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Endovascular repair of renal artery aneurysm with the multilayer stent – a short report

Znotrajžilno zdravljenje anevrizme ledvične arterije z novo večslojno mrežasto žilno opornico – kratko poročilo

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Ključne besede:
anevrizma ledvične arterije, znotrajžilno zdravljenje, večplastna znotrajžilna opornica

Key words:
renal artery aneurysm, endovascular treatment, multilayer endovascular stent

Abstract

Background: Complex renal artery aneurysms (RAA) involving major branches of renal artery are difficult to treat. Surgery may be associated with extensive invasiveness and morbidity in the context of major intra-abdominal surgery. Stent-grafts or selective coil embolization are contra-indicated when large branches are involved in the aneurysmal sac. A case of the patient with complex renal artery aneurysm involving all major arterial branches treated with a new type of multilayer stent is described.

Case report: A 56-year old woman whose right kidney had been removed five years before because of renal cell carcinoma was incidentally found to have a large (22 x 26 mm) saccular aneurysm in the main left renal artery involving all three major branches of the renal artery. Via a percutaneous femoral approach a multilayer stent was deployed without complications. Blood flow inside the sac was immediately and significantly reduced. All the renal branches remained patent.

Conclusion: New multilayer fluid modulating stent concept appears to be a very useful and attractive alternative to surgery or other endovascular techniques for those RAA involving or very close to major branch vessels, especially in patients with very high risk of loosing the only viable kidney, as in our case.

Razširjen povzetek

Uvod: Anevrizme ledvične arterije so redke. Pojavljajo se v približno enem odstotku vseh klinično ugotovljenih anevrizem. Običajno so asimptomatske in praviloma jih odkrijemo po naključju. Indikacije o zdravljenju so protislovne. Večina zdravnikov se strinja, da je invazivno zdravljenje smiselno, ko anevrizma po premeru preseže dva centimetra, s čimer narašča tveganje za razpok, trombozo ali disekcijo. Zdravimo jih lahko kirurško ali znotrajžilno. Poseben primer so zapletene anevrizme ledvične arterije, ki zajemajo področje razcepišča poglavitnih vej za parenhim. Znotrajžilno zdravljenje z oplaščenimi opornicami ali z embolizacijo pri takih anevrizmah ni možno. Kirurško zdravljenje pa je tvegano in povezano z večjo pojavnostjo zapletov. Prikazan je primer bolnice z eno samo ledvico, ki je imela zapleteno anevrizmo leve ledvične arterije. Uporabili smo novo vrsto znotrajžilne opornice. Gre za posebno opornico, sestavljeno iz več slojev pletene mreže in brez zunanjega plašča. Posebnost opornice je njena zmožnost, da ohrani pretok krvi v tistih vejah arterije, ki jih prekrije, hkrati pa povzroči trombozo anevrizme.

Prikaz primera: Oseminpetdesetletna bolnica je bila napotena iz druge ustanove, kjer je bila na običajnem kontrolnem pregledu trebušne votline z ultrazvokom. Kontrolne preglede so ji opravljali enkrat letno, saj so ji pred petimi leti odstranili desno ledvico zaradi ledvičnega karcinoma. Med pregledom so našli veliko anevrizmo v hilusu leve ledvične arterije. Napravljena je

