

Role of radiology in geriatric care

A primer for family physicians

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Demographic changes and longer life-spans mean that family medicine is increasingly important in modern geriatric care. While history and physical examination remain integral to diagnosis in geriatric patients, expensive imaging techniques have proliferated over the past few decades. Radiology plays a particularly important role in the care of elderly patients, in whom complex symptomatology and a high prevalence of disease necessitate definitive imaging. This article reviews the indications for and appropriateness of various diagnostic tests and interventional procedures.

Quality of evidence

Relevant published articles were identified using a literature search and cross-referencing. We conducted a MEDLINE search using key words relevant to the specific radiology techniques or procedures in question. Only articles that provided level I or II evidence were included in our review, as graded by the 3-point classification system of evidence-based medicine.

Diagnostic radiology

Family physicians often require consultation from diagnostic radiology for the following disorders, which are common among the elderly:

Cerebrovascular disease. While history and physical examination remain the cornerstones of diagnosing cerebrovascular disease, radiology is often required for diagnosis and management. Doppler ultrasound provides a quick and noninvasive method for diagnosing carotid atherosclerosis and is the test of choice after any transient ischemic attack. Advances in computed tomographic angiography (CTA) and magnetic resonance angiography (MRA) provide alternate methods for imaging the carotid

This article has been peer reviewed.

Cet article a fait l'objet d'une révision par des pairs.

Can Fam Physician 2009;55:32-7

Abstract

OBJECTIVE To present family physicians with the options available for diagnosing and treating a selection of common diseases in the elderly using diagnostic and interventional radiology.

QUALITY OF EVIDENCE Articles providing level I or II evidence were included in our review. Most articles presented results from randomized or other case-controlled studies.

MAIN MESSAGE Geriatric care has become a complicated, multidisciplinary effort, with the family physician often leading the team. The expanding cohort of patients is not only better informed than their predecessors, but also more demanding of better care through cutting-edge technology and treatment. Specifically, the role of radiology has expanded quickly in geriatric medicine. Because of complex clinical presentations and rising costs, it is essential for primary care physicians to understand the appropriate use of imaging and radiological intervention.

CONCLUSION There are a number of new and innovative radiological techniques and procedures available for elderly patients. This review aims to inform primary care physicians of a selected number of these techniques.

Résumé

OBJECTIF Présenter aux médecins de famille les options disponibles pour diagnostiquer et traiter un certain nombre de maladies fréquentes chez les personnes âgées à l'aide de la radiologie diagnostique et d'intervention.

QUALITÉ DES PREUVES Notre revue comporte des articles contenant des preuves de niveau I ou II. Dans la plupart des articles, les résultats provenaient d'essais cliniques randomisés ou d'études cas-témoin.

PRINCIPAL MESSAGE Les soins gériatriques exigent maintenant des interventions complexes d'une équipe multidisciplinaires dont le médecin de famille est souvent le chef. La cohorte grandissante de ces patients est non seulement mieux informée que les précédentes, mais elle exige aussi de meilleurs soins basés sur les plus récents développements technologiques et thérapeutiques. Ainsi, le rôle de la radiologie a connu un essor rapide en médecine gériatrique. Compte tenu de la complexité des cas et de l'augmentation des coûts, il est essentiel que le médecin de première ligne connaisse l'utilisation appropriée de l'imagerie et des interventions radiologiques.

CONCLUSION Il existe maintenant un certain nombre de techniques radiologiques nouvelles et innovatrices pour les patients âgés. Cette revue vise à faire connaître certaines de ces techniques aux médecins de première ligne.

arteries. These tests should be combined with imaging of the brain when necessary, such as after an acute or subacute presentation of stroke.

Dementia: Computed tomography (CT) should also be performed for all patients with dementia, as imaging can change management in up to 15% of cases.¹ More generally, CT examination should be undertaken during any acute change in neurologic status as well as in cases of presumed age-related dementia.

Cardiovascular disease. Chest radiography should accompany any workup for cardiovascular disease. Results of chest x-ray scans can suggest congestive heart failure and pericardial disease; however, other forms of examination might still be required for diagnosis. Although chest radiography is in many circumstances neither sensitive nor specific for cardiovascular disease, the new modalities of cardiac CT and magnetic resonance imaging (MRI) can help obtain both structural and functional information about a patient's cardiovascular status.

