Int J Clin Exp Med 2018;11(3):2778-2784
www.ijcem.com /ISSN:1940-5901/IJCEM0058759

Case Report

Refractory hypertension due to renal artery stenosis in a solitary kidney: case report and literature review

Xiquan Yan[1,2], Mingxia Ding[1], Jin Li[2], Hui Zhan[1], Yigang Zuo[1], Haifeng Wang[1], Yinglong Huang[1], Jiansong Wang[1]

[1]*Department of Urology, The Second Affiliated Hospital of Kunming Medical University, Kunming 650101, Yunnan, P.R. China;* [2]*Department of Urology, Xiangtan Central Hospital, Xiangtan 411100, Hunan, P. R. China*

Received June 4, 2017; Accepted December 15, 2017; Epub March 15, 2018; Published March 30, 2018

Abstract: In this article we reported a patient with the refractory hypertension which attribute to the severe atherosclerotic renal artery stenosis (ARAS) in a solitary kidney. The percutaneous transluminal renal angioplasty with stent (PTRAS) was proved to be an effective method in refractory hypertension. Then we systematically reviewed related articles to evaluate the benefit of PTRAS on patients with ARAS, especially those who combined with other certain clinical conditions. Although several clinical trials failed to show that stenting has any significant benefit over medical therapy in ARAS, we propose that the procedure should be considered as a viable option for acute critical cases.

Keywords: Atherosclerotic renal artery stenosis, renovascular hypertension, solitary kidney, percutaneous transluminal renal angioplasty with stent

Introduction

Renal artery stenosis (RAS), which presents in 1% to 5% of patients with hypertension [1], is mostly caused by atherosclerosis [2]. Treatments for atherosclerotic renal artery stenosis (ARAS) include surgical revascularization, percutaneous transluminal renal angioplasty with stent (PTRAS), as well as the management of high blood pressure (BP) and the control of other atherosclerotic risk factors with medical therapy [3]. However the optimal treatment of ARAS remains controversial. Here, a patient with a solitary kidney presented with refractory hypertension. After the angiographic which showed a severe (85%) right RAS, she was treated with PTRAS. During 2 years follow-up, she presented normal blood pressure and renal function. This case is a demonstration that PTRAS is safe and effective in patients with high risk ARAS. We then systematically reviewed related articles about whether PTRAS is superior to medical therapy in the ordinary patients and high risk patients. In this study, we concluded that though the lack of randomized data to support PTRAS for ARAS, certain subgroups of patients with high risk ARAS may benefit from this treatment.

Case report

A 55-year-old female presented with headache associated with dizziness was transferred to our institution. The physical examination revealed hypertension of 186/110 mmHg. Her medical history was significant for left radical nephrectomy because of kidney cancer at age of 42, and type 2 diabetes mellitus (T2DM) at age of 40. Her medication has been only insulin to control glucose in the recent 5 years.

Laboratory examination revealed that serum aldosterone, catecholamine, potassium, sodium, creatinine and urea levels were within normal limits. While the blood-lipid parameters, indicated the patient with a hyperlipemia. The level of plasma renin activity and plasma angiotensin II were both above the reference range. Despite administration with antihypertensive (nifedipine, metoprolol, valsartan and hydrochlorothiazide), the mean 24 h-ambulatory BP was in the high range of 168/93 mmHg (day-

