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CASE REPORT

Massive retroperitoneal haemorrhage after extracorporeal shock wave lithotripsy (ESWL)

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Abstract A 76-year-old male suffering from nephrolithiasis developed a shock syndrome 5 days after extracorporal shock wave lithotripsy (ESWL). CT scan of the abdomen showed massive haemorrhage around the right kidney. Although nephrectomy was performed immediately, the haemorrhage could not be controlled. Numerous units of erythrocytes were transfused, but the patient died. The autopsy revealed massive retroperitoneal haemorrhage around the right kidney. The kidney showed a subcapsular haematoma and a rupture of the capsule. The right renal artery was dissected. The inferior vena cava was lacerated. Accordingly, a hemorrhagic shock as the cause of death was determined, which might mainly have resulted from the laceration of the inferior vena cava due to ESWL. ESWL seems to be a relatively non-invasive modality, but one of its severe complications is perirenal hematoma. The injuries of the blood vessels might have been caused by excessive shock waves. Subsequently, anticoagulation therapy had been resumed 3 days after EWSL, which might have triggered the haemorrhage. Physicians should note that a haemorrhage after an ESWL can occur and they should pay attention to the postoperative management in aged individuals especially when they are under anticoagulation therapy.

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Introduction

Extracorporal shock wave lithotripsy (ESWL) was first presented for the treatment of urinary lithiasis in Germany in the early 1980s [1]. ESWL has been currently recognised worldwide as the most common treatment because it can be easily used and is relatively non-invasive for patients; it has high efficiency not only in the treatment of kidney and ureter stones but also in the treatment of pancreatic stones [2–4]. ESWL, however, is not completely safe, and minor or major complications may be noted. Almost all complications of ESWL as pain, ureter obstructions, infections induced by the disruption of renal vessels or the destruction of infected calculi can be related to stone fragments and are regarded as not so severe. However, since ESWL acts on stones via cavitation, shear and spelling, resulting in stone fragmentation, these forces may lead to the injury of vessels in the kidney or adjacent tissues, and haemorrhagic complications such as haematuria and haematoma can follow [2, 5]. Dhar et al. [6] reported that subcapsular or perinephric haematomas developed in 4.1% of the patients after ESWL, and that the probability of this complication would increase in proportion to the increasing age of the patient, but in cases when the treatment of the haematomas was conservative, there were fewer clinical adverse effects [2]. Indeed, deaths following ESWL are rare events but would be caused by haemorrhagic complications.

Case report

Clinical history A 76-year-old man, who suffered from diabetes mellitus, hypertension and arteriosclerosis, had been admitted to hospital for the treatment of nephrolithiasis by ESWL. Because he had two myocardial infarctions about 10 years ago, a coronary artery bypass grafting had been done, and an artificial aortic valve was implanted. In the following days, he had taken 3-(l′-phenyl-propyl)-4-hydroxycoumarin (phenprocoumon, Marcumar®) but this treatment was stopped 2 weeks before the first ESWL and replaced by the injection of low molecular heparin. On the next day and on the 6th day after admission, he had been twice treated by ESWL. Complications were not observed. He left the hospital on the 8th day after admission. On the next day after discharge, the anticoagulation therapy had been resumed with Macumar® at the preoperative dose. On the 2nd day after discharge, however, he had complained of severe abdominal and back pain, and therefore he was admitted to the same hospital. The CT scan of the abdomen revealed a perirenal haematoma, for which the physicians had tried a conservative therapy with many transfusions. However, because the condition of the patient deteriorated, he was brought to another hospital for surgical treatment. In the surgical report it is documented that the right kidney showed a rupture of the capsule, subcapsular haemorrhage and massive haemorrhage around the right kidney. Therefore a nephrectomy had to be done 5 days after the second ESWL. Moreover, there were three small lacerations of the inferior vena cava at the right dorso-lateral region 3 cm beneath the junction of the right renal vein and the inferior vena cava, which had been sutured. The nephrectomy and the suture of the inferior vena cava had succeeded in stopping the haemorrhage; however, the man died 20 min after the surgery. His family claimed that he died because of medical malpractice; therefore, a medico-legal autopsy was performed.