Coronary artery disease: Early results comparing CTA with traditional angiography demonstrate high sensitivity, high specificity, and strong negative predictive value for significant (defined as ≥ 1 stenoses with $>50\%$ luminal obstruction) coronary artery disease (CAD).² Moreover, CTA has a higher diagnostic accuracy than MRI for detection of significant CAD, although MRI can determine prognosis and myocardial viability in patients with left ventricular dysfunction.³ Computed tomographic angiography might also be useful for detecting stenoses in patients with low or intermediate pretest probability for severe stenotic disease,^{4,5} and calcium scoring on CT examination can be useful in further risk assessment.⁶ However, guidelines do not yet advocate the use of CTA in determining patient prognosis.³

Respiratory disease. As in cardiovascular disease, chest radiography remains the initial test of choice for diagnosing respiratory symptoms.⁷ Pulmonary fibrosis, pneumonia, and lung cancer can be detected with reasonable sensitivity and specificity. Because it is readily available and requires only a low radiation dose, chest radiography should be the first step in diagnosis. If abnormalities appear on a chest x-ray scan, or if clinical concern remains, CT should be used to better characterize any lung pathology.

Levels of evidence

Level I: At least one properly conducted randomized controlled trial, systematic review, or meta-analysis

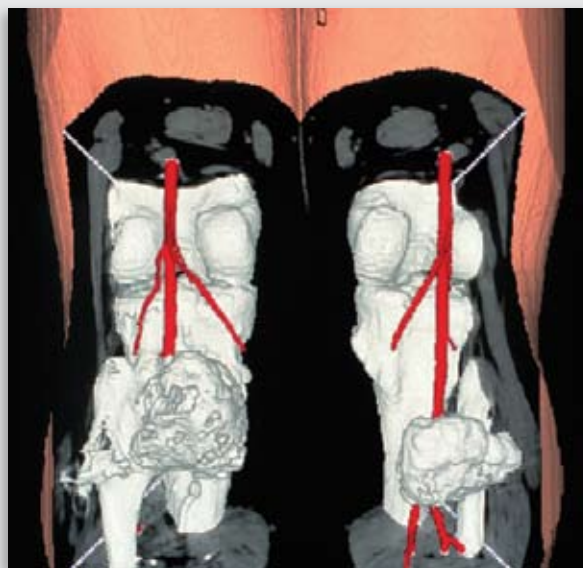
Level II: Other comparison trials, non-randomized, cohort, case-control, or epidemiologic studies, and preferably more than one study

Level III: Expert opinion or consensus statements

Pulmonary nodules: Discovery of a lung nodule on a chest x-ray scan demands further workup with CT, and appropriate follow-up of nodules on CT has been described in the literature.⁸ Nodules less than 4 mm in diameter do not require further follow-up in low-risk patients.⁸ High-risk individuals with a smoking or occupational exposure history might benefit from screening with CT.⁹

Peripheral vascular disease. Imaging of leg vasculature is useful for deciding on appropriate treatment of claudication. Although traditional catheter angiography represents the criterion standard for diagnosing peripheral vascular disease, technological advances have increased the sensitivity and specificity of CTA and MRA to acceptable levels for diagnosis (Figure 1).^{10,11} Computed tomographic angiography and MRA when available should be considered as diagnostic tools for peripheral vascular disease. The use of angiography is outlined below (see Peripheral vascular disease and carotid stenosis). Angiography should be employed when CT and MRI are not available or do not provide a diagnosis despite a high clinical suspicion.

Figure 1. Computed tomographic angiography of the lower extremities



Musculoskeletal disease. Arthritis and degenerative disk disease are highly prevalent in the elderly population. Aside from plain radiography for suspected fracture or arthritides, CT and MRI offer better characterization of most musculoskeletal diseases. Suspected soft tissue or bony masses, as well as acute back pain, require CT or MRI. Computed tomographic imaging provides superior visualization of suspected bony lesions or occult fractures, while MRI should be employed for suspected soft tissue mass or invasion.

Gastrointestinal disease. Bowel obstruction and ileus are common geriatric problems and should be investigated initially with an abdominal radiograph. If obstruction is suspected, CT is required for further assessment. Gallbladder and diverticular disease can be ruled out with ultrasound and CT examination, respectively. Any patient presenting with acute abdomen will benefit from CT investigation. In one recent study, CT was diagnostic for acute abdominal pain in 57% of elderly patients and in 85% of cases requiring surgical intervention.¹²

Bowel malignancy: Suspected colon or other bowel malignancy also requires radiological imaging. Double-contrast barium enema studies can be used to investigate colonic masses when access to colonoscopy is limited, although colonoscopy should still be used for screening according to current guidelines.¹³ Computed tomographic colonography provides excellent sensitivity and specificity for masses or polyps at least 1 cm in size.¹⁴ Further research and evolving protocols will help increase the accuracy of CT and magnetic resonance colonography in the future.¹⁵

Genitourinary disease. Hematuria is common among the geriatric population and requires appropriate workup. Specifically, renal and bladder carcinoma must be ruled out. Abdominal ultrasound should serve as a first-line diagnostic tool, with contrast-enhanced CT as the next step in the diagnostic algorithm.