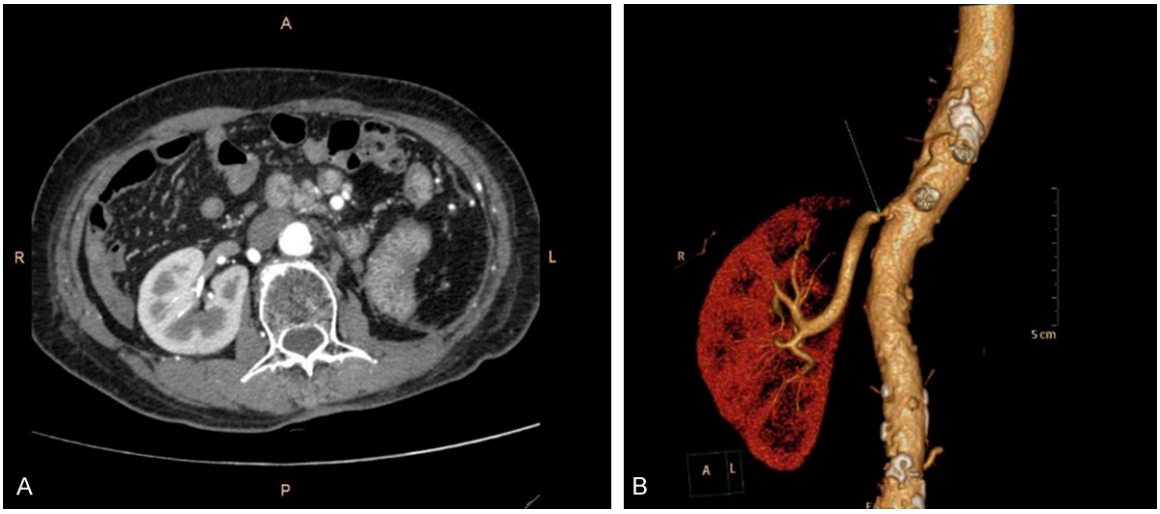

Figure 1. The absence of the left kidney and the stenosis of the right kidney. A. The enhanced CT scan indicated the absence of the left kidney. B. The preoperative three-dimensional visualization CT illustrated the absent left kidney and 85% stenosis of the right renal artery.

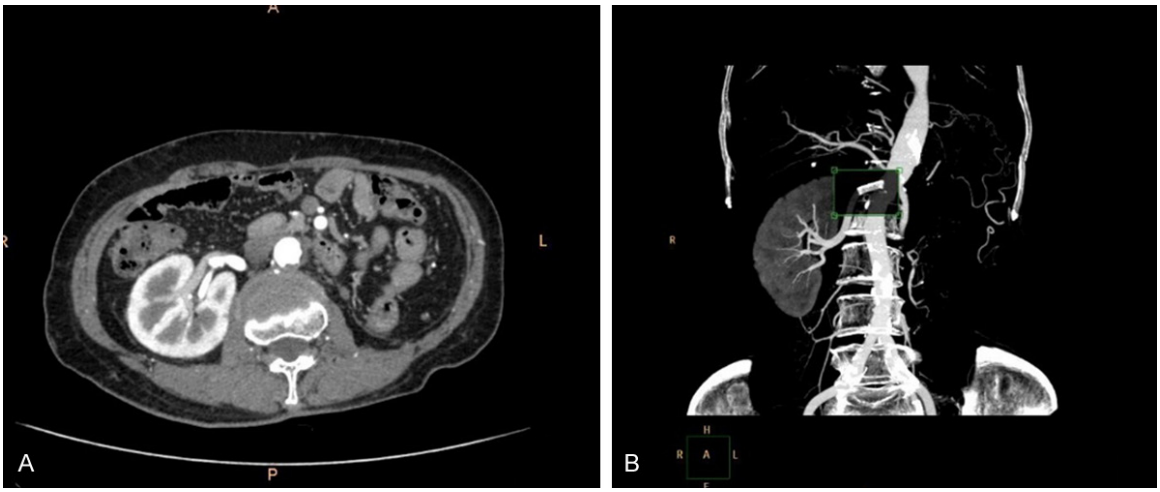

Figure 2. The enhanced CT scan (A) and the three-dimensional visualization CT (B) of abdomen showed no residual renal artery stenosis after PTRAS.

time mean BP was 189/118 mmHg, nighttime mean BP was 161/80 mmHg). Enhanced CT scan pointed out a severe right RAS at the beginning segment and absence of the left renal (**Figure 1**).

