ULTRASOUND DIAGNOSIS OF THE RENAL ARTERY STENOSIS IN A TRANSPLANTED KIDNEY IN THE EARLY POSTOPERATIVE PERIOD

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Abstract

In this clinical case, stenosis of a renal artery of transplant was detected in time by angiography using dynamic Doppler ultrasound control. The chosen treatment method allowed the restoration of arterial patency and thus renal graft function in the shortest possible time and with minimal trauma. However, due to the high risk of restenosis in the plastic area, continuous dynamic ultrasound monitoring and monitoring of the patient's creatinine level are required. The purpose of this presentation is to present a case of early detection of a postoperative complication by Doppler ultrasound, which made it possible to prevent vascular dysfunction, often leading to loss of the renal graft.

Materials and Methods. In this article, we report a case of timely detection of renal artery stenosis by ultrasound in a patient, followed by confirmation by angiography and restoration of renal artery and graft function by endovascular balloon angioplasty. All major hemodynamic changes in Doppler ultrasound parameters characteristic of renal artery stenosis are described in this article.

Results. Dynamic Doppler ultrasound monitoring and angiography allowed early detection of the described complication of renal transplantation. The optimal choice of treatment tactics allowed the restoration of arterial patency and renal graft function in the shortest possible time, thus preventing graft rejection.

Conclusion. Our clinical case demonstrates the importance of the monitor in the assessment of renal perfusion. The outcome of kidney transplantation largely depends on the successful resolution of these issues, which determines the relevance.

DOI:10.35805/BSK2024III005
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recieved: 03.09.2024
accepted: 13.09.2024

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Conflict of interest:
The authors declare no potential conflict of interest requiring disclosure in this article.

Keywords:
kidney transplant, complication, stenosis, survival, restoration of function, angioplasty, Dopplerography of kidney vessels, anastomosis.

Introduction

Renal graft arterial stenosis develops in 2-12%,[1,2] and according to some sources in up to 23% of cases,[3,4] and more frequently in the delayed period, from 3 months to 2 years after transplantation.4 In most cases, this complication is diagnosed in the first 6 months. Stenosis of the renal artery after transplantation can lead to uncontrolled increases in blood pressure and kidney graft dysfunction.[4,5]

A significant amount of scientific research is devoted to analyzing the diagnostic efficacy of the resistance index. Literature data indicate that the resistance index (RI) is the most important parameter for quantitative determination of renal blood flow changes in renal pathology. Thus, for example, Patel K.N. with co-authors, when using the threshold value, RI - 0.7, obtained a sensitivity equal to 78% with a low specificity of - 40%, while with the threshold value of Ri equal to 0.9, the specificity was 100%, sensitivity - 16%.[5]

Case presentation

Patient Zh., born in 1980, underwent living donor kidney transplantation into the right iliac region at the Center for Hepatopancreatobiliary Surgery, Onco-hepatology and Organ Transplantation of LLP NNOC on May 26, 2023. After the surgery, the kidney transplant function was satisfactory, and the creatinine level gradually decreased. However, from June 8, 2023, there was an increase in the creatinine level, which peaked at 370 μmol/L. According to ultrasound and Doppler ultrasound: at the level of the renal artery anastomosis, the peak systolic velocity (PSV) increased to 600 cm/s

(Figure 1), with a stenotic blood flow pattern, resulting in decreased renal graft perfusion, the appearance of a "tardus parvus" blood flow pattern in the interlobular arteries, and a sharp decrease in resistance index (RI) to 0.29 (Figure 2).