Citirajte kot/Cite as:
Zdrav Vestn 2012;
81: 753–8

Prispelo: 7. dec. 2011,
Sprejeto: 7. mar. 2012

bila CT preiskava s kontrastom, ki je ultrazvočni izvid potrdila. Najdena je bila velika anevrizma (22 x 26 mm) na razcepišču glavne veje leve ledvične arterije. Iz anevrizme so izhajale tri veje za ledvični parenhim. Zdravljenje z oplaščeno znotrajžilno opornico ni bilo možno. Prav tako ni bila možna embolizacija. Kirurški poseg je bil ocenjen kot tvegan predvsem zaradi zarastlin po prvi operaciji. Bolnici smo predstavili vse možnosti zdravljenja, tudi možnost z vstavitvijo nove vrste večslojne mrežaste žilne opornice. Privolila je v vstavitev nove vrste opornice. Tri dni pred posegom je pričela dobivati klopidrogel (75mg/dan). Poseg je bil opravljen v lokalni omami skozi desno skupno stegensko arterijo. Med in po posegu ni bilo zapletov. Opornica je anevrizmo izključila iz krvotoka in pri tem ohranila odprte vse arterijske veje za parenhim. Bolnica je bila iz bolnišnice odpuščena dan po posegu. Mesec in šest mesecev po posegu kontrolna CT preiskava kaže popolno izključitev anevrizme iz krvotoka, laboratorijske preiskave pa kažejo normalno ledvično funkcijo.

Zaključek: Nova vrsta mrežaste večslojne žilne opornice, ki lahko ohrani prehodne tudi tise arterijske veje, ki jih prekriva, je videti izvrstna alternativa kirurškemu zdravljenju zapletenih anevrizem ledvične arterije, še posebej v primerih, ko je tveganje invazivnega zdravljena visoko, tako kot pri predstavljeni bolnici z eno samo ledvico.

Introduction

Renal artery aneurysms (RAA) are relatively rare occurrence in contemporary clinical practice. They have an estimated incidence from 01–1 %,[1,2] although the trend for more widespread investigation of the renal arteries with noninvasive methods has in some series resulted in an incidence up to 10 %.[3,4] In most cases the clinical relevance of the aneurysm is uncertain, as patients have no symptoms directly related to the aneurysm. Some patients may present with arterial hypertension, renal ischemia, hematuria, or flank pain, but the cause-and effect relationship is hard to establish.[4-6] The natural history of RAA is poorly documented.[2,3] RAA are usually incidentally detected in patients during various diagnostic procedures. Although rupture is not common, the risk of RAA rupture is significantly increased in pregnancy and polyarteritis nodosa (PAN) and is also related to the aneurysm size.[6,7] The accepted indications for RAA treatment include symptomatic patients, women who are pregnant, or those contemplating pregnancy, PAN, and enlarging lesions.[4,8,9] Most physicians would advocate invasive treatment when the aneurysm is larger than 2 cm or causing renal compromise.[4,5] Treatment of RAA involves surgical repair and endovascular techniques, depending on the size of RAA, morphologic characteristics of aneurysm and its location along the renal artery.[4-7] Endovascular treatment of renal artery aneurysms was initially introduced for patients at a high risk with significant comorbidities or aneurysms of parenchymal branches with difficult surgical access. Yet, the high technical success with low procedural morbidity and mortality rates has made this approach the treatment of choice for most RAA in many centers.[10,11] However, for complex RAA located at the renal artery bifurcation, and for those involving distal branches, open surgical repair by *in situ* or *ex vivo* repair respectively, was suggested to be the gold standard of treatment.[5,8,9,12] But a new type of multilayer self-expanding stent technology has been developed that may offer an endovascular alternative in complex RAA where stent-grafts or embolotherapy could not be applied.[13] Stent-grafts are contraindicated when large branches must be covered, such as in our patient. The fluid modulating multilayer stent is a new technology that allows treatment of RAA without the risk of branch occlusion or renal infarction.[13]

Case presentation

A 56-year old woman was referred from another hospital. Her right kidney had been removed because of renal carcinoma five years before. During regular follow-up examination with ultrasound a large left renal artery aneurysm was detected. Ultrasound showed slightly enlarged left kidney with normal shape, no signs of hydronephrosis