Autopsy findings The deceased was 177 cm tall and weighed 90 kg (body mass index (BMI)=28.7). There was weak postmortem lividity on the back. No significant injury was found except for a longitudinal incision for nephrectomy on the middle of the abdomen. Additionally, there were some operative scars on both the chest and the abdomen. In the abdominal cavity there were 300 ml of blood. The right kidney had been removed and a widely spread retroperitoneal haemorrhage around the position of the right kidney could be seen. Within this retroperitoneal haemorrhage, the adventitia of the right side of the inferior vena cava had been sutured surgically, and there were three small lacerations 2–3 cm below the right renal vein in the intima of the inferior vena cava (Fig. 1).

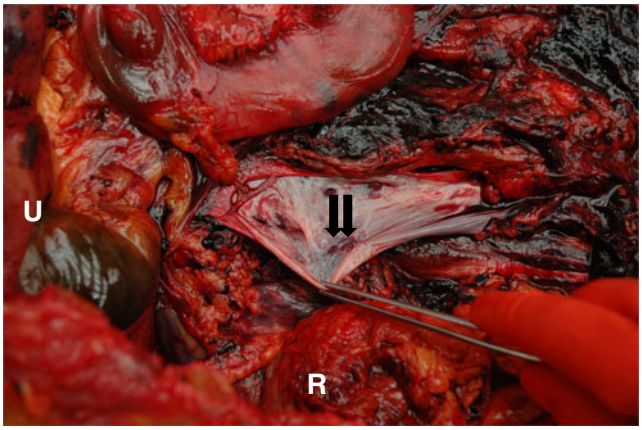
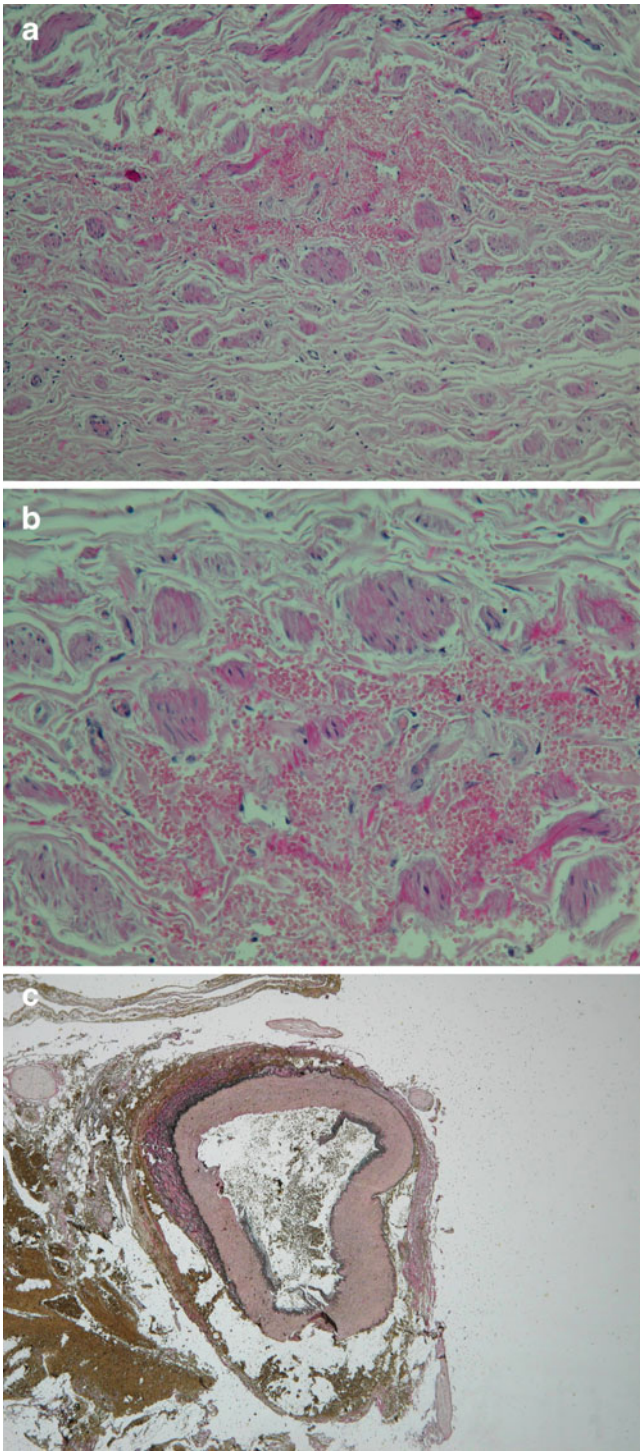