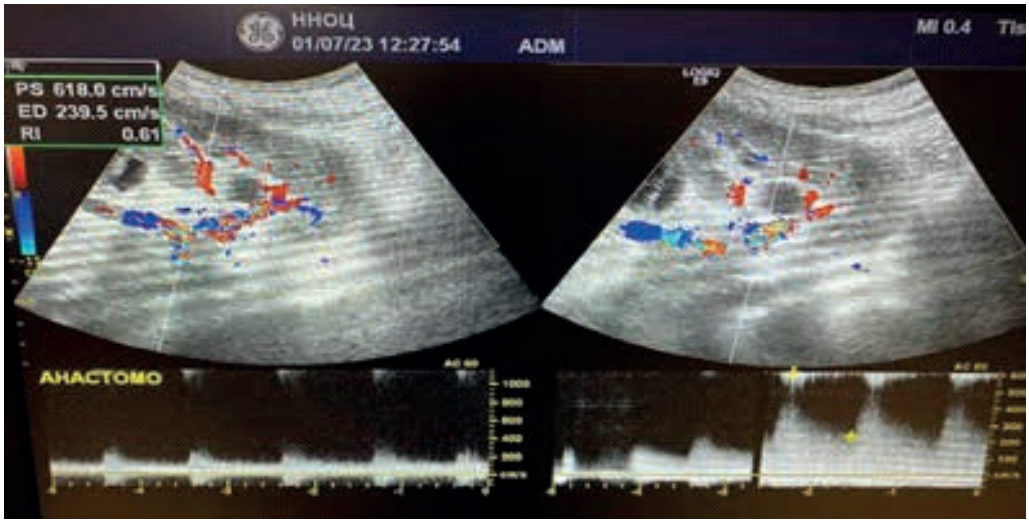

Figure 1.
Elevated velocity in the renal artery at the anastomosis level.

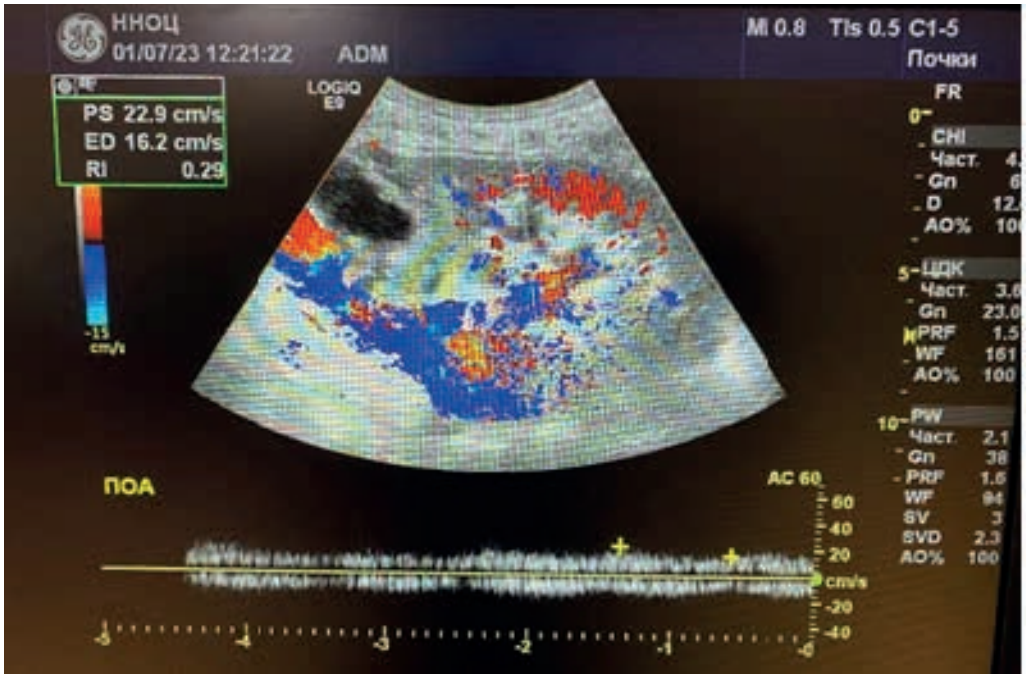

Figure 2.
Low velocity and RI in the renal artery in the kidney transplant parenchyma. RI - resistance index.

PSV in the external iliac artery was 219 cm/s and the iliac-renal artery ratio (RAR) was 2.7. A hemodynamically significant stenosis was noted at the renal artery anastomosis, with a progressive decrease in velocity parameters and RI at the intrarenal level.

