

[CASE REPORT]

Usefulness of Renal Autotransplantation for Radiotherapy-induced Renovascular Hypertension

Shinichi Wakabayashi¹, Hiroyuki Takaoka¹, Hideaki Miyauchi², Tomokazu Sazuka³,
Yuichi Saito¹, Kazumasa Sugimoto¹, Nobusada Funabashi¹, Tomohiko Ichikawa³,
Hisahiro Matsubara² and Yoshio Kobayashi¹

Abstract:

We experienced a young woman with congestive heart failure (CHF) caused by renovascular hypertension (RVH) and subsequent hypertensive heart disease. She underwent tumor resection and intraoperative radiation therapy because of neuroblastoma at age 2. She was diagnosed with RVH and hypertensive heart disease due to radiation-induced renal artery stenosis at age 12. Thereafter, she was hospitalized with CHF caused by uncontrolled RVH at age 19, and renal autotransplantation with extraction of left kidney was performed after the recovery of CHF. Her blood pressure has been well controlled without CHF readmission during four years of follow-up after the operation.

Key words: renovascular hypertension, hypertensive heart disease, renal autotransplantation, neuroblastoma

(Intern Med 58: 1897-1899, 2019)

(DOI: 10.2169/internalmedicine.2001-18)

Introduction

Renal artery stenosis (RAS) is a common cause of secondary hypertension (1). However, the appropriate treatment has not been established. We experienced a young woman with heart failure (HF) caused by severe renovascular hypertension (RVH). In this case, renal autotransplantation (RAT) was effective for controlling RVH and HF. To our knowledge, this is the first case in which RVH was caused by radiation therapy for neuroblastoma and RAT of right kidney was effective for controlling not only RVH but congestive HF (CHF). RAT was previously performed in cases with complex RAS mainly caused by fibromuscular dysplasia (FMD) or Takayasu arteritis. After the operation, her blood pressure decreased, and she has not been rehospitalized for CHF.

Case Report

A 19-year-old woman visited our hospital because of gen-

eral malaise, a fever and dyspnea. She had a history of a primary left adrenal gland neuroblastoma and had undergone left kidney-sparing tumor resection and intraoperative radiation therapy (RT) (12 Gy), followed by systemic chemotherapy (9.9 Gy) and autologous stem cell transplantation at age 2. She was diagnosed with RVH and hypertensive heart disease due to radiation-induced RAS when she was hospitalized with ischemic colitis at age 12. Thereafter, her systolic blood pressure had not been well controlled (ranging from 140 to 180 mmHg) despite the administration of several anti-hypertensive medicines. At the present admission, chest X-ray revealed severe pulmonary edema with an enlarged heart and consolidation (Fig. 1A). Her systolic blood pressure was >200 mmHg, and her SpO₂ was 93% on 10 L/minute of oxygen. Her serum creatinine and brain type natriuretic peptide were elevated to 1.98 mg/dL (normal, 0.46-0.79 mg/dL) and 1,793 pg/mL (normal, <18.4 pg/mL), respectively, even though her serum creatinine was 0.53 mg/dL at 1 month before admission. The left ventricular ejection fraction had decreased to 24% on transthoracic echocardiography. She was diagnosed with

¹Department of Cardiovascular Medicine, Chiba University Graduate School of Medicine, Japan, ²Department of Frontier Surgery, Chiba University Graduate School of Medicine, Japan and ³Department of Urology, Chiba University Graduate School of Medicine, Japan

Received: October 17, 2018; Accepted: December 17, 2018; Advance Publication by J-STAGE: February 25, 2019

Correspondence to Dr. Hiroyuki Takaoka, tapy21century@yahoo.co.jp

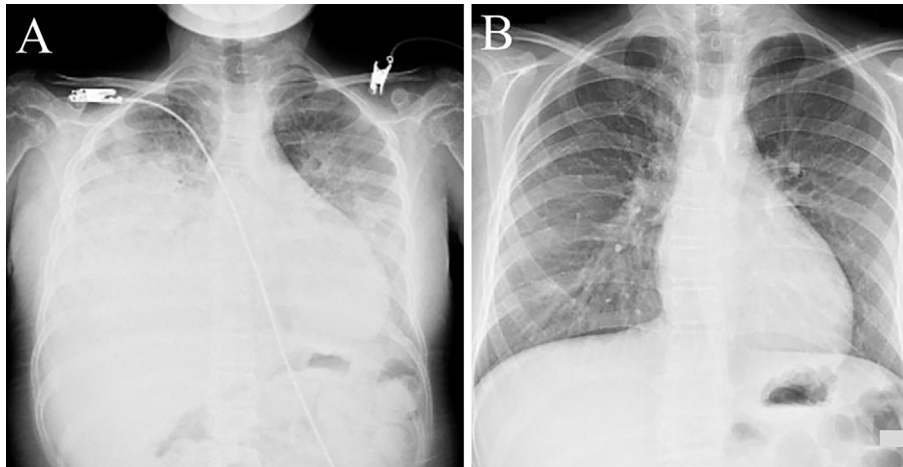


Figure 1. Chest X-ray performed at admission and after the treatment. A: Chest X-ray revealed severe pulmonary edema with an enlarged heart and consolidation at admission. B: Pulmonary edema and consolidation disappeared on chest X-ray after treatment.