Fig. 1 Retroperitoneal haemorrhage around inferior vena cava after the right nephrectomy. Three small lacerations are observed on right-lateral side of the intima of inferior vena cava (*black arrows*). *U* upper side, *R* right side

The heart showed an eccentric cardiomyopathy (700 g), with adhesion to the pericardium. There was a severe stenosis of the main trunk of the left coronary artery of about 80% with calcification at the beginning, while coronary calcification was diffusely observed in the other coronary arteries. There were two grafts of coronary arteries from the beginning of the aortic arch to distal segments of the left anterior descending coronary artery and the right coronary artery, respectively. In the entire myocardium, many small scars were observed. The aortic valve had been replaced by an artificial valve. The aorta showed severe atherosclerosis with diffuse calcification and ulceration. Arteriosclerosis was detected diffusely in the cerebral arteries which had caused many lacunar infarctions in bilateral basal ganglions.

As consequence of severe haemorrhage signs of shock, brain oedema, anaemia of the liver, and congestion of the lungs were found (lung weights: left, 800; right, 680 g). The left kidney weighed 160 g, in which the surface was rough and the cross-section surface showed the appearance of a shock organ.

Histology In inferior vena cava, haemorrhage spread in media and mostly in adventitia, and in the right retroperitoneal adipose tissue, but Fe-staining negative. The longitudinal muscle bundles in the adventitia were driven apart and the erythrocytes were washed out with beginning infiltration of some lymphocytes and macrophages (Fig. 2a, b). The right renal artery was dissected with inflammatory cells infiltration between media and adventitia, and the haemorrhage was circumferentially spread from ruptured adventitia, but was also negative by iron staining. Elastica van Gieson staining showed that the wall of the right renal artery was normal though both internal and external elastic lamina were dissected (Fig. 2c). The myocardium showed hypertrophy of myocytes, diffuse myocardial fibrosis, and infiltration of lymphocytes. Severe arteriolosclerosis was also observed diffusely in the myocardium, and little coronary arteries were severely stenosed. In the left kidney,



◀ **Fig. 2** Microscopic examination of inferior vena cava and right renal artery. **a** and **b** Haemorrhage spreads in the media and the adventitia of inferior vena cava with the infiltration of lymphocytes and macrophages. The longitudinal muscle bundles in the adventitia are driven apart and the erythrocytes are washed out. However, this haemorrhage is negative by iron staining (a, HE×100; b, ×200). **c** Right renal artery is dissected between the media and the adventitia with haemorrhage and inflammatory infiltration, which is also negative by iron staining. Both internal and external elastic laminas are multilayered, but component shows normal (Elastica van Gieson×40)

severe arteriolosclerosis and hyalinization of glomeruli were diffusely observed with interstitial inflammatory infiltration. Some membranes of the glomeruli were hyperplastic, which was considered to be due to diabetic nephropathy. The lumen of the proximal renal tubule was diffusely dilated, but it was difficult to differentiate between autolysis and acute tubular necrosis due to haemorrhagic shock. Both of the lungs showed an emphysema and slight bronchitis and pneumonia.

Toxicology Blood alcohol concentration: 0.00 mg/g. No drugs were detected.

Legal outcome According to the opinion of forensic expert, the removal of the kidney stones was indicated, the disclosure of possible risks was sufficient and the ESWL was the right mean of choice. The fatal bleeding was regarded as a typical complication of ESWL. However, there were reproaches from the side of the family concerning the use of an old device for the ESWL and that the transport of the patient to the emergency operation to stop the bleeding had belated. But the survival of the patient was questioned due to the pre-existing diseases if the operation had been done in time. The prosecution was abandoned against the payment of a fine of 5,000 euro.

