Embolization with absolute ethanol injection of insufficiently ligated renal artery after open nephrectomy

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ABSTRACT
A 54-year-old woman was admitted to hospital for hypotension and anemia which was due to intermittent hemorrhage from a lumbar drain. She had undergone open nephrectomy ten days earlier in another hospital for the right dysfunctional kidney with staghorn calculi. Ultrasound in our hospital showed a right retroperitoneal hematoma. Surgical exploration was performed twice whereby the hematoma was partially eliminated; however, the point of bleeding was not identified. Repeated attacks of bleeding from the drain accompanied by acute pain made the hypotension with tachycardia even worse, which led to a life-threatening hemorrhagic shock. Extravasation from the insufficiently ligated right renal artery was then shown on computed tomography arteriography. After selective catheterization of this arterial stump with a mixture of alcohol and contrast media, complete occlusion of the remaining part of the resected renal artery was achieved. Application of absolute alcohol, though risky, proved to be a quick and efficient alternative method of occlusion of the bleeding renal arterial stump.

Key words: • nephrectomy • renal artery • therapeutic embolization • absolute alcohol

Retroperitoneal hematoma occurs spontaneously or as a consequence of blunt trauma, penetrating and puncture wounds, or as a complication of open, laparoscopic or percutaneous procedures. Kidney or posterior abdominal wall vessel lesions may be in the form of pseudoaneurysms, arteriovenous shunts, or active extravasations. Bleeding from a lacerated main renal artery occurs with blunt or open kidney trauma of the highest grade but rarely is the consequence of open surgery (1). Bleeding complications due to lesions of the lumbar artery, deep circumflex iliac artery and iliac-lumbar artery are reported in 3.7% of cases after different laparoscopic operations (2). As to the percutaneous renal methods, most of the bleeding occurs after percutaneous nephrolithotomy (3). Stone size is the only significant factor in predicting the occurrence of such vascular lesions (4). Analysis of the overall incidence of iatrogenic vascular lesions reveals percutaneous biopsy as the most common; however, such lesions are mainly less extensive and organ limited (3). Treatment options for hemorrhagic intrarenal and extrarenal vascular lesions include observation, transcatheter arterial embolization (TAE) and surgical procedures. According to Dinkel et al., patients are divided into two broad groups: those with arteriovenous (AV) fistulas, pseudoaneurysms and no signs of vital parameter impairment, and patients with hemodynamic instability that is usually treated surgically (1). In the second group of the vitally threatened patients, TAE, rather than surgery, is recommended as the first therapy option because it can assure circulation stability with lower mortality and morbidity rates than can surgical procedures (1).

The advent of co-axial microcatheter systems and the increased number of embolic agents available allow selective blockade at different levels of the arterial bed (5). Choice of the embolic agent depends on the size of the blood vessel, the organ that is to be embolized, the diameter of the catheter, which enables distal catheterization, and whether permanent, temporary or repeated embolization is necessary. To the best of our knowledge, there is no previously published report about transcatheter embolization of the bleeding renal artery with absolute alcohol.

Case report
A 54-year-old woman had undergone open nephrectomy for staghorn calculi in the non-functional right kidney ten days before she was admitted to our hospital. The patient had hypotension, tachycardia and severe anemia due to intermittent hemorrhage from a lumbar drain. During the early postoperative period the output with hemorrhagic content from the drain averaged 300 mL/day with abrupt episodes of heavy bleeding on the sixth and ninth postoperative days. Ultrasonography revealed a right retroperitoneal hematoma measuring 18 cm in cranial-caudal diameter and 14 cm in anterior-posterior di-
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The insufficiently ligated right renal artery was the cause of bleeding (Fig. 2). In order to induce endothelium husking with lumen thrombosis, 4 mL of absolute ethanol was injected manually into the remaining part of the right renal artery by means of selective catheterization. The catheter used in the process was a 7 F, visceral double curve type (Johnson and Johnson, The Netherlands), which was placed in the “wedge” position at the point of the partial artery ligation. The contrast media (Iopromid 370, Schering AG, Germany) was mixed with alcohol in the proportion of 1:1 to make the radioscopic monitoring possible (Fig. 3). The patient, who was sedated with analgesics, was constantly monitored, which included tension, pulse and electrocardiography checkups. Immediately after the alcohol administration, blood pressure rose to 150/80 mmHg and heart beat decreased to 72 beats/min. Technical success of the procedure was documented by “flash” aortography (Fig. 4). The patient received wide-spectrum antibiotics before, during and for 7 days following the procedure. In order to correct the existing anemia, transfusions of blood and its products were regularly administered. The blood parameters changed as follows: hemoglobin 84 g/L to 106 g/L, red blood cell 2.21 x 10^{12}/L to 3.29 x 10^{12}/L; and platelets rose to 525 x
There were no signs of infection. The drain exudation decreased to 50 mL/24 hours on the seventh day after the embolization, when the patient, fully recovered, was discharged. Control ultrasonography demonstrated a residual retroperitoneal hematoma measuring 2.3 x 4.0 cm. Output, dark brown in color, from the drain continued for the next two months at the rate of 10–20 mL per day, without any signs of infection.

