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INTERVENTION RADIOLOGY IN GERIATRIC MEDICINE

Dr. Ghanshyam Dev*[1] and Dr. Sonali Sharma[2]

[1]Professor and HoD, Department of Radiology, Govt Medical College, Jammu, J&K.
[2]Senior Resident Department of Radiology, Govt. Medical College, Jammu, J&K.

***Corresponding Author: Dr. Ghanshyam Dev**

Professor and HoD, Department of Radiology, Govt Medical College, Jammu, J&K.

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ABSTRACT

Geriatric health care has become an intricate and multidisciplinary field. With the enhanced life expectancy; an ever demanding cohort of well informed aged patients is continuously increasing. Specifically, the role of radiology has expanded quickly in geriatric medicine and plays a particularly important role in the care of elderly patients, in whom complex symptomatology, a high prevalence of disease and comorbidity states necessitate and dictate definitive diagnostic imaging and miniscule therapeutic interventions. This article reviews and summarises the indications for and suitability of various diagnostic tests and interventional radiological procedures and further aims to notify the primary care physicians of both the available and the elected options of these available techniques.

KEYWORDS: Geriatric health care, Radiology, Musculoskeleton disease and interventional radiology.

INTRODUCTION

Elders are the fastest growing segment of our society. In fact in this longevity revolution with an increase in life expectancy, radiologists are facing diverse challenges while imaging this growing population.[1] This 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. Moreover, because of complex clinical presentations and rising costs,[2] it is essential for primary care physicians to understand the appropriate use of imaging and radiological interventions.

According to studies, it is 10 times more difficult to obtain useful clinical imaging information in elderly patients than in younger ones. Social, Psychological, Cognitive & economics of aging is to be understood simultaneously. In order to avoid over diagnosis and overtreatment, it is essential not to confuse the healthy elderly patient complaining of pain with another elderly patient who really needs medical intervention, which is a very common phenomenon in "Geriatric Imaging"[3-4] This reason has triggered a significant increase in demand for health services, along with the development of new effective therapeutic protocols dedicated to geriatric patients, as well as non-invasive techniques and increasingly accurate diagnostic methods.[5]

According to a 2010 United Nations (UN) Department of Economic and Social Affairs report, in 2009 more than 700 million people in the world were age 60 and older - triple that of the 1950 population.[6,7] The segment of people aged 60 and