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Optimizing Evaluation of Split Renal Function in a Living Kidney Donor Using Scintigraphy and Calculation of the Geometric Mean: A Case Report

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Key Words
Living kidney donor · Scintigraphy · Renal function · Geometric mean

Abstract
Within the evaluation process of living kidney donors, split renal function is usually evaluated by renal scintigraphy. Since split renal function measured by conventional posterior scans depends on the position of the kidney, actual suitable donors may be rejected because of an inaccurate examination technique. We report the case of a 28-year-old male living kidney donor. Due to a complex vascular anatomy of the right kidney, only his left kidney was considered eligible for transplantation. In conventional posterior Tc99m-mercapto-acetyltriglycine scintigraphy, the left kidney had a relative function of 60%. A second scintigraphy using anterior and posterior dimercaptosuccinic acid scans with calculation of the geometric mean showed an adapted relative function of the left kidney of 53%, now meeting the inclusion criteria for living kidney donation. This case shows that the geometric mean method using simultaneous anterior and posterior views obtained with a dual-head gamma camera can be a very helpful approach to determine split renal function of potential living kidney donors. Further investigation is necessary to prove the benefit of a general bilateral scan before living kidney donation.

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Introduction

To qualify as a donor for living kidney transplantation, several preoperative criteria have to be met. The preoperative evaluation should include blood and urine screening tests, chest X-ray, electrocardiogram, an age- and family history-appropriate cardiac stress test and radiographic assessment of the kidneys and vessels [1, 2]. Regarding the selection of the explantation side, vascular anatomy and split renal function are crucial. The latter is usually evaluated by renal scintigraphy, and there is consensus that the relative function of the donated kidney should not exceed 55% [3]. However, since split renal function may depend on the respective scintigraphy method used, actual suitable donors may be rejected based on inaccurate examination techniques.

Case Presentation

We report the case of a 28-year-old healthy male applying to donate a kidney to his 61-year-old father. Preliminary assessment showed no contraindications. The computed tomography (CT) angiogram performed showed 2 short renal veins and 2 arteries of the right kidney (fig. 1). Due to the complex anatomy and consequently increased risks for the donor and recipient, a living kidney transplantation of the right kidney was not considered by mutual agreement. However, the left kidney had a relative function of 60% in conventional posterior Tc99m-mercaptoacetyltriglycin (MAG3) scintigraphy (fig. 2), and MAG3 total clearance was in the lower normal range (242 ml/min/1.73 m^2). Considering that the position of the kidney (e.g. malrotation) determines the activity measured, a second scintigraphy using anterior and posterior Tc99m-dimercaptosuccinic acid (DMSA) scans was performed. As expected, the posterior DMSA scan confirmed the results of the posterior MAG3 scan: left kidney 60%. In the additional anterior scan, however, the left kidney now had a relative function of only 46% (fig. 3). Calculating the geometric mean ($\sqrt{a \times p}$), the adapted relative function of the left kidney was 53%, now meeting the inclusion criteria for living kidney donation. Confirmatory, CT-based renal cortex volume calculation was almost the same on both sides (97.23 and 97.31 ml on the left and right, respectively). After extensive education of the donor and recipient, live donor transplantation was carried out without any intra- or postoperative complications. Postoperative renal function (eGFR) of the donor was 62.59 ml/min/1.73 m^2 one week after transplantation (vs. 124.13 ml/min/1.73 m^2 preoperatively). Serum creatinine levels of the donor and recipient were normal at the time of discharge. Six months after transplantation, the eGFR of the donor and recipient were 90.75 and 73.64 ml/min/1.73 m^2, respectively.

Discussion

To our knowledge, this is the first reported case of a living kidney donor who would have been rejected due to an incorrect result of conventional posterior MAG3 scintigraphy.

The influence of left versus right kidney depth variation in renal scintigraphy results has long been understood [4–9]. If the right and the left kidney lie at different distances from the gamma camera, the ratio of the count rates will not reflect the true relative function because of the different amounts of gamma-ray attenuation [4]. Geometric mean images from combined anterior and posterior views are much less affected by kidney depth and offer the opportunity of more accurate and precise quantification [5]. In 1987, Wujanto et al. [4]

reviewed 277 DMSA scans and showed that erroneous results were obtained in 32% of patients over 20 years of age when using the posterior view only. Yapar et al. [6] studied 891 DMSA scans retrospectively. They found a clinically meaningful difference between posterior imaging and the geometric mean method in 55/316 (17.4%) patients over 10 years of age. Although there is consensus that depth correction is not needed in the vast majority of adults [7], this case shows that using the geometric mean can influence the decision whether to perform a kidney donation.

As there is no difference in duration of the examination, costs and radiation exposure between conventional posterior scintigraphy and simultaneous anterior and posterior view, our clinic has adjusted the preliminary assessment of potential living kidney donors: dual scans and calculation of the geometric mean are performed regularly to reduce clinically relevant misinterpretations of split renal function.

References

1 Delmonico FL; Council of the Transplantation Society: A report of the Amsterdam Forum on the care of the live kidney donor: data and medical guidelines. Transplantation 2005;79(suppl 6):S53–S66.
2 Ethics Committee of the Transplantation Society: The consensus statement of the Amsterdam Forum on the care of the live kidney donor. Transplantation 2004;78:491–492.
3 Goh YS, Wu MW, Tai BC, Lee KC, Raman L, Teo BW, Vathsala A, Tiong HY: Comparison of creatinine based and kidney volume based methods of estimating glomerular filtration rates in potential living kidney donors. J Urol 2013;190:1820–1826.
4 Wujanto MB, Lawson RS, Prescott MC, Testa HJ: The importance of using anterior and posterior views in the calculation of differential renal function using 99mTc-DMSA. Br J Radio 1987;160:869–872.
5 Fleming JS: A technique for analysis of geometric mean renography. Nucl Med Commun 2006;27:701–708.
6 Yapar AF, Aydin M, Reyhan M, Yapar Z, Sukan A: The conditions for which the geometric mean method revealed a more accurate calculation of relative renal function in 99mTc-DMSA scintigraphy. Nucl Med Commun 2005;26:141–146.
7 Prigent A, Cosgriff P, Gates GF, Granerus G, Fine EJ, Itoh K, Peters M, Piepsz A, Rehling M, Rutland M, Taylor A Jr: Consensus report on quality control of quantitative measurements of renal function obtained from the renogram: International Consensus Committee from the Scientific Committee of Radionuclides in Nephrourology. Semin Nucl Med 1999;29:146–159.
8 Gruenewald SM, Collins LT, Fawdry RM: Kidney depth measurement and its influence on quantitation of function from gamma camera renography. Clin Nucl Med 1985;10:398–401.
9 Cosgriff P, Brown H: Influence of kidney depth on the renographic estimation of relative renal function. J Nucl Med 1990;31:1576–1577.

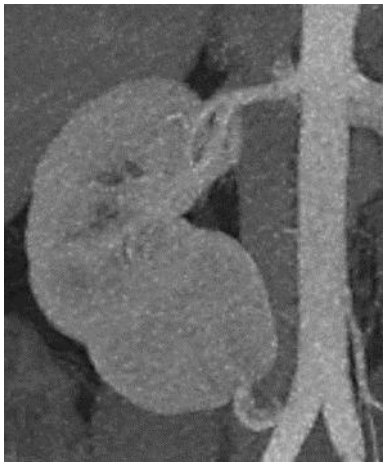

Fig. 1. CT angiogram of the right kidney with complex vessel anatomy.

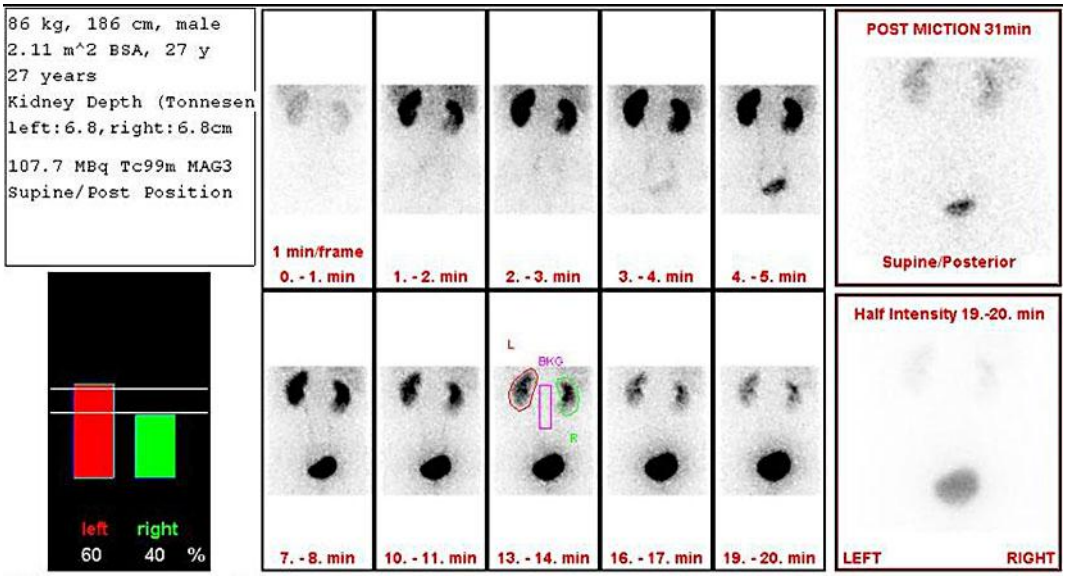

Fig. 2. Conventional posterior Tc99m-MAG3 scintigraphy.

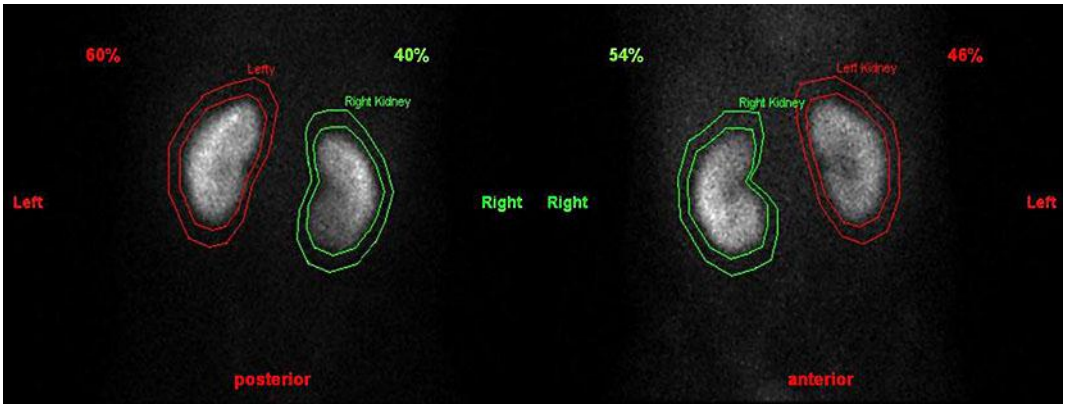

Fig. 3. Posterior and anterior DMSA scintigraphy.