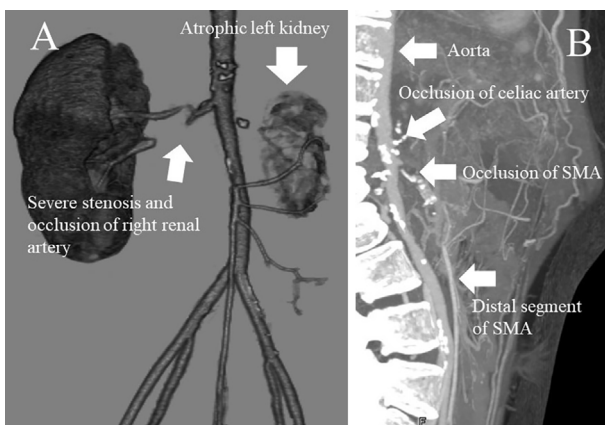


Figure 2. CT revealed severe abdominal atherosclerosis before renal autotransplantation. A: CT revealed severe stenosis and occlusion of her right renal artery as well as an atrophic left kidney on a volume rendering image. B: Her celiac and superior mesenteric artery were also occluded on the maximum intensity projection image. SMA: supra mesenteric artery

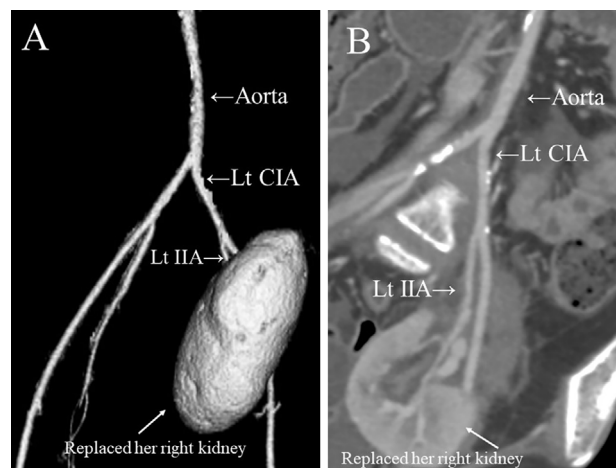


Figure 3. CT revealed replacement of the right kidney. A: CT revealed that her right kidney had been replaced on her left fossa iliaca on the volume rendering image. B: CT revealed that her right renal artery had been bypassed by her left internal iliac artery on the curved planner reconstruction image. Lt CIA: left common iliac artery, IIA: internal iliac artery

pneumonia and acute heart failure and subsequently hospitalized.

She was treated with meropenem and levofloxacin, and her pneumonia improved after a few days. Her CHF was well treated by noninvasive positive-pressure ventilation, diuretics and vasodilators after admission. However, even after pulmonary edema and consolidation had disappeared on chest X-ray (Fig. 1B), her plasma renin activity and aldosterone were still elevated at 19.0 ng/mL/h (normal, 0.3-2.9 ng/mL/h) and 997 pg/mL (normal, 29.9-159 pg/mL), respectively. Contrast computed tomography (CT) revealed severe arteriosclerosis of the abdominal aorta with occlusion of the celiac artery and superior mesenteric artery (Fig. 2A), and significant stenosis and total occlusion of the right RAs with an atrophic left kidney were noted (Fig. 2B). Significant stenosis of coronary arteries was not detected, but an

incomplete duplicated right ureter trunk was detected on CT. Those severe atherosclerotic changes of abdominal arteries were attributed to radiation therapy at 2 years old. Her renogram revealed no function of the left kidney and an obstructive pattern of excretion of the right ureter. Because reconstruction of her right RA with the ureter trunk was required, renal autotransplantation (RAT) with extraction of the left kidney rather than aortic bypass surgery or RA angioplasty was finally performed. Her right kidney was replaced on her left fossa iliaca, and her right renal artery was bypassed by the left internal iliac artery (Fig. 3).

The procedure was successful, and her plasma renin activity and aldosterone decreased to 2.3 ng/mL/h and 27.6 pg/mL, respectively, after the operation. Her serum creatinine level had been elevated to 2.27 mg/dL even after medical

treatment for CHF during admission, but it decreased to 1.44 mg/dL at roughly 4 years after the operation. Her blood pressure was well controlled, so she was discharged. During four years of follow-up after the operation, she had no recurrence of HF. Her left ventricular ejection fraction improved to 45% and her systolic blood pressure was 110-130 mmHg under medication with 2 antihypertensive agents (calcium channel blocker and beta-blocker) and a thiazide diuretic agent.