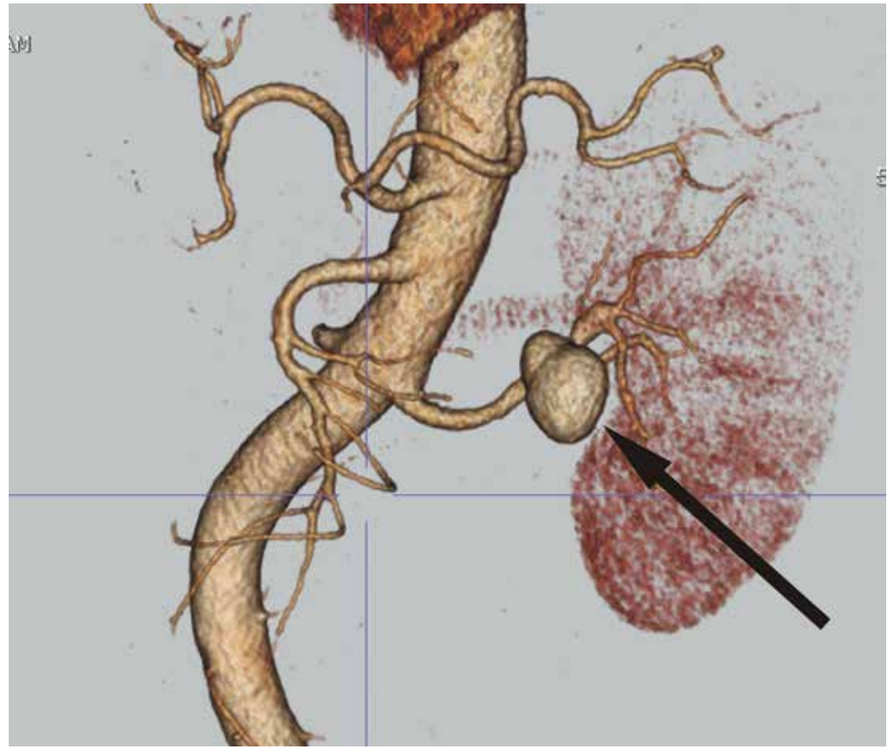

Figure 1: 3D CTA reconstruction of the abdominal aorta and left renal artery before endovascular treatment. The right renal artery is absent after removal of the right kidney years ago because of renal cell carcinoma. Arrow is denoting the aneurysm of the left renal artery.

and normal echotexture. Interlobar artery resistance index was below 0.7. On admission, the patient was asymptomatic. She was taking medications for high blood pressure for five years (angiotensin-converting enzyme inhibitor ramipril and diuretic hydrochlorothiazide). Her average blood pressure during hospital stay before invasive treatment was 160/100 mmHg. Her serum urea and creatinine levels were normal. Her glomerular filtration rate calculated by MDRD equation was 71 ml/min.[14] The urine test showed no blood, protein or bacteria in her urine. CTA examination confirmed a large saccular aneurysm of the left hilum of the kidney (Fig. 1). On digital subtraction angiography the aneurysm measured 2.3 x 2.7 cm (Fig. 2). Three large terminal branches were involved in the aneurysm, which precluded the use of stent-graft or coils (Fig. 1 and 2). Surgical procedure was considered to be associated with high risks due to adhesions from the previous surgery. The option of an endovascular procedure with a new stent was explained to the patient, who consented to the procedure. Three days prior to procedure the patient started taking clopidogrel (75 mg/dl).

Under local anesthesia, the right common femoral artery was catheterized and 5000 units of heparin were given intra-arterially. The left renal artery was selectively catheterized with a 7čF RDC guiding catheter (Cordis, Warren, NJ, USA). An angiogram confirmed the size and location of the aneurysm. A stiff 0.018-inch guidewire (Boston Scientific, Natick, MA, USA) was placed in the left renal artery. Over this wire, a 6x30 mm Multilayer stent (Cardiatis, Isnes, Belgium) protected by a 6-F delivery catheter was advanced and easily deployed across the neck of aneurysm, covering the main renal artery trunk and medium renal artery. All the branches remained intact (Fig. 3). The patient was discharged the next day with instruction to continue taking clopidogrel for 1 month and the acetylsalicylic acid indefinitely. At discharge, the patient's renal function was normal. Her glomerular filtration rate calculated by MDRD equation was

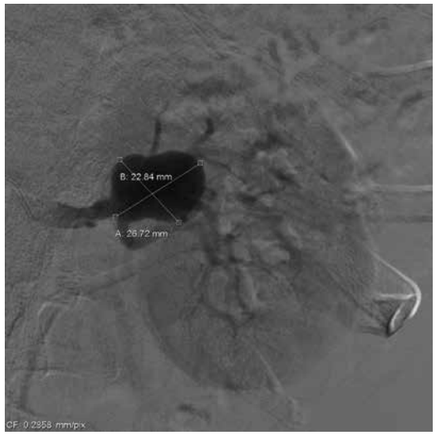

Figure 2: Digital subtraction angiography of the left renal artery. Renal artery aneurysm measures 22 x 26 mm along its long axes.