Discussion

One of the most severe complications related to ESWL is renal hematoma. There have been two reports that patients had died of renal haemorrhage after ESWL. In one case, the patient had died of the rupture of a small vein in the perirenal adipose capsule 23 h after ESWL [7]. In the other case, the intraparenchymal haemorrhage of the kidney and the rupture of the renal capsule was the cause of death 11 h after ESWL [8]. In our case, the patient had no complaints for 2 days, after the second ESWL to discharge of the hospital at least. Nevertheless, surgical treatment was necessary 5 days after ESWL and revealed subcapsular haemorrhage, rupture of the capsule of the right kidney, and laceration of the inferior vena cava. There were no injuries externally and internally except for medical interventions, so it is likely that these injuries had been caused by ESWL. On the other hand, the man had resumed taking phenprocoumon as anticoagulative therapy 3 days after the second ESWL, but which was rather late considering ESWL [9]. On the next day, however, he had complained of severe abdominal and back pain. Bleeding is the primary complication of anticoagulation therapy, even when the international normalised ratio (INR)

would be maintained within therapeutic ranges [10]. Hylek et al. [11] reported that major haemorrhage had occurred within 2 weeks in 4.4% of the patients whose INRs had been lower than 6.0, in anticoagulation therapy used by warfarin. Moreover, because the sensitivity of warfarin might alter after surgery [12], INR should be measured after the resumption of anticoagulation therapy. At any rate, since the ageing of the retroperitoneal haemorrhage might be estimated at a few days from the results of the histological examinations [13–16], the anticoagulation therapy resumed after the ESWL might have affected the massive haemorrhage from the injuries of the right kidney and inferior vena cava caused by ESWL, although we could not investigate the right kidney because it could not be obtained from the hospital. In other words, it is likely that the injuries of the right kidney and inferior vena cava had been attributed to ESWL; however the bleeding had been slight before the resumption of anticoagulation therapy so that iron staining was negative. Then, the anticoagulation therapy might have reduced the clotting ability, resulting in massive retroperitoneal haemorrhage. Therefore, we decided that the cause of death had been haemorrhagic shock induced by ESWL and supported by the subsequent anticoagulation therapy.

Cases with injuries of the inferior vena cava lead to high mortality due to exsanguinations because it is difficult to immediately recognise injuries and then quickly control the haemorrhage [17]. The injuries of the inferior vena cava may be caused by penetrating injury, blunt force injury or medical treatment [17, 18]; however, as far as we know, there has never been a report that the inferior vena cava was injured by ESWL. Moreover, the right renal artery had been dissected in this case. Renal artery dissection commonly occurs as a consequence of abdominal aortic dissection, and an isolated renal artery dissection is very rare, and it may result from percutaneous angioplasty or blunt abdominal trauma in the condition of renal arteriosclerosis [19, 20]. Since the patient had suffered from diabetes mellitus and hypertension, he had been under the condition that renal artery dissection could have easily occurred. From the results of histological examination, the right renal artery dissection might have occurred at the same time as the retroperitoneal haemorrhage.

In this case, the second ESWL had been performed using 3,000 shockwaves at a rate of 100/min and an intensity of stage 4 of the maximum. This application was within the therapeutic range for older patients. Vella et al. [21] divided several variables effecting on the outcome of ESWL into three categories. As patient variables, the outcome of ESWL might tend to get worse in proportion to BMI of the patient. Additionally, ESWL is likely to fail in patients with more than 10 cm distance from skin to stone. As operator variables, adequate anaesthesia can prevent the patient from moving beyond necessity, resulting in the success of ESWL. In this case, the BMI of 28.7 might be a risk factor. According to the medical record, the patient had been treated against pain without anaesthesia during performing ESWL. Thus, one possibility is to assume that ESWL might have gone wide of the target due to both the obesity and the patient moving during ESWL.

In conclusion, we experienced the autopsy case where ESWL had caused not only subcapsular haemorrhage and the rupture of capsule in the right kidney but also the injury of inferior vena cava, leading to haemorrhagic shock. Although the subcapsular haemorrhage and the rupture of the capsule in the kidney alone could be caused by ESWL in aged individuals, the other complications in this case might have been prevented by careful postoperative checks. At any rate, physicians should notice that ESWL is not completely a safe modality, and they need deliberate managements before and after ESWL.

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