Angioplasty of the left main RAS was performed using a 5 mm balloon. A 6 mm Genesis stent (Cordis, South Ascot Berks) was inserted. After confirmed with right RAS during the angiographic, the patients underwent percutaneous transluminal renal angioplasty with stent (PTRAS). And then the completion angiogram showed patency of vessels. The next day, the patient's BP was 128/78 mmHg without any antihypertensive medications. According to the observation of normal BP in the next 48 h, she was successfully discharged back home and prescribed aspirin 100 mg per day and clopidogrel hydrogensulfate tablets 75 mg per day.

One week after operation, the patient had normal serum plasma renin activity, angiotensin II and aldosterone. The BP was 125/76 mmHg without any antihypertension medication. And CT scan showed the renal artery recover normal size (**Figure 2**). In view of 15 year history of T2DM and the higher level of LDL, she was

Table 1. Characteristics and improvments of RAS patients with PTRAS

Study, Year	Reference	Specific clinical conditions coexist	Clinical improvements	Follow-up
George et al., 2005	19	RAS in a single functioning kidney	Improvement in renal function	1 month
Kumar et al., 2006	20	Bilateral RAS, flash pulmonary edema	Asymptomatic	3 months
Kuznetsov et al., 2007	21	Bilateral RAS, hypertensive emergency, acute renal failure	Immediate recovery of renal function, improvement in BP	-
Campbell et al., 2008	22	Anuric renal failure, bilateral RAS	Renal function	-
Wykrzykowska et al., 2008	23	Refractory hypertension, congestive heart failure, pulmonary edema	Improvement in BP, alleviate symptoms of congestive heart failure and pulmonary edema	-
Chrysochou et al., 2009	24	Anuric acute renal failure, pulmonary oedema, bilateral renal artery, poorly controlled hypertension	Improvement in BP, renal function	8 months
Dziemianko et al., 2009	25	Refractory hypertension, bilateral RAS	Improvement in renal function and blood pressure	6 months
Islam et al., 2009	26	Acute renal failure, bilateral RAS, acute pulmonary edema	Improvement in renal function, no recurrence of chest pain or dyspnea	4 months
Kanamori et al., 2009	27	Acute renal failure, acute pulmonary edema, bilateral RAS, poor controlled BP	Improvement in BP, asymptomatic	-
Zankl et al., 2009	28	A solitary kidney, anuric renal failure	Improvement in renal function	6 months
George et al., 2011	29	Recurrent flash pulmonary edema, bilateral renal artery, uncontrolled hypertension	Prevents recurrent flash pulmonary edema, improvement in renal function	2 months
Kindo et al., 2011	30	Flash pulmonary edema, bilateral RAS	Asymptomatic, improvement of renal function	36 months
Navaravong et al., 2011	31	Heart failure, anuric renal failure	Improvement in renal function and BP	-
Li et al., 2012	32	Bilateral RAS, pulmonary oedema	No further episodes of pulmonary oedema	48 months
Noce et al., 2012	33	Refractory hypertension, acute renal failure, bilateral RAS	Improvement in renal function and BP	-
Alonso et al., 2013	34	Acute pulmonary edema, bilateral RAS	No further episodes of pulmonary oedema	3 months
Chrysochou et al., 2013	35	Acute flash pulmonary oedema, bilateral RAS	Improvements in the cardiac morphology and function, renal function	12 months
Demming et al., 2013	36	Recurrent flash pulmonary oedema, renal failure, poor controlled BP, bilateral RAS	Improvement in renal failure and BP, alleviate symptoms of pulmonary oedema	18 months
Ishida et al., 2013	37	Progressive renal failure	Improvement in renal function	12 months
Luiken et al., 2013	38	RAS in a solitary kidney, progressive renal failure, poor controlled BP	Improvement in renal failure and BP	-
Nagashima et al., 2014	39	Acute worsening of chronic renal failure, pulmonary oedema	Renal function, inprovemnt in pulmonary oedema	-
Mizuma et al., 2016	40	Malignant hypertension, posterior reversible encephalopathy syndrome	Improvement in renal failure and BP, brain MRI were improved	-

advised to use insulin (16 units twice a day) to control blood sugar and simvastatin (5 mg/day) to alleviate hyperlipidemia. During the 24 months' follow-up, her BP maintained normal and the data from serum biochemical indexes and Doppler ultrasound of the renal arteries indicated the good clinical outcomes.