83 ml/min. The urine test showed no blood, protein or bacteria in her urine.

After one month, the control CTA showed shrinkage of the aneurysmal sac. All major renal artery branches remained patent (Fig. 4). The patient remained in excellent condition, with normal blood pressure (130/60 mmHg) and renal function and no anthypertensive medication.

Discussion

There is controversy regarding the indications for repair of RAA, but may include risk of rupture, rapid growth, hypertension, hematuria, dissection and symptomatic disease.[4,5,8-11] Our patient met multiple indications for repair of her renal artery aneurysm. She was hypertonic and it was considered that there was a significant risk for rupture. Primarily, the patient was left with only one viable kidney and the diameter of aneurysm exceeded two centimeters. The risk of loosing the remaining kidney due to rupture of RAA could not be neglected. The second indication for repair was blood pressure control.[5] Henke and coworkers suggested that patients who had successful repair of aneurysm had improved blood pressure control compared to controls.

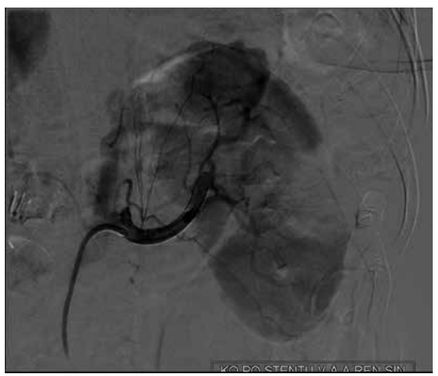

Figure 3: Angiography immediately after new multilayer endovascular stent placement. Aneurysm is excluded from the blood flow and all distal branches are patent.

For complex RAA located at the renal artery bifurcation, such as in our patient, and for those involving distal branches, open surgical repair by *in situ* or *ex vivo* repair respectively, was suggested to be the gold standard of treatment.[5,8,9] However, the open surgical approach for complex RAA is associated with extensive invasiveness and morbidity due to major intra-abdominal surgery.[5] In complex lesions, intentional nephrectomy occurs in up to 20 % of cases and unplanned nephrectomy in 5 % of cases.[9] In an effort to reduce invasiveness and morbidity associated with open surgical RAA repair, the laparoscopic and robot-assisted laparoscopic approach has been proposed as a possible alternative.[8] Minimally invasive robot-assisted laparoscopic surgery has been applied recently in the field of vascular surgery to reduce operative trauma and to improve the technical limitations of classic laparoscopy.[8] However, even with robotic system the total operation time with patient under general anesthesia exceeds 300 minutes and during the procedure surgeon is not able to work without total warm renal ischemia thus increasing the risk of procedure.[8]

Among endovascular techniques, stents represent a possible alternative to surgical repair of visceral aneurysms because they allow for organ flow preservation with minimal tissue trauma and warm ischemia time.[4,10,11] The current use of stents was restricted to RAA involving the main renal artery trunk, with edges located at least 15 mm away from the renal bifurcation and renal ostium.[4,10,11,15] Stent-grafts, selective coil embolization, stent-assisted coiling or use of liquid embolic agents are contraindicated when large branches are involved in aneurismal sac, such as in our patient.[4,10,11]

The recent advent of a new type of stent offered a potential endovascular alternative to manage RAA involving one or more