Clinically: decreased urine output.

It was decided to perform diagnostic angiography in the Interventional Surgery Department of the NNOC. On July 11, 2023, angiography revealed: subocclusion of the renal artery at the level of the renal artery anastomosis of the kidney transplant (Figure 3).

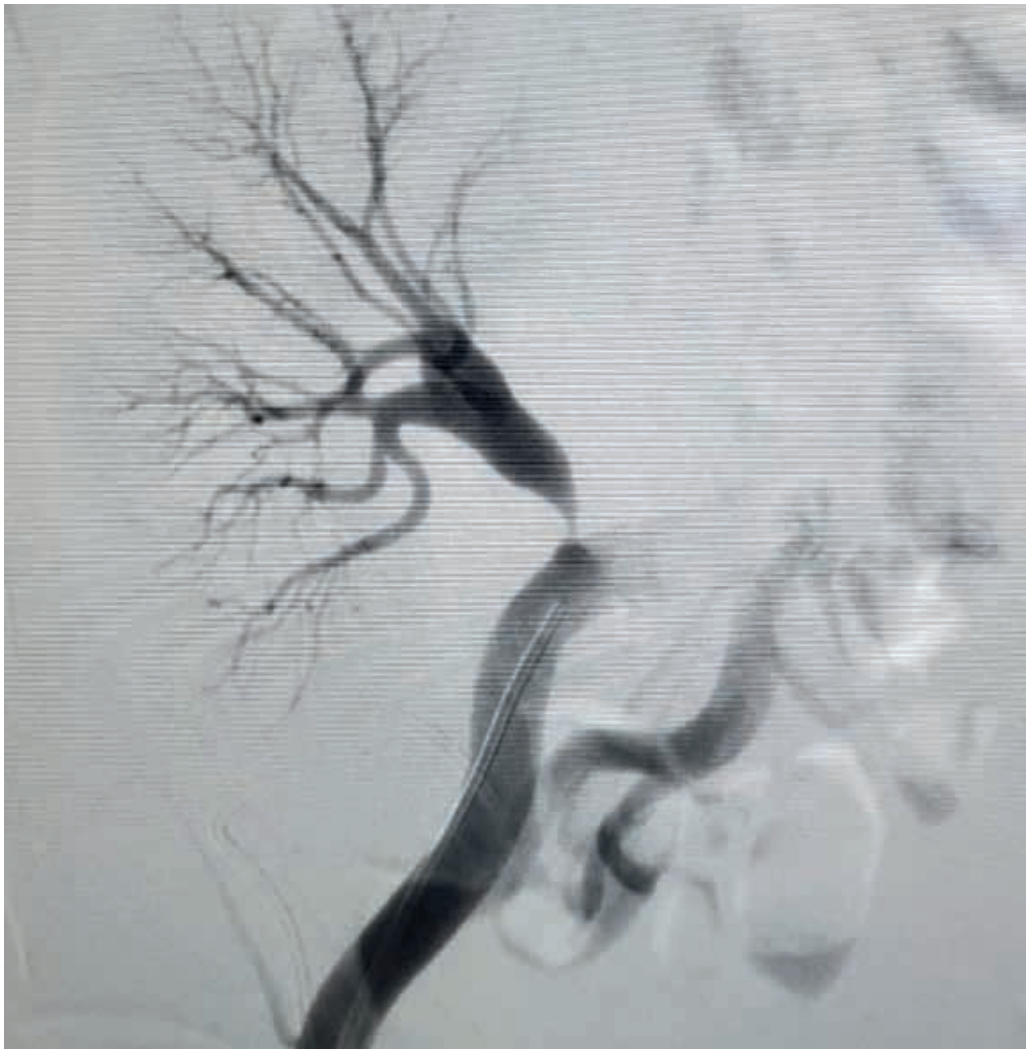

Figure 3.
Angiography before balloon angioplasty: stenosis at the level of the renal artery anastomosis.