Discussion and literature review

Here we report a patient with ARAS in a solitary kidney. Because of the refractory hypertension, she was treated with PTRAS and present good clinical outcomes. As the population aging process accelerating the prevalence of ARAS continues to increase, which is an important public issue [4, 5]. However it is still in the debate about the benefit of PTRAS verse medical therapy alone in the adults with ARAS [6].

The medical administration on ARAS include antiplatelet medication (such as aspirin or clopidogrel) and other drugs to control blood pressure, glucose and lipid level [7, 8]. The PTRAS procedures were usually performed by femoral approach under local anesthesia. Two large studies, Angioplasty and Stenting for Renal Artery Lesions (ASTRAL) [4] and Cardiovascular Outcomes in Renal Atherosclerotic lesions (CORAL) [5] compared the outcomes of PTRAS and medical therapy alone. The ASTRAL trail was conducted as a randomized and unblinded trial during a 5-year period. It compared renal function trail blood pressure, the time to renal

and major cardiovascular events, and mortality in the participants receiving PTRAS or medical therapy alone. The trail failed to find a clinical superiority of the patients undergoing PTRAS over medical therapy alone. The CORAL trail performed a randomized clinical trial to analyze the occurrence of adverse cardiovascular and renal events during the follow-up in a large sample of patients receiving PTRAS or medical therapy alone. They found that the rate of composite primary end point or any of its individual components, including death from cardiovascular or renal causes, stroke, myocardial infarction, congestive heart failure, progressive renal insufficiency, and the need for renal-replacement therapy did not differ significantly between the two groups. Other trails, including randomized controlled trials [9-11] and non-randomized studies [12, 13] assessed whether renal artery stenting bringing benefit to the RAS and showed no significance in the rate of mortality and renal replacement therapy. Moreover, a meta-analysis with 2,139 patients compared the efficacy of revascularization verse medical therapy in ARAS patients. They concluded that angioplasty with or without stenting was not superior to medical therapy [14]. All these studies seemed to be proved that revascularization and medical therapy alone might be similar in ARAS [15]. However these conclusions had some limitations, such as the relatively small sample size and stable kidney function, the moderate hypertension and degree of stenosis (50%-70%), the exclusion of patients with serious complications [6]. That is to say, these trails failed to find potential benefits from the subset of patients who with a sever stenosis or decompensated ARAS.

As we know, severe renal stenosis results in poor controlling of hypertension, progressive renal insufficiency, left ventricle hypertrophy and heart failure. Nevertheless few studies evaluated the benefits of stenting on the patients with significant renal stenosis when compared to the patients with medical therapy [6]. Milewski et al. [16]. analyzed the clinical improvement of 265 consecutive patients with ARAS treated with stenting. All participants had more than 50% de novo RAS and accorded to at least one of the following inclusion: poorly controlled hypertension (mean systolic blood pressure of more than 160 mmHg) under at least three anti-hypertensive medications, deterioration of renal function (estimated Glomerular Filtration Rate (eGFR) of less than 60 mL/min/1.73 m^2), and unexplained congestive heart failure or recurrent acute pulmonary oedema. They did not find any significant benefits of eGFP and systolic blood pressure with the administration of anti-hypertensive medications before the procedure and follow up. However, after the treatment with stenting and a median about 2 years' follow up, they concluded that PTRAS treatment in RARS may confer preservation of renal function and improvement of blood pressure control. Moreover, a retrospective analysis evaluates outcomes of endovascular therapy of ARAS in patients with a solitary functioning kidney [17]. They assessed preoperative GFR, renal size, the occurrence of acute functional injury after the procedure and proved that patients with a solitary functioning kidney got clinical benefit from the intervention. Considering the few applicable data to guide the therapy for high risk patients with ARAS, James et al. explored the effect of revascularization compared to medical therapy on presentation with flash pulmonary edema, refractory hypertension or rapidly declining kidney function [18]. Interestingly, their data supported that patients presenting with high risk presentation may benefit from the treatment of revascularization in reducing risk for death and cardiovascular event. However, some caveats exist in the study, such as the non-randomized design, the lack of other parameters which influenced the clinical outcomes. Many recently published case reports presented the patients with ARAS as well as other certain clinical conditions (**Table 1**) and suggested that all of them benefited from stenting [19-40]. In these reports, rapid clinical improvements were seen after treated with stenting. However the inclination of reporting the success after stenting and the over-emphasis of benefit of some certain patients limited their ability to reveal the difference between PTRAS and medical therapy alone in most RARS patients.