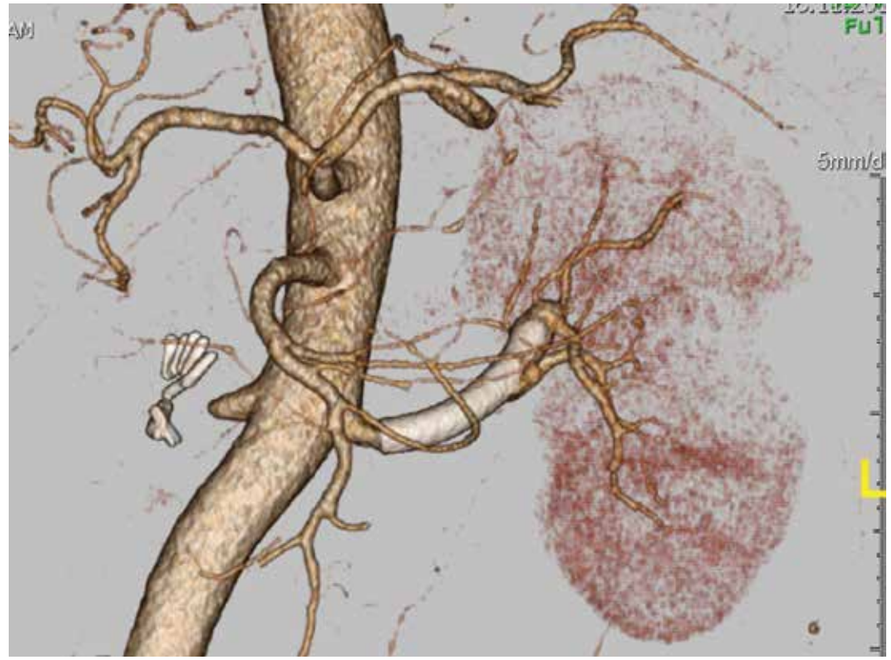

Figure 4: 3D CTA one month after multilayer stent placement. There is no blood leakage into the aneurismal sac and all renal branches are patent.

branching vessels.[13] The fluid modulating multilayer stent has been available in Europe since 2006, and the first successful use in humans was reported for popliteal aneurysm in 2007.[16] The main advantage of three dimensional multilayer stent is that it reduces flow velocity and vortex into the sac, while improving laminar flow in the main artery and the surrounding vital branches. Without collateral branch, the multilayer stent eliminates the damaging flow vortex pressure and redirects its flow along the wall in the same directions as the systemic pressure leading to a physiological organized thrombus. If there is collateral branch, the multilayer stent laminates the flow in the aneurysm and the branch, directs the flow to the branch, and thus increased flow in the branch leads to a progressive collapse of the aneurismal wall. One of the major advantages of the multilayer stent is suggested to be its effect on collateral branches. Placed in front of collateral branches, a multilayer stent laminates the flow in these collaterals and improves the inflow into collateral circulation, keeping different size collateral arteries patent. All of these characteristics may help to reduce the shear stress on the diseased arterial wall and increase the formation of an organized thrombus in aneurismal sac.[13,16]

Tests on animals have shown a significant difference in the flow to collaterals before and after implanting a multilayer stent. Better flow circulation in the branches was observed after a multilayer stent had been placed. All explants after one month showed that flow in the collaterals was maintained regardless of the size of the branch.[13] This sustained permeability is associated with the fact that the multilayer stent, unlike classical stents, becomes lined with endothelium except in the area of collaterals.[13]

To date only few cases of renal or visceral aneurysms treated with this new stent have been reported. Henry and coworkers first reported successful exclusion of a large renal artery aneurysm and also suggested its application for peripheral aneurysms.[13] Baldieri and coworkers excluded a large hepatic aneurysm and Carrafiello and coworkers successfully treated a patient with celiac trunk aneurysm.[16,17]

To date Henry and coworkers have treated more than 32 patients with new multilayer stent.[18] There were no short- and medium-term complications. In 30-month follow up all the side branches remained patent. All aneurysms thrombosed with diameter reduction in some patients.[18]

Conclusion

A new concept of stent, the multilayer stent without any covering was developed to treat aneurysms. First midterm results show that this new technology could be a very useful and attractive alternative to surgery or other endovascular techniques for those RAA involving or situated very close to major branch vessels, especially in patients with very high risk of loosing the only viable kidney, as in our case.

