Dynamic imaging with case studies

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Renography has been a well recognised standard diagnostic test in nephrourology for over fifty years, ever since Taplin first used radio-labelled contrast media for assessment of renal function (1). In 1960 ^{131}I Hippuran was developed by Tubis et al. and because of its tubular secretion this became the standard radio-pharmaceutical for probe renography. In 1970 ^{99m}Tc DTPA became available, allowing renograms to be acquired easily with a gamma camera (3) but DTPA has lower renal uptake because it is only filtered. The advent of ^{123}I Hippuran enabled gamma camera renograms to be acquired with a tubular secretion agent (4) but subsequently ^{99m}Tc MAG3 has replaced Hippuran in many parts of the world due to its better availability.

This talk will identify how presentation of the data may influence the report of a renogram. In interpreting renograms it must be remembered that some of the descriptions reported in the literature refer to specific methods of acquiring the data and to the particular radiopharmaceutical used, as there are distinct differences in interpretation between them. For example, normal uptake on a DTPA renogram would be abnormal for ^{123}I Hippuran or MAG3.

The renogram curve is a complex superimposition of renal uptake, transit and elimination, with possibly also a background contribution. This presentation will show how the various components of the renogram curve affect its appearance and address how a reporter should interpret the shape of the curve. Early probe renograms were usually displayed without any background subtraction and this influenced the description of the classic three phases of the renogram – phase 1 (vascular), phase 2 (uptake) and phase 3 (elimination). However, with modern gamma camera renograms, correct background subtraction should remove the vascular component. Incorrect background subtraction can significantly change the appearance of the curve. Moreover the third phase is actually a balance between elimination and continuing uptake, so a rising or falling curve cannot simply be interpreted as obstructed or not-obstructed.

For proper interpretation it is important to display the renogram in an optimum manner. A vertical axis measured in counts per second gives no indication of absolute kidney function unless administered activity and collimator sensitivity are taken into account. Using a vertical axis converted to percentage of administered activity overcomes this problem and gives a much better idea of absolute kidney function. Standardising the maximum values of the axes so that they are the same for all studies makes it easier to compare serial studies on one patient and to see at a glance whether function is good or poor.

Other aspects of the renogram that need to be considered when formulating a report include the quality of the injection, because a delayed input results in a delayed output, and the state of hydration of the patient, since in the elimination component radiotracer is simply following water through the kidney. The position of the kidneys relative to the camera can also affect the apparent uptake and postural mobility and congenitally aberrant positioning can make the relative function calculated from renography incorrect.

Examples of these problems will be demonstrated and ways to identify potential pitfalls highlighted.

References

1. Taplin GV, Meredith OM, Kade H and Winter CC. The Radioisotope Renogram. J Lab. Clin Med 1956; 48:886
2. Tubis M, Posnick N and Nordyke RA. The preparation and use of ^{131}I labelled sodium ortho-iodohippurate in kidney function tests. Proc Soc Exp Biol Med 1960; 103: 498.
3. Hauser W, Atkins HL, Nelson KG and Richards P. ^{99m}Tc-DTPA: A new radiopharmaceutical for brain and kidney scanning. Radiology 1970; 94: 679-684.
4. O'Reilly PH, Herman KJ, Lawson RS, Shields RA and Testa HJ. 123-Iodine: A new isotope for functional renal scanning. Br J Urol 1977; 49: 15-21.
5. A PDF version of the presentation will be available on request from mary.prescott@cmft.nhs.uk.