Since the patient with a sever stenosis in the solitary kidney presented a poor controlled blood pressure in our report, she was treated with PTRAS. As reported previously [17], the treatment has proved to be a safe procedure and improved the clinical conditions. Although clinical benefits of PTRAS on ARAS remain controversial, revascularization with stenting has been commonly accepted by the patients with

high risk. Future studies should focus on determining appropriate candidates who are putatively most likely to benefit from PTRAS [41, 42]. Those who are proved to be resistant to drug therapy, hemodynamically significant ARAS or have signs of decompensation should consider to be treated with PTRAS.

Acknowledgements

We are grateful to the patient for the participation in our study. This study was supported by the National Natural Science Foundation of China (Nos. 81260374 and 81460384), the Yunnan Provincial Department of Education Fund (No. 2014Z072).

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Jiansong Wang, Department of Urology, The Second Affiliated Hospital of Kunming Medical University, Yunnan Institute of Urology, 374 Dianmian Road, Kunming 650101, Yunnan, P.R. China. E-mail: jiansongwang@126.com

References

[1] Derkx FH and Schalekamp MA. Renal artery stenosis and hypertension. Lancet 1994; 344: 237-239.

[2] Simon G. What is critical renal artery stenosis? Implications for treatment. Am J Hypertens 2000; 13: 1189-1193.

[3] Meier P. Atherosclerotic renal artery stenosis: update on management strategies. Curr Opin Cardiol 2011; 26: 463-471.

[4] Wheatley K, Ives N, Gray R, Kalra PA, Moss JG, Baigent C, Carr S, Chalmers N, Eadington D, Hamilton G, Lipkin G, Nicholson A and Scoble J. Revascularization versus medical therapy for renal-artery stenosis. N Engl J Med 2009; 361: 1953-1962.

[5] Cooper CJ, Murphy TP, Cutlip DE, Jamerson K, Henrich W, Reid DM, Cohen DJ, Matsumoto AH, Steffes M, Jaff MR, Prince MR, Lewis EF, Tuttle KR, Shapiro JI, Rundback JH, Massaro JM, D'Agostino RB Sr and Dworkin LD; CORAL Investigators. Stenting and medical therapy for atherosclerotic renal-artery stenosis. N Engl J Med 2014; 370: 13-22.

[6] Raman G, Adam GP, Halladay CW, Langberg VN, Azodo IA and Balk EM. Comparative effectiveness of management strategies for renal artery stenosis: an updated systematic review. Ann Intern Med 2016; 165: 635-649.

[7] Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive summary of the third report of the national cholesterol education program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel III). JAMA 2001; 285: 2486-2497.

[8] Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, Jones DW, Materson BJ, Oparil S, Wright JT Jr and Roccella EJ. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. Jama 2003; 289: 2560-2572.

[9] Bax L, Woittiez AJ, Kouwenberg HJ, Mali WP, Buskens E, Beek FJ, Braam B, Huysmans FT, Schultze Kool LJ, Rutten MJ, Doorenbos CJ, Aarts JC, Rabelink TJ, Plouin PF, Raynaud A, van Montfrans GA, Reekers JA, van den Meiracker AH, Pattynama PM, van de Ven PJ, Vroegindeweij D, Kroon AA, de Haan MW, Postma CT and Beutler JJ. Stent placement in patients with atherosclerotic renal artery stenosis and impaired renal function: a randomized trial. Ann Intern Med 2009; 150: 840-848, w150-841.