Conflict of interests

Michel Henry is consultant for Cardiatis, producer of new multilayer stents. The other authors have no commercial, proprietary, or financial interest in any products connected with Cardiatis.

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In memoriam

prim. Marjan Veber, dr. med.

(1924–2012)

V aprilu 2012 je primarij Marjan Veber, dr. med., specialist šolske higiene dopolnil 88 let. V avgustu 2012, v času šolskih počitnic, pa je ugasnilo življenje enega prvih šolskih zdravnikov v Sloveniji.

Rojen je bil v Celju, kjer je tudi zaključil osnovno šolo in gimnazijo. Druga svetovna vojna je za nekaj časa prekinila primarijevo študijsko pot. Po končani vojni leta 1945 se je vpisal na Medicinsko fakulteto v Ljubljani in jo leta 1951 zaključil.

Kot zdravnik ja začel službeno pot v bolnišnici Celje na internem oddelku in na pediatriji. Od leta 1953 dalje pa je svoje delo, znanje in izkušnje posvetil šolskim otrokom in mladostnikom. Mnogo let kasneje je večkrat v pogovorih poudaril, da se nikoli ne bi odločil kako drugače kot za pot šolskega zdravnika.

Od vsega začetka svojega dela kot šolski zdravnik je sodeloval s Službo za zdravstveno varstvo šolskih otrok in mladine na Republiškem zavodu za zdravstveno varstvo (sedanjem Inštitutu za varovanje zdravja RS). Bil je dejaven član Republiškega strokovnega kolegija za šolsko medicino od njegove ustanovitve. Aktivno je sodeloval na kongresih, tudi na 1. slovenskem kongresu sekcije za šolsko in visokošolsko medicino leta 1994, na strokovnih srečanjih Sekcije za šolsko in visokošolsko medicine pri SZD.

Vedno je imel vodilno vlogo na področju zdravstvenega varstva otrok in mladostnikov na celjskem področju. Uvedel je preventivne ambulante. V okvirju Dispanzerja za šolske otroke je vpeljal okulistično, ORL, ortopedsko in zobozdravstveno ambulanto. V tem obdobju so otroci in mladostniki imeli takojšen dostop do ustreznega zdravljenja pri specialistih. To dejstvo je vedno rad zapisal v svoja poročila in članke. Uvedel je sistematične preglede učencev šol v takratnem celjskem okraju. Vpeljal je terapevtsko telovadbo za otroke s težjimi anomalijami telesne drže in okvarami hrbtenice in telovadbo za astmatike. Prevzel je naloge sanitarne inšpekcije za šolsko higieno.

V svoji ambulanti je kar nekaj časa posvetil zdravljenju nočne enureze pri šolarjih.

Na celjskem je imel predavanja za starše, učitelje in zdravstvene delavce.

Leta 1988 je dobil naziv primarij. V starosti 65 let se je upokojil. Stik s šolarji in mladostniki pa je ohranil še dolgo po sedemdesetem letu starosti. Njegov moto je bil, da lahko vsak sam največ naredi za svoje zdravje. Ni videl ozdravitve samo v medikamentnem zdravljenju, ampak predvsem v umirjenem, zdravem načinu življenja. Volontersko je vodil avtogene treninge za posamezne starostne skupine šolajočih se otrok v našem dispanzerju. Tako je ohranjal stik z nami. V zdravljenju psihosomatskih stanj in bolezni je videl uspeh šolske medicine.

Ostajajo lepi spomini na čase, ko je kot predstojnik dispanzerja in kasneje kot mentor številnim otrokom in mladostnikom pri avtogenem treningu vedno z žarom in zaupanjem v šolsko medicino orisal čar in pomen tega dela.

Naj zaključim z njegovimi besedami, ki jih je zapisal v Zdravstvenem vestniku ob 70-letnici šolske zdravstvene službe v Celju: »Kljub vsemu obstaja upanje, da navdaja pristojne zavest, da so otroci naše bogastvo in narodova perspektiva. Če je tako, potem lahko mirno zremo v prihodnost.«

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