Discussion

Atherosclerotic RAS is the most common cause of RVH (1). Although interventional revascularization of renal arteries for cases with uncontrolled RVH has been shown to modestly but significantly reduce the blood pressure, it does not reduce the risk of future cardiac and renal events compared with medical therapy based on the CORAL trial (2). However, in their observational study, Chábová et al. reported that the renal function was often deteriorated, and antihypertensive medication requirements increased in cases with RAS that were managed initially without revascularization (3). The mortality and risks of deterioration of the renal function were particularly high in cases with bilateral RAS or RAS of a solitary functioning kidney. In addition, patients with both CHF and RAS had a worse clinical outcome, longer admission days and more frequent admission than those without RAS (4). Thus, interventional revascularization of RAS is recommended in cases with FMD and hypertension or a decreased renal function, and surgical revascularization is recommended in cases with complex renal arteries after a failed endovascular procedure or during open aortic surgery based on the recent guidelines (1). Because the patient in the present case had RAS at a solitary functioning kidney with severe renal dysfunction and her hypertension had not been well controlled, a revascularization strategy should have been recommended, even though she did not have FMD. The anatomical complexity in the present case was challenging, and reconstruction of the right ureter trunk was also necessary. Therefore, RAT was ultimately performed.

Neuroblastoma is the most frequent extracranial solid tumor in children and commonly presents in patients younger than 10 years old. Approximately 90% of all cases occur in children less than 5 years old. Almost half of all patients with neuroblastoma have metastases at presentation, and its clinical presentation varies from benign to severely progressive (5). Advanced neuroblastoma requires interdisciplinary treatments, including surgical resection, radiation, chemotherapy, or stem cell transplantation. RAS has been reported as a late complication after radiation therapy, and treatment of radiation-induced RAS is sometimes difficult (6).

RAT has been recognized as a useful treatment for RVH,

especially in cases with complex RAS (7). Previous reports have shown that RAT was more beneficial for RVH in cases with RAS caused by FMD or Takayasu arteritis than in those caused by atherosclerosis because of their younger age and less-severe renal atrophy (8). Given the age and sex predilection of FMD and Takayasu arteritis, young women with RVH may be good candidates for RAT. There was a case report in which a patient with renal dysfunction underwent bypass surgery for RAS developed as a side effect of radiation therapy for neuroblastoma, and the patient's renal function was improved (6). Simple bypass surgery was not suitable for our case because of her severe atherosclerosis of the abdominal arteries and duplicated ureter trunk, so RAT was selected in this patient. RAT was effective for preventing CHF readmission and the deterioration of the renal function.

Conclusions

RAT was useful for controlling refractory RVH caused by complicated RAS, which was a side effect of previous radiation therapy sessions for neuroblastoma.

The authors state that they have no Conflict of Interest (COI).

References

1. Aboyans V, Ricco JB, Bartelink MEL, et al. 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with the European Society for Vascular Surgery (ESVS): document covering atherosclerotic disease of extracranial carotid and vertebral, mesenteric, renal, upper and lower extremity arteries Endorsed by: the European Stroke Organization (ESO); The Task Force for the Diagnosis and Treatment of Peripheral Arterial Diseases of the European Society of Cardiology (ESC) and of the European Society for Vascular Surgery (ESVS). *Eur Heart J* **39**: 763-816, 2018.
2. Cooper CJ, Murphy TP, Cutlip DE, et al. Stenting and medical therapy for atherosclerotic renal-artery stenosis. *N Engl J Med* **370**: 13-22, 2014.
3. Chábová V, Schirger A, Stanson AW, et al. Outcomes of atherosclerotic renal artery stenosis managed without revascularization. *Mayo Clin Proc* **75**: 437-444, 2000.
4. Bourantas CV, Loh HP, Lukaschuk EI, et al. Renal artery stenosis: an innocent bystander or an independent predictor of worse outcome in patients with chronic heart failure? A magnetic resonance imaging study. *Eur J Heart Fail* **14**: 764-772, 2012.
5. Ahmed AA, Zhang L, Reddivalla N, et al. Neuroblastoma in children: update on clinicopathologic and genetic prognostic factors. *Pediatr Hematol Oncol* **34**: 165-185, 2017.
6. Luehr M, Siepe M, Beyersdorf F, et al. Extra-anatomic bypass for recurrent abdominal aortic and renal in-stent stenosis following radiotherapy for neuroblastoma. *Interact Cardiovasc Thorac Surg* **8**: 488-490, 2009.
7. Dubernard JM, Martin X, Gelet A, et al. Renal autotransplantation versus bypass techniques for renovascular hypertension. *Surgery* **97**: 529-534, 1985.
8. Chiche L, Kieffer E, Sabatier J, et al. Renal autotransplantation for vascular disease: late outcome according to etiology. *J Vasc Surg* **37**: 353-361, 2003.

The Internal Medicine is an Open Access journal distributed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. To view the details of this license, please visit (<https://creativecommons.org/licenses/by-nc-nd/4.0/>).