.Ghaleb@ttuhsc.edu (M. Ghaleb), br.davis@ttuhsc.edu (B.R. Davis).

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Table 1
Stage T1 of the non-embolization group.

Non-embolization group						
	Tumor size (cm)	Stage	Length (min)	Blood loss (cc)	PRBC	Surgery
	4 × 4 × 3	T1	117	25	0	Laparoscopic right nephrectomy
	4 × 3 × 3	T1	138	50	0	Laparoscopic right nephrectomy
	5 × 5 × 4	T1	83	1400	4	Left nephrectomy
	6 × 6 × 5	T1	117	250	0	Laparoscopic right nephrectomy
Mean	5 × 4 × 4		114	431		

Table 2
Higher stage tumors in the transarterial embolization group.

Transarterial embolization group						
	Tumor size (cm)	Stage	Length (min)	Blood loss (cc)	PRBC	Surgery
	8 × 6 × 5	T3	129	300	0	Laparoscopic right nephrectomy
	12 × 10 × 9	T2	261	400	0	Left nephrectomy
	6 × 5 × 4	T1	128	200	0	Right nephrectomy
	8 × 7 × 6	T2	122	100	0	Right nephrectomy
Mean	9 × 7 × 6		160	250		

tumor pathology, stage, and type of surgery. Patients were all greater than 18 years of age. There were a total of eight patients included in this study that met the criteria. Exclusion criteria included patients undergoing surgery for nephrolithiasis, atrophic kidneys, and pyelonephritis.

Renal artery embolization was performed using coils (Cook or Interlock) introduced selectively into the renal artery. Coils were introduced until complete embolization was found on angiography. The Seldinger technique was utilized with local anesthesia. The time to surgery post embolization varied from several hours to one day. Nephrectomy was then performed utilizing a laparoscopic technique or open surgery.

Four patients underwent radical nephroureterectomy with preoperative TAE for clear cell carcinoma. One patient had laparoscopic (hand assisted) surgery; the remaining patients received open surgery. Operative blood loss averaged 250 cc and average operative time was 160 min. Three underwent TAE of the affected kidney the day of surgery while one underwent embolization the day before surgery. Average dimensions of the tumor were 9 cm × 7 cm × 6 cm. One patient was TNM stage T1, two were T2, and the last was T3. None required blood transfusion. Three had an uneventful postoperative course and were discharged on day three of hospitalization. One developed a pulmonary embolism and was discharged on day thirteen. The average age was 57.5 years old (range 49–61). There were no reports of the post-embolization syndrome of fever or pain since the embolizations were performed within 24 h of nephrectomy.

Case-matched control methods identified four patients undergoing nephroureterectomy for renal clear cell cancer without angioembolization. Three of the four patients had laparoscopic nephrectomy for low stage tumors. Surgical blood loss had a mean of 431 cc. The duration of surgery averaged 114 min. Average tumor size of this group was 5 cm × 4 cm × 4 cm. Average length of stay for this group was 3.25 days. The average age of this group was 49.75 (range 32–57). All tumors were stage T1 (Table 1).

In comparison between the two groups, TAE allowed higher stage tumors of greater average size to be removed with decreased blood loss and comparable outcomes. There was no statistical difference between the two groups for operative blood loss or length of stay (Table 2).

3. Conclusion

Transarterial embolization (TAE) is recognized as a technique that facilitates nephrectomy in selected patients. There have

been demonstrated reductions in transfusion requirements, intra-operative blood loss and duration of surgery in patients with tumors of either large size or advanced stage [7]. Benefits include decreased tumor vascularity which allows early ligation of the renal vein. TAE is especially useful in cases where the tumor involves the renal hilum [8].

While the small sample size of our study limited the power of our findings we did see similarities to other studies. Zielinski et al. demonstrated an increase in five and ten year survival with TAE when compared to surgery alone. This was a non-randomized study at a single institution and the difference only applied to T2 and T3 tumors [9]. A more recent study by May et al. found no difference in survival between patients treated with surgery and TAE compared to surgery alone. These findings may be inaccurate as follow up was longer for the TAE group. This same study also found no significant difference in complications although there was a significant increase in the transfusion requirement for the non-TAE group ($p < 0.01$) [10].

Surgeons recommend TAE prior to surgery as it aids in dissection due to edema of the tissue planes. There are also some surgeons who hypothesize that increased survival with TAE is due to the immunomodulatory effect of the embolization. Post embolization tumor necrosis upregulates a lymphoproliferative state and with a specific tumor response of natural killer cells [11,12]. TAE is usually well tolerated with a small number of patients complaining of post infarction syndrome characterized by nausea, pain, and fever [13]. Complications associated with TAE have been reported by Lammer et al. to include erroneous infarction of bowel, contralateral kidney and spine with a mortality of 3.3% and serious morbidity of 9.9% in a series of 121 procedures [14].

Studies have demonstrated that preoperative TAE has been associated with decreased blood loss which is consistent with findings from our institution [7]. TAE facilitates resection of a larger and more advanced stage tumor with comparable blood loss to nephrectomy alone. Shortcomings with our study are associated with the low power, the case-matched format and the technique of embolization with coils. Coils have been demonstrated to be less effective in embolization as the current preferred technique uses *n*-butyl cyanoacrylate glue which allows rapid and definitive distal occlusion of a voluminous vascular bed and causes necrosis in perivascular tissue [15]. While TAE prior to operative intervention has been shown to decrease blood loss for advanced stage tumors, prospective randomized trials are needed to demonstrate a survival benefit from renal artery embolization combined with surgery.

Conflict of interest

The authors do not have any conflict of interest to declare.

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Ethical approval

This case series was reviewed approved by the institutional review board for the protection of human subjects at Texas Tech University Health Sciences Center. A copy of the IRB approval with waived consent form is available for review by the Editor-in-Chief of this journal.

Author contributions

Henry Reinhart, MD performed a thorough review of all patients that were included in this review. Dr. Reinhart also performed a thorough review of the literature concerning this subject and was the major contributor in writing this manuscript. Brian Davis, MD has also performed a thorough review of the literature and was a major contributor to the writing of this manuscript. Melhem Ghaleb, MD performed all angio embolizations and aided in patient selection and exclusion. All of the authors have read and approved this manuscript.

Research registry

Approved by the TTUHSC IRB. IRB # E-12074. researchregistry284

Guarantor

I, Brian R. Davis, M.D., F.A.C.S., F.A.S.G.E., accept full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish.

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