Interventional radiology

Interventional radiology offers an increasing number of less invasive and safer options for elderly patients. Because comorbidities are common in the elderly population, surgical treatments present considerable risk of morbidity and mortality. Interventional radiology can often minimize these risks through percutaneous access and a decreased need for general anesthesia.

Central venous access for antibiotics, chemotherapy, and dialysis. Geriatric patients often require long-term venous access for medication or dialysis. A number of different catheters are available for insertion by interventional radiology, depending on indication and expected length of treatment. Intermediate-term access for antibiotics or total parenteral nutrition (TPN) is best accomplished through a peripherally inserted central catheter line, which is usually used for treatments lasting between 2 weeks and 6 months; longer-term access is usually managed through insertion of tunneled catheters such as Hickman or Broviac lines. Tunneled catheters greatly reduce the risk of infection¹⁶ and can often be used for up to 3 years. Multiple cycles of chemotherapy can also be easily administered through a subcutaneous port, enabling easy needle access for treatment while avoiding the inconvenience and infection risk of an external

line. In the past, similar ports were inserted surgically, but the radiological approach is quick, more accurate, and does not require general anesthesia. Complications might occur with central venous catheters and include infection, thrombosis, and bleeding.

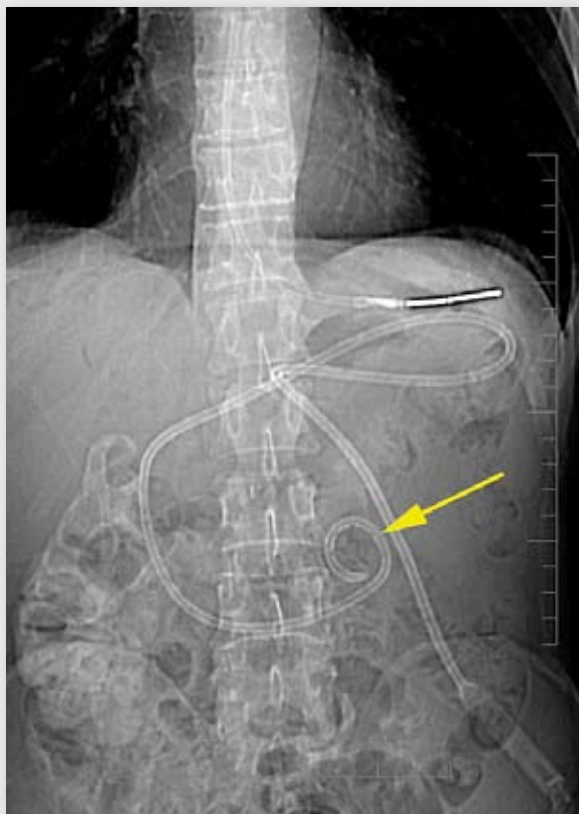
Decreased or obstructed oral intake necessitating alternate feeding. Feeding tubes and catheters can help combat inadequate nutrition in the elderly due to decreased oral intake or an obstructing lesion in the gastrointestinal (GI) tract.

Gastric and gastrojejunal feeding tubes: Balanced nutrition can be delivered to the GI tract through percutaneously inserted feeding tubes (**Figure 2**). Common indications include decreased oral intake by mouth due to neurologic or psychosocial factors. In addition, gastric and gastrojejunal tubes can be used to temporize the need for TPN, reducing associated problems like TPN cholelithiasis and line sepsis.

Total parenteral nutrition: Percutaneously placed venous access catheters (peripherally inserted central catheter lines and tunneled catheters) can provide medium- and long-term solutions for the delivery of TPN, as described above.

