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Transarterial embolisation for congenital renal arteriovenous malformations improves clinical condition even with partial obliteration

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AIM: To evaluate the efficacy and safety of transarterial embolisation (TAE), used to treat congenital renal arteriovenous malformations (CRAVMs).

MATERIALS AND METHODS: The medical records were searched retrospectively to identify patients who underwent TAE to treat CRAVM from January 2003 to August 2015. Patient demographics, clinical presentations, and imaging findings were reviewed. TAE outcomes, including complete or partial obliteration, clinical success, complications, renal function changes, and relapse of symptoms or signs after the final TAE, were assessed.

RESULTS: Over the 12-year period, 16 patients (nine male, seven female; median age, 47 years) who underwent 21 TAE procedures to treat 16 CRAVMs were enrolled in the study. The most common clinical presentation was haematuria (81.3%). Thirteen patients (81.3%) had cirsoid and three (18.7%) had aneurysmal CRAVMs. Of the 16 CRAVMs, 11 (68.8%) were peripheral, four (25%) were central, and one (6.3%) was both peripheral and central. The complete obliteration rate was 56.3%. The clinical success rate was 87.5% over a median follow-up period of 398.5 days. Two (9.5%) major complications and 14 (66.7%) minor complications were encountered. No statistically significant change in renal function was evident after TAE.

CONCLUSION: TAE was safe and effective when used to treat CRAVM; the complication profile was acceptable and renal function was preserved. TAE improved the clinical condition of CRAVM patients even when obliteration was only partial.

Introduction

Renal arteriovenous malformations are abnormal communications between the renal arteries and veins anywhere upstream of the capillary level. Aetiologically, the condition is classified as either acquired or congenital. Acquired renal arteriovenous malformations account for approximately 75% of cases[1] and are usually caused by trauma, malignancy, inflammation, surgery, or percutaneous kidney procedures. Congenital renal arteriovenous malformations (CRAVMs) are extremely rare (estimated prevalence, 0.04%)[2] and are classified as cirsoid or aneurysmal. Cirsoid CRAVM is characterised by a tangle of dilated and tortuous arteriovenous communications, a so-called vascular nidus, supplied by multiple arteries. Aneurysmal CRAVM, also termed idiopathic or cavernous CRAVM, usually presents as an

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arteriovenous fistula with a single arterial feeder. CRAVM may be asymptomatic or associated with gross haematuria, hypertension, or cardiac failure.[3] The goal of treatment is to eradicate the vascular lesion completely, with maximal preservation of the renal parenchyma. Open surgery was the most common approach in the past; however, this is associated with a risk of injury to the renal parenchyma because of the peripelvic location of the vascular anomaly, which necessitates extensive branch artery dissection. Today, developments in endovascular techniques have rendered transarterial embolisation (TAE) the first-line treatment. As CRAVM is rare, only a few case series and case reports on TAE used to treat CRAVM have appeared. Therefore, the purpose of the present study was to review retrospectively the outcomes of patients undergoing TAE to treat CRAVM.

Materials and methods

Patient population

The medical records were searched retrospectively to identify patients who underwent TAE to treat CRAVM from January 2003 to August 2015 in Linkou Chang Gung Memorial Hospital. The institutional review board approved the review of patient medical data, including demographics, clinical presentations, and imaging findings. Informed consent was obtained from all patients prior to TAE. CRAVM diagnoses were based on clinical histories, computed tomography (CT), and angiography. No patient had a history of renal trauma, malignancy, inflammation, surgery, or any percutaneous procedure. Follow-up continued to the time of hospital discharge or the final documented outpatient visit; all follow-up durations were recorded.

TAE procedures

Nine radiologists with 3–20 years of experience in interventional radiology performed the TAE procedures. Arterial access was obtained through the common femoral artery under local or general anaesthesia. Diagnostic renal angiography was performed to delineate the CRAVM vasculature (Fig 1). Subsequently, an angiocatheter was advanced to a point as close to the feeding artery as possible, prior to embolisation, to maximally preserve the renal parenchyma. A wide variety of embolic agents were used individually or in combination; these included gelatin sponges, coils, trisacryl gelatin microspheres (Embospheres), absolute ethanol, N-butyl-2-cyanoacrylate (NBCA), and ethylene vinyl alcohol copolymer (Onyx). The choice of embolic agents was based on the characteristics of the vasculature, the catheter position that was attainable, the availability of embolic agents, and the physician's preference. Angiography was performed after embolisation to confirm successful occlusion. The number of TAE sessions per patient was recorded. Patient complaints made during TAE sessions were reviewed.

Outcome assessment

Outcomes assessed after the final TAE session included complete or partial obliteration, clinical success, renal function changes, and relapse of symptoms or signs. Partial obliteration was defined as a $<$90% reduction in CRAVM volume. Clinical success was defined as the absence of any requirement for further intervention or surgery, as evidenced by the resolution of the initial presentations (e.g., gross haematuria) or an absence of residual CRAVM on post-TAE images. Complications developing during each TAE session were classified using the definitions of the Society of Interventional Radiology.[4] Major complications included those creating an unplanned need for more care, prolonged hospitalisation, permanent adverse sequelae, or death. Minor complications included those that had no sequelae and required only nominal observation or a short hospital stay.

To assess changes in renal function, the serum creatinine (SCr) level was recorded, and the estimated glomerular filtration rate (eGFR) was calculated using the Modification of Diet in Renal Disease (MDRD) formula.[5] The pre-TAE SCr level was the latest value obtained before the first TAE. The post-TAE SCr level was the first value obtained at least 1 month after the last TAE. SCr levels recorded within 1 month after the last TAE were excluded from consideration, to avoid any possible confounding effect of obstructive uropathy following haematuria and reversible contrast-induced nephropathy. Relapse during follow-up was recorded in terms of symptoms and signs.

Statistical analysis

All statistical analyses were performed using Statistical Analysis System (SAS) software (ver. 9.3). Descriptive values for categorical and continuous variables are presented as numbers with percentages and as medians with interquartile range (IQR), respectively. The Wilcoxon signed-rank sum test was used for two-tailed comparison of SCr and eGFR levels before and after TAE. The level of statistical significance was set at $p<0.05$.

Results

Patient characteristics

The demographics, TAE characteristics, and outcomes of the 16 patients are summarised in Table 1. Over the 12-year period, 16 patients (nine male, seven female; median age, 47 years; IQR: 35–62.5 years) underwent 21 TAE procedures to treat 16 CRAVMs. The median follow-up period after the final TAE was 398.5 days (IQR: 52.5–1,716.5 days). One patient had only one kidney because of a history of nephrectomy to treat renal cell carcinoma. The most common clinical presentation was haematuria (81.3%); 11 cases of gross haematuria and two of microscopic haematuria. Other symptoms included flank pain in five patients (31.3%), acute urinary retention in four (25%), and hypertension in three (18.8%). Three patients (18.8%) were asymptomatic and no patient exhibited cardiac failure. TAE was performed on

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