The Use of n-Butyl-2 Cyanoacrylate as an Embolic Agent in the Minimally Invasive Treatment of Renal Arteriovenous Malformations

Dear Editor,

Renal arteriovenous malformations (AVMs) are uncommon congenital lesions consisting of abnormal communications between the renal artery and the renal vein via a vascular nidus. Renal AVMs can be classified as cirsoid, angiomatous or aneurysmal.[1]

Cirsoid lesions are often large with multiple feeder vessels. Angiomatous lesions are smaller with one vessel feeding multiple interconnected distal branches and veins. Less often, large lesions can present as aneurysmal AVMs, where single feeding vessels are shown to be calcified and associated with renal artery aneurysmal disease.[1] The aneurysmal AVMs more commonly produce cardiovascular signs and symptoms such as hypertension, while the other types tend to present with gross haematuria. The indications for intervention are haematuria, hypertension, heart failure and rupture.

Treatment of renal AVMs can be performed by either surgery or embolisation. Transcatheter embolisation is minimally invasive, has fewer complications than surgery and is currently the preferred treatment for renal AVMs.[1-3] While several embolic materials can be used, tissue glue (n-Butyl-2 cyanoacrylate) is optimal in treating renal AVMs because of its high curative potential.[2]

We reviewed 6 patients who underwent embolisation with tissue glue for the treatment of renal AVMs. To the best of our knowledge, this report represents the largest case series of patients with renal AVMs treated by tissue glue to date.

Materials and Methods

This is a retrospective study spanning 9 years from January 1998 to December 2006. Approval of our institutional review board was obtained. There were 2 male and 4 female patients with mean age of 48 years (range, 29 to 64 years). Diagnosis was established for these renal AVMs via ultrasound in 2, computed tomography in 3 and angiography in one.

For the intervention, a flush abdominal aortogram was first performed, followed by selective and superselective angiograms to delineate the anatomy of the lesion. Embolisation was then performed superselectively via microcatheters using a mixture of tissue glue and lipiodol, a radio-opaque oil-based contrast agent that can alter the viscosity and polymerisation time of tissue glue based on the percentage of dilution.[2]

Based on pre- and post-embolisation angiograms, the proportion of AVM nidus obliterated and parenchymal loss of the treated kidney were estimated, performed with simple eyeballing by an experienced radiologist. The patients were followed-up clinically for recurrence of symptoms, and by imaging when necessary.

Results

Five of the 6 patients presented with macroscopic haematuria, one of whom had loin pain and acute urinary retention due to blood clots. The remaining patient was diagnosed after investigation for asymptomatic microscopic haematuria. Two of the 6 lesions were aneurysmal AVMs. The rest of the lesions were of the cirsoid type, with one having up to 6 feeder vessels. The results of treatment are summarised in Table 1.

The proportion of the AVM nidus occluded after embolisation ranged from 50% to 100%. Five patients required only 1 session of embolisation while 1 patient required 2 injection sessions due to the complex cirsoid AVM configuration. Renal parenchymal loss ranged from 0% to 30%.

Post-procedure follow-up spanned a mean of 68 months. Till date, only 1 patient developed recurrence of macroscopic haematuria, 41 months post-procedure. This was subsequently treated with embolisation using alcohol-lipiodol as the feeding arteries were very small in calibre, precluding safe delivery of tissue glue-lipiodol.

Discussion

Embolisation has become the treatment of choice for symptomatic renal AVMs.[1-3] Liquid embolic agents like tissue glue are preferred as they can penetrate and obliterate the AVM nidus. However, embolisation using liquid agents is technically challenging due to variations in configuration and flow rate of renal AVMs.

Table 1: Procedure and Follow-up Results

Patient	AVM nidus obliterated (%)	Parenchymal sacrifice (%)	Follow-up duration (Months)	Recurrence	Follow-up remarks
A	70	0	21	No	
B	100	10	112	No	Ultrasound 5 years post-embolisation showed complete AVM occlusion.
C	50 (after 2 sessions)	20	42	Yes, after 41 months post-embolisation	Presented with recurrence of haematuria, successfully treated with alcohol-lipidol embolisation
D	100	0	150	No	Ultrasound 12 years post-embolisation showed complete AVM occlusion
E	100	30	69	No	
F	60	0	12.2	No	

AVM: Arteriovenous malformation

We individualise every embolisation procedure by organising several pre-embolisation rehearsed injections using iodinated contrast and saline. This provides first-hand knowledge of the flow rate and dynamics of the AVM. It is only then that embolisation with tissue glue is performed. This technique resulted in no discernable distant non-target embolisation in all 6 patients. Renal parenchymal loss within the treated kidney was negligible in 3 patients, and ranged between 10% to 30% in the other 3 patients.

Alcohol has also been used as an embolic agent to treat renal AVMs.[4] However, complete embolisation is difficult to achieve with studies showing increased infarction of renal parenchyma and systemic effects due to distant non-target embolisation.[2,4,5] The use of alcohol is also more challenging in AVMs where there is high flow across the arteriovenous shunt.[3] On the other hand, tissue glue provides for better control even when delivered through a high flow shunt.

When delivered superselectively, tissue glue can form a mould within the nidus of the AVM, thus having high curative potential.[2] The only other embolic agent with a similar property is Onyx (ethylene vinyl alcohol). Onyx is radiopaque, non-adhesive and is more predictable than tissue glue as it comes in a range of liquid viscosities.[3] However, its biggest limitation is its high cost.

We did treat a patient with asymptomatic microscopic haematuria as he was uncomfortable with conservative management. It is notable that his microscopic haematuria resolved after embolisation. However, our preferred approach is to manage an asymptomatic patient conservatively.

During follow-up, we recorded no symptom recurrence in 5 patients. One patient, in whom only partial embolisation (50%) could be achieved, developed recurrence of macroscopic haematuria after more than 3 years. This was treated successfully with repeat embolisation.

Comparatively, Takebayashi et al[5] described a total of 30 patients with renal AVMs who underwent embolisation with a variety of particulate and liquid embolic agents. Our results are in keeping with Takebayashi's report of recurrence of symptoms in 13% of his patients. This recurrence rate is acceptable considering the ability of renal preservation and the minimally invasive nature of the technique, which allows for repeat embolisation if necessary.

Conclusion

Tissue glue is one of the embolic agents of choice used in the treatment of renal AVMs. In our case series of 6 patients, we have shown good long-term outcomes with maximal preservation of renal parenchyma. The individualised rehearsed pre-embolisation injections are useful in reducing the risk of non-target organ embolisation.

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