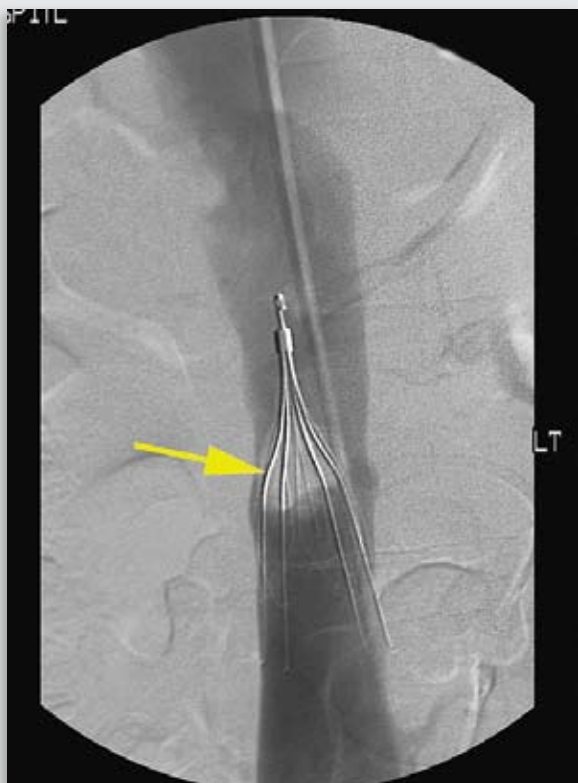
Deep-vein thrombosis and pulmonary embolus. Deep-vein thrombosis in patients with contraindications to

Figure 2. Gastrojejunal tube placement



anticoagulation or for whom anticoagulation has failed can necessitate placement of an inferior vena cava (IVC) filter (**Figure 3**). The femoral vein is accessed percutaneously, and a filter is placed below the renal veins to capture venous emboli en route to the lungs. The main indications for IVC filters are a contraindication to or failure of medical anticoagulation, and these have been summarized in the literature.¹⁷ Newer filters are retriev-

Figure 3. Inferior vena cava filter with large filling defect



able, and thus even short periods of contraindication to anticoagulation can be managed with IVC filters.¹⁸

Spinal compression fractures and osteoporosis. Osteoporosis is prevalent in the elderly population and some of its consequences can now be managed safely through interventional radiology. Specifically, compression fractures can be treated with percutaneous vertebroplasty—a new technique that uses injectable methyl methacrylate cement to stabilize fractured vertebral bodies and thus

decrease pain.^{19,20} A needle is inserted into the fractured vertebral body under CT or fluoroscopic guidance and cement is injected. Vertebroplasty provides symptomatic relief for a condition that can otherwise cause substantial morbidity among the elderly.

Biopsies. Masses discovered on imaging often require pathologic characterization. Interventional techniques provide quick and safe ways to make a pathologic diagnosis. Ultrasound and CT-guided biopsies are commonly performed for the liver, kidneys, lungs, and retroperitoneal masses that require tissue diagnosis; musculoskeletal and genitourinary masses can also be safely biopsied.

Ascites and abscess drainage. Abdominal fluid collections can be successfully drained percutaneously; results are similar to those achieved with surgical drainage.²¹⁻²³ Fluoroscopy, ultrasound, or CT is used to facilitate percutaneous access to purulent collections and provide drainage without the risks of general anesthesia and intra-abdominal surgery. Once a temporary drain has been inserted, weekly or biweekly reassessment through contrast injection (sinogram) can ensure abscess resolution and help exclude fistula formation. Large or complex collections might be better achieved through surgery, and thus require consultation with both a general surgeon and an interventional radiologist.

Biliary obstruction: Similarly, patients with biliary obstruction due to malignancy or stricture might benefit from percutaneous transhepatic cholangiogram and drainage. Generally, drainage and decompression of the biliary tree into the GI tract is attempted first, in order to support normal digestion; if this is not possible, then external drainage can provide symptomatic relief. A temporary percutaneous biliary drain can be left in place to provide continuous drainage. Endoscopic retrograde cholangiopancreatography or surgery might also be necessary; thus, consultation with a gastroenterologist or general surgeon is required.

Ascites: Large amounts of free intraperitoneal fluid, which might be found in cirrhotic patients, can also be drained using a percutaneous technique. Ultrasound guidance is used to ensure that bowel loops and other vital organs are avoided.

Peripheral vascular disease and carotid stenosis. As previously mentioned, CTA, MRA, or catheter angiography can be used to diagnose stenotic lesions in the peripheral vasculature, and balloon angioplasty or stenting can be performed to relieve claudication symptoms.²⁴ Clearly, one of the benefits of catheter angiography is the ability to concurrently perform therapeutic procedures. Similarly, carotid stenosis discovered by Doppler ultrasound or angiography can be treated by carotid