Predilatation was performed with a 2.0mm*20mm Powerline balloon in the stenotic segment followed by placement of a 4.0mm x 150mm balloon. Balloon dilatation was performed at 12-14 atm for 60 seconds. On control arteriography: patency of the renal graft artery was restored (Figure 4).

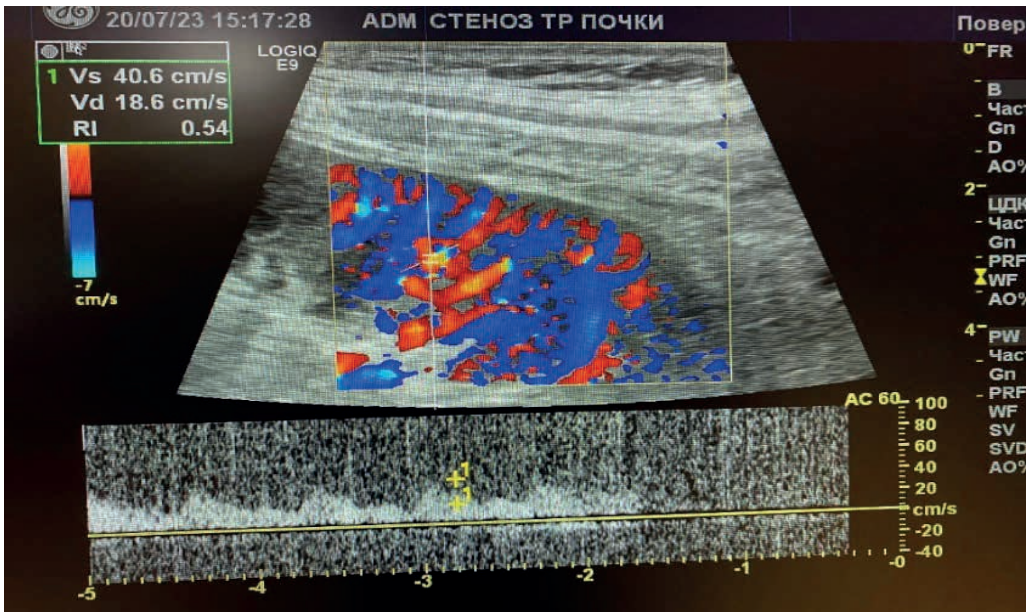

Figure 4.
Blood flow in the interlobular and arcuate arteries of the renal artery has been restored. RI within normal limits. RI - resistance index; RA - renal artery.

On July 17, 2023, follow-up Doppler ultrasound showed: with color Doppler mapping, the vascularization of the graft was closer to satisfactory, and parenchymal blood flow was preserved.

Velocity parameters: blood flow in parenchymal arteries: PSV - 40 cm/s, RI - 0.54; in the main trunk at the hilum PSV - 127 cm/s, RI - 0.65; at the projection of the renal artery anastomosis PSV - 179 cm/s, RI - 0.74, without spectral changes.

Ultrasound and Doppler findings are within acceptable limits (Figures 3 and 4).

Laboratory and instrumental data from January 20, 2022: creatinine 101 μmol/L.

There are several parameters to evaluate the efficacy of the procedure, i.e., changes in the arterial lumen confirmed by angiography and ultrasound, hemodynamic parameters measured by Doppler ultrasound, and clinical parameters such as decreased blood pressure, reduced edema, increased glomerular filtration, appearance of diuresis, and graft survival. All parameters should be assessed immediately after the procedure and several months later.

Discussion

Early detection and treatment of complications helps to preserve the function of the transplanted kidney. In particular, the vascular anastomosis zones of the renal arteries require regular postoperative Doppler ultrasound monitoring due to the high risk of ischemia and graft loss. Modern methods such as ultrasound and radiography are the most minimally invasive and informative. Although only angiography provides a definitive diagnosis, Doppler ultrasound is the best screening method because it does not cause the complications associated with radiologic contrast studies. Duplex scanning requires no contrast media, no radiation exposure, is relatively inexpensive, and has high sensitivity (87-94%) and specificity (86-100%).[1,2]