Control spiral CT with 3D volumetric analysis, six months after the embolization procedure, revealed fibrous scar tissue in the right renal fossa (Fig. 5). CT aortography (90 mL of contrast medium plus 50 mL of saline at the rate of 4 mL/s) clearly depicted the occluded lumen of the right renal artery (Fig. 6).

Discussion

Coils, glue, gelfoam and polyvinyl alcohol are the most widely utilized embolic agents for the management of renal and perirenal bleeding (6, 7). Microspheres, detachable balloons, ethiodized oil, autologous materials, hot contrast media are rarely employed embolic agents. The majority of vascular lesions are organ limited or of minor degree and in such cases TAE usually combines the use of liquids or particles for capillary embolization and coils for larger vessel occlusion. Some authors claim that the use of microcoils alone is sufficient in majority of the cases (8). Retroperitoneal hematomas, intrarenal pseudoaneurysms and arteriovenous fistulas, which may occur after nephron-sparing surgery, have been dealt with by means of coils except in one case where coils were combined with particles of PVA for distal embolization (9). In cases of intrarenal hematoma with pseudoaneurysms or/and arteriovenous fistula the combination of coils, gel foam and autologous blood clot was used (3, 10). Dinkel et al. reported a case with kidney avulsion treated with main renal artery TAE (1). One of the microcoils used in the process reportedly migrated into the lumbar artery in their case without significant consequences. That is why they suggested the use of delivery devices with the possibility of coils’ repositioning. Nevertheless, such delivery devices’ high cost makes them practically inaccessible (1). In circumstances when dense coil packing within the lumen is impossible or inadequate, mechanical occlusion of the vessel lumen mostly relies upon the coil-induced thrombosis, necessitating time to form.

A few different kinds of liquids, known as tissue sealants or glues, are used as permanent embolic materials in the management of AV malformations, AV fistulas and vessel injuries. These glues, either synthetic (cyanoacrylates) or biological (fibrin, collagen-based, glutaraldehyde-based), rapidly polymerize and harden when contacted with blood, thus enabling the mechanical vessel lumen occlusion (11). N-butyl-2-cyanoacrylate (NBCA) was employed as the only embolic agent in a group of patients with acute arterial hemorrhage from varied etiologies and at varied anatomic sites. NBCA embolization successfully stopped the bleeding in 75% of cases, while in almost a quarter of cases treatment failed because blood flow re-established (12). Report of another study mentions a 100% success rate for lumbar, renal and iliac artery injury embolization using coils and NBCA (13). Histopathological study performed in embolized and resected AV malformations (cerebral) showed that capillary recanalization was present in all the cases in which different kinds of tissue glue or particles were applied (14). The function of tissue sealants is mechanical and if the vessel-obstructive fibrosis does not occur the blood flow is not permanently prevented.

Absolute alcohol is a lasting and distal embolic agent, used mostly in preoperative and palliative management of renal cell cancer, although the opinion on its efficacy is not unanimous (15). Alone or in combination with particles and coils, alcohol was used in the treatment of bleeding angiomyolipomas (16). The alcohol embolotherapy proved effective in patients with uncontrolled nephrotic syndrome and, in patients with polycystic kidneys as well as in those with end-stage hydronephrosis (17–19). It is efficient in lowering proteinuria and systemic hypertension, shrinkage of cystic masses, and prevention of bleeding disorders.
The advantage as well as the main limitation of alcohol as an embolic agent refers to its low viscosity. In patients with AV shunts it is difficult to avoid the significant overflow into the venous circulation, therefore indicating alcohol embolization solely in terms of terminal type arteries. The application of an occlusive balloon catheter in the artery during alcohol injection prevents the other potential risk—alcohol's backflow into the aorta.

Active extravasations in our case occurred periodically. The huge, retroperitoneal hematoma encircling the blood vessel acted as a vent, which would open after a larger output through the lumbar drain or after the surgical hematoma evacuation. CT aortography enabled its visualization and the control of its injection. Transcatheter embolization of the bleeding renal artery with absolute alcohol proved to be a life-saving procedure, alternative to coil embolization and surgical hemostasis.

Since the renal artery lumen was narrow enough due to the incomplete ligation in the presented case, it was possible to wedge the catheter tip to ensure complete lumen occlusion. The incomplete ligation by itself fixed the visceral 7 F catheter, thus occluding the artery lumen and preventing alcohol reflux. On the other hand, the presence of a short segment of the artery between the points of incomplete ligation ruled out the use of an occlusive balloon catheter. Mixing alcohol with contrast medium enabled its visualization and the control of its injection. In addition, the remaining part of the artery from the point of ligation to the point of resection was 5 mm—long enough to enable its shrinkage.

Absolute ethanol almost immediately led to the chipping of the intima and lumen thrombosis in our case. Technical success of the procedure was documented by flash aortography, while the medical success was manifested through vital parameters’ improvement. The vessel lumen occlusion was permanent, documented by CT follow-up 6 months after the intervention. Transcatheter embolization of the bleeding renal artery with absolute alcohol proved to be a life-saving procedure, alternative to coil embolization and surgical hemostasis.

References