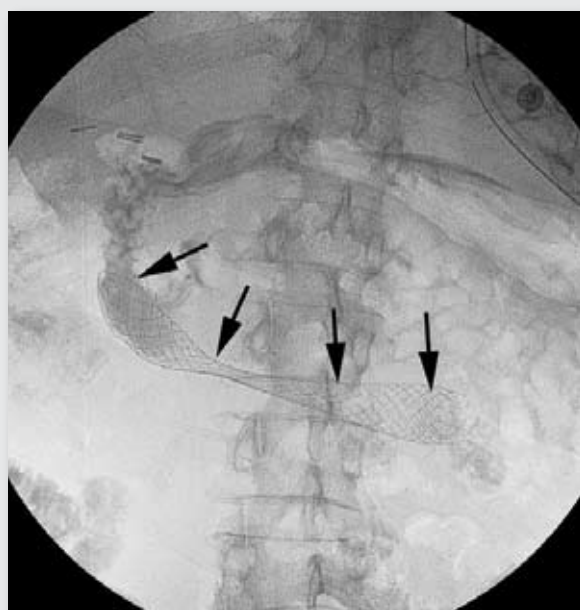
On-line resources

Canadian Association of Radiologists: www.car.ca
 Canadian Interventional Radiology Association:
www.ciraweb.org
 Society of Interventional Radiology: www.sirweb.org

Figure 4. Duodenal stent (preplacement)



Figure 5. Duodenal stent (postplacement)



stenting (Figures 4 and 5). As vascular lesions might restenose, follow-up with angiography and retreatment might be required.

Abdominal aortic aneurysm. With the increased use of ultrasound and CT in the elderly, an increasing number of aortic aneurysms are diagnosed before complications occur. Because of increased surgical risks of vascular procedures, an endovascular approach (ie, endovascular aneurysm repair) is useful for the geriatric population. Covered stents can be used to treat abdominal aortic aneurysms. Early results have been encouraging, showing


either a slight benefit or comparable outcomes when compared with surgery.^{25,26} Endovascular repair should be considered in patients with serious comorbidities.

Special considerations

Renal function and contrast nephropathy. Intravenous contrast material (or “dye”) is a well-known cause of dose-dependent renal failure (contrast-induced nephropathy) in geriatric patients. As creatinine levels are an insensitive means of assessing renal function, all requests for imaging in which intravenous contrast can be used should include a more reliable estimate of renal function, such as estimated glomerular filtration rate or creatinine clearance, in order to facilitate risk stratification. When contrast use is deemed necessary for patient management, preprocedure hydration, avoidance of nephrotoxic medications (eg, nonsteroidal anti-inflammatory drugs, diuretics, aminoglycosides), and, occasionally, administration of N-acetyl cysteine might be required in order to reduce the likelihood of nephropathy.²⁷⁻²⁹

Dementia and motion artifact. Neuroimaging and interventional radiology in particular require patients’ strict adherence to instructions in order to obtain adequate images for interpretation. The problems that a confused or combative patient will pose in this regard should not preclude the use of imaging or interventional techniques.

Conclusion

Radiology plays an increasingly important role in primary care management of the elderly. This review serves as an outline for physicians dealing with the elderly population, providing guidance for the appropriate use of imaging and interventional techniques in this complex group of patients. As this cohort of patients continues to expand and radiology continues to evolve, the complex relationship between geriatric care and radiology will continue to be redefined. 

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Contributors

Dr O’Brien was the primary writer of the manuscript. **Drs Baerlocher, Myers,** and **Asch** contributed to the editing of the manuscript.

Competing interests

Dr Baerlocher has received honoraria from Boston Scientific in the past. **Dr Asch** receives research support from Cook Group Incorporated and Dermaport. **Dr Myers** has received honoraria and research support from Boston Scientific and Cook Group Incorporated.

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EDITOR'S KEY POINTS

- With the aging of the population and the shortage of geriatricians, most elderly patients will primarily be cared for by their family physicians. Although a careful history and physical examination can still lead to diagnosis of problems in complex elderly patients, there is an increasing role for specialized imaging techniques in this population.
- This concise clinical review summarizes for busy family physicians the indications for, and appropriateness of, a range of radiologic tests and interventions in the geriatric population, using an evidence-based framework.

POINTS DE REPÈRE DU RÉDACTEUR

- Avec le vieillissement de la population et la pénurie de gériatres, la plupart des patients âgés seront principalement soignés par leur médecin de famille. Même si un historique et un examen physique attentifs peuvent encore permettre de diagnostiquer les problèmes complexes des patients âgés, les techniques d'imagerie spécialisées jouent un rôle de plus en plus grand chez cette population.
- Cette brève revue clinique basée sur des données probantes résume pour le médecin de famille surchargé les indications et les occasions appropriées pour un certain nombre d'examen et d'interventions radiologiques dans la population gériatrique.

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