Endovascular balloon angioplasty is currently the first-line treatment for patients with RA stenosis. This is due to the lower incidence of restenosis (10%) compared to surgical correction (16-62%).[3] There is also evidence that the immediate technical success rate of this procedure is greater than 80%, with clinical success ranging from 74-87%. Long-term clinical success, defined as improvement in blood pressure or stabilization or improvement in renal function, is reported to be 53-70% within one year.[4,5]

Ultrasound with Doppler remains a key tool in the diagnosis and monitoring of postoperative complications with a sensitivity of 95.7%. Radiologic methods confirm the presence of complications and help to clarify their nature, thus guiding further treatment tactics.

The presented clinical case illustrates a rather dangerous but reversible complication that occurred after allotransplantation. Differentiation of complications after kidney transplantation is a complex process. The similarity of symptoms may lead to misinterpretation of the nature of the complication and incorrect treatment, possibly resulting in graft loss or death.

Limitations: This study is a case report and the problem requires a large-scale study of the effectiveness of monitoring for possible vascular complications after kidney transplantation.

What's known? Early detection of complications, followed by immediate treatment, allows preserving the functioning of the transplanted kidney. In particular, the areas of vascular anastomosis of the renal arteries require regular postoperative ultrasound Doppler monitoring due to the high risk of developing ischemia of the renal transplant and its loss.

What's New? In this clinical case, thanks to dynamic, regular Doppler US control, the early detection of the complication of kidney transplantation was possible. Since ultrasound and Dopplerography is an operator-dependent method, the technique of proper and accurate determination of the location of stenosis, the degree of severity and dynamic daily control of accurate speed indicators in the stenotic zone. In this clinical case, the early and accurate detection of the complication of the early post-transplant period by ultrasound made it possible to provide the patient with immediate treatment and preserve the function of the kidney transplant.

Conclusion

In this clinical case, thanks to dynamic Doppler US, angiography was able to detect the above-mentioned complication of kidney transplantation in time. The chosen method of treatment made it possible to restore the arterial patency and thus the function of the kidney graft with minimal trauma.

Acknowledgement: We would like to thank the Department of Interventional Surgery, Ultrasound and Functional Diagnostics, Center for Hepatobiliary Surgery of NNOC for the opportunity to use patient data.

Authors' contribution: O.D.: Conceptualization, A.S.: methodology, A.Y.: verification, A.Y., T.A., I.G.: formal analysis, S.I., A.Y.: writing (original draft preparation), A.E.: writing (review and editing), A.S., T.A., I.G., T.G., S.I.: selection of literature and resources.

Funding: Not funded

References

1. Montali F, Panarese A, Binda B, Lancione L, Pisani F. Transplant Renal Artery Stenosis: A Case Report of Functional Recovery Six Months After Angioplasty. Transplant Proc. May 2021;53(4):1272-1274. doi:10.1016/j.transproceed.2021.03.019
2. Nazari I, Zargar MA, Alavi SMA. Percutaneous transluminal angioplasty with stenting for transplant renal artery stenosis at the anastomosis site in a young female patient: A case report. Int J Surg Case Rep. Feb 2024;115:109209. doi:10.1016/j.ijscr.2023.109209
3. Granata A, Clementi S, Londrino F, et al. Renal transplant vascular complications: the role of Doppler ultrasound. J Ultrasound. Jun 2015;18(2):101-7. doi:10.1007/s40477-014-0085-6
4. Chen W, Kayler LK, Zand MS, Muttana R, Chernyak V, DeBoccardo GO. Transplant renal artery stenosis: clinical manifestations, diagnosis and therapy. Clin Kidney J. Feb 2015;8(1):71-8. doi:10.1093/ckj/sfu132
5. Patel KN, Patel NA, Gandhi SP. Comparison between doppler ultrasound resistive index, serum creatinine, and histopathologic changes in patients with kidney transplant dysfunction in early posttransplantation period: A single center study with review of literature. Saudi J Kidney Dis Transpl. May 2016;27(3):533-8. doi:10.4103/1319-2442.182391