[10] Marcantoni C, Zanoli L, Rastelli S, Tripepi G, Matalone M, Mangiafico S, Capodanno D, Scandura S, Di Landro D, Tamburino C, Zoccali C and Castellino P. Effect of renal artery stenting on left ventricular mass: a randomized clinical trial. Am J Kidney Dis 2012; 60: 39-46.

[11] Ziakka S, Ursu M, Poulikakos D, Papadopoulos C, Karakasis F, Kaperonis N and Papagalanis N. Predictive factors and therapeutic approach of renovascular disease: four years' follow-up. Ren Fail 2008; 30: 965-970.

[12] Dichtel LE, Gurevich D, Rifkin B, Varma P, Concato J and Peixoto AJ. Renal artery revascularization in patients with atherosclerotic renal artery stenosis and impaired renal function: conservative management versus renal artery stenting. Clin Nephrol 2010; 74: 113-122.

[13] Sofroniadou S, Kassimatis T, Srirajaskanthan R, Reidy J and Goldsmith D. Long-term safety and efficacy of renin-angiotensin blockade in atherosclerotic renal artery stenosis. Int Urol Nephrol 2012; 44: 1451-1459.

[14] Riaz IB, Husnain M, Riaz H, Asawaeer M, Bilal J, Pandit A, Shetty R and Lee KS. Meta-analysis of revascularization versus medical therapy for atherosclerotic renal artery stenosis. Am J Cardiol 2014; 114: 1116-1123.

[15] Perkovic V. Review: revascularization and medical treatment may be similar in atherosclerotic renal artery stenosis. Ann Intern Med 2016; 165: Jc71.

[16] Milewski K, Fil W, Buszman P, Janik M, Wanha W, Martin T, Krol M, Gorycki B, Wiernek S, Krzych L, Kiesz RS, Wojakowski W and Buszman P. Renal artery stenting associated

with improvement in renal function and blood pressure control in long-term follow-up. Kidney Blood Press Res 2016; 41: 278-287.
[17] Davies MG, Saad WE, Bismuth JX, Naoum JJ, Peden EK and Lumsden AB. Endovascular revascularization of renal artery stenosis in the solitary functioning kidney. J Vasc Surg 2009; 49: 953-960.
[18] Ritchie J, Green D, Chrysochou C, Chalmers N, Foley RN and Kalra PA. High-risk clinical presentations in atherosclerotic renovascular disease: prognosis and response to renal artery revascularization. Am J Kidney Dis 2014; 63: 186-197.
[19] George PV, Pati PK, Chandy ST, Gupta S and Samuel V. Recanalization of a single functioning kidney. Indian Heart J 2005; 57: 741-743.
[20] Kumar SC. Bilateral renal artery stenosis presenting as flash pulmonary edema. J Assoc Physicians India 2006; 54: 651-654.
[21] Kuznetsov E, Schifferdecker B, Jaber BL, Soukas P and Liangos O. Recovery of acute renal failure following bilateral renal artery angioplasty and stenting. Clin Nephrol 2007; 68: 32-37.
[22] Campbell JE, John M and Bates MC. Surgical rescue and restoration of renal function in an anuric renal failure patient: a case report. W V Med J 2008; 104: 22-24.
[23] Wykrzykowska JJ, Williams M and Laham RJ. Stabilization of renal function, improvement in blood pressure control and pulmonary edema symptoms after opening a totally occluded renal artery. J Invasive Cardiol 2008; 20: E26-29.
[24] Chrysochou C, Sinha S, Chalmers N, Kalra PR and Kalra PA. Anuric acute renal failure and pulmonary oedema: a case for urgent action. Int J Cardiol 2009; 132: e31-33.
[25] Dziemianko I, Kuzniar J, Dorobisz A, Zynek-Litwin M, Garcarek J and Klinger M. Critical bilateral renal arterial stenosis presenting as cardio-renal syndrome: isolated ultrafiltration preceding percutaneous transluminal revascularization. Congest Heart Fail 2009; 15: 96-98.
[26] Islam MA, Rosenfield K, Maree AO, Patel PM and Jaff MR. Percutaneous revascularization of occluded renal arteries in the setting of acute renal failure. Vasc Med 2009; 14: 365-369.
[27] Kanamori H, Toma M and Fukatsu A. Improvement of renal function after opening occluded atherosclerotic renal arteries. J Invasive Cardiol 2009; 21: E171-174.
[28] Zankl AR, Dengler TJ, Andrassy M, Volz HC, Katus HA and Zeier M. Recovery of renal function after delayed percutaneous dilation of a subtotal in-stent restenosis of the renal artery in a left solitary kidney. NDT Plus 2009; 2: 236-238.
[29] George T, Latchumanadhas K, Abraham G, Devapriya S, Ezhilan J and Mullasari AS. Successful hybrid procedure in flash pulmonary edema. Saudi J Kidney Dis Transpl 2011; 22: 531-533.
[30] Kindo M, Gerelli S, Billaud P and Mazzucotelli JP. Flash pulmonary edema in an orthotopic heart transplant recipient. Interact Cardiovasc Thorac Surg 2011; 12: 323-325.
[31] Navaravong L, Ali RG and Giugliano GR. Acute renal artery occlusion: making the case for renal artery revascularization. Cardiovasc Revasc Med 2011; 12: 399-402.
[32] Li WS, Gilchrist M, Robertson S and Isles C. Bilateral renovascular disease with cardiorenal failure: intervene early or watch and wait? Qjm 2012; 105: 567-569.
[33] Noce A, Canale MP, Durante O, di Villahermosa SM, Rovella V, Fiorini F, Parolini C and Di Daniele N. Refractory hypertension and rapidly progressive renal failure due to bilateral renal artery stenosis: case report. Arch Ital Urol Androl 2012; 84: 249-252.
[34] Alonso JV, Caballero RM, Lopera EL, Avalos FC and Navarro C. Flash pulmonary edema and renal artery stenosis: pickering syndrome. Am J Emerg Med 2013; 31: 454.e451-454.
[35] Chrysochou C, Schmitt M, Siddals K, Hudson J, Fitchet A and Kalra PA. Reverse cardiac remodelling and renal functional improvement following bilateral renal artery stenting for flash pulmonary oedema. Nephrol Dial Transplant 2013; 28: 479-483.
[36] Demming T, Frey N and Langer C. Pickering syndrome: high-risk stenting of a renal artery stenosis in a multimorbid patient presenting with progressive congestive heart failure. Clin Res Cardiol 2013; 102: 615-617.
[37] Ishida R, Komaki K, Nakayama M, Sonomura K, Nakanouchi T, Naya Y, Mori Y and Kusaba T. Percutaneous transluminal renal angioplasty remarkably improved severe hypertension and renal function in a patient with renal artery stenosis and postrenal kidney failure. Ren Fail 2013; 35: 551-555.
[38] Luiken GP, Jonkman JG, van der Sluijs JW and Dees A. Endovascular stenting in a stenotic solitary kidney; renal failure due to atherosclerotic renal artery stenosis. Ned Tijdschr Geneeskd 2013; 157: A5753.
[39] Nagashima M and Yamashita T. Renal artery stenting crucial to the recovery from acute worsening of chronic renal failure. Intern Med 2014; 53: 2223-2226.
[40] Mizuma A, Kouchi M, Nakayama T and Takizawa S. Percutaneous transluminal angioplasty improved posterior reversible encephalopathy syndrome due to renovascular hypertension. J Stroke Cerebrovasc Dis 2016; 25: e7-8.

[41] Choi D. BR 05-2 angioplasty of atherosclerotic renal artery stenosis: WHO benefits? J Hypertens 2016; 34 Suppl 1 - ISH 2016 Abstract Book: e380.

[42] Tafur JD and White CJ. Renal artery stenosis: when to revascularize in 2017. Curr Probl Cardiol 2017; 42: 110-135.