removal of the radiopharmaceutical from a specific organ. A static study merely provides perfusion and morphologic information, such as assessing adequacy of blood flow; organ size, shape, and position; and any space-occupying lesions.

DIAGNOSTIC IMAGING

Some radiopharmaceuticals are formulated to be placed within a target organ. ^{131}I is taken up actively by thyroid cells following absorption into the bloodstream after oral administration of a capsule or solution. The extent of uptake of the dose by the gland helps assess thyroid function, or an image of the gland can be obtained after administration. Alternatively, when ^{131}I was labeled with orthoiodohippuric acid (^{131}I-orthoiodohippurate, or OIH) and intravenously injected, kidney tubules would actively secrete this agent into urine. Measuring the time course of activity over the kidney with a gamma camera and plotting the rate of radioactivity accumulation and removal versus time yield a measure of kidney function. This dynamic study, termed a *renogram*, is particularly useful to assess renal function in patients with transplanted kidneys. The visualization of the entire kidney anatomically is known as a pyelogram (Fig. 18.1).

There are, however, limitations to the use of ^{131}I-orthoiodohippurate. Because of its beta emissions, the dose must be held from 200 to 400 μCi. The required lower dose with the 364-KeV gamma and beta emissions produces a poorer image than ^{99m}Tc-Mag-3, which has pure gamma emissions of 140 KeV, allowing for a higher dose and enhanced image quality without increasing the total body radiation burden. ^{99m}Tc-Mag-3 undergoes tubular secretion and glomerular filtration in the kidney and provides excellent renograms.

The most common diagnostic imaging procedure is myocardial perfusion imaging (MPI). For many years, this procedure was performed using ^{201}Tl-thallous chloride. However, in recent years, ^{201}Tl has been replaced as the "gold standard" in MPI by the ^{99m}Tc-based radiopharmaceuticals (e.g., ^{99m}Tc-sestamibi, ^{99m}Tc-tetrafosmin) (6).

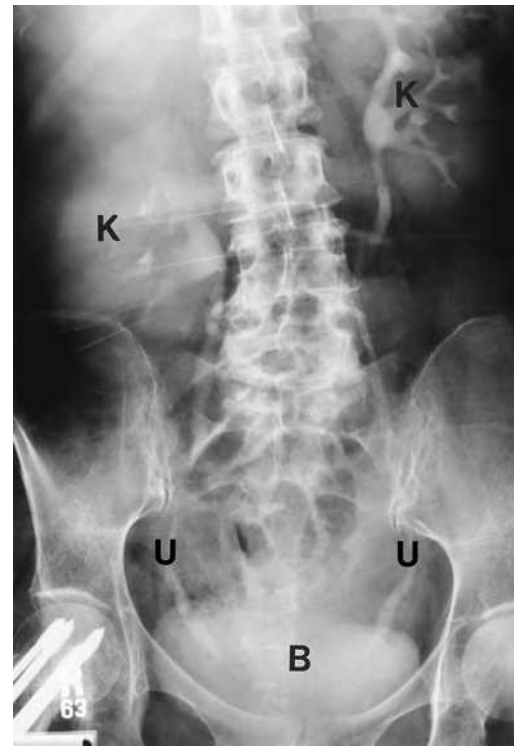

FIGURE 18.1 Intravenous pyelogram in an elderly patient. Note contrast visualization of the kidneys (*K*), ureters (*U*), and bladder (*B*). The patient also has fixation screws in her right hip to stabilize a hip fracture. (Reprinted with permission from Hunter TB, Walsh TK, Hall JN. Agents for diagnostic imaging. In: Block H, Beale JM Jr, eds. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry. 11th Ed. Baltimore, MD: Lippincott Williams & Wilkins, 2004:478.)

Radiopharmaceuticals are useful to evaluate a patient's response to drug therapy and surgery. These agents can detect early changes in physiologic function that come before morphologic or biochemical end points. An example is perfusion lung imaging using ^{99m}Tc macroaggregated albumin particles to detect pulmonary embolism. Once the embolism is confirmed and thrombolytic and/or anticoagulant therapy initiated, this lung-perfusing agent can be administered again to evaluate its resolution with drug therapy. Cardiac radionuclide ventriculograms using ^{99m}Tc-labeled red blood cells are performed to assess left ventricular function (e.g., ejection fraction, regional wall motion) to evaluate the effect of surgery (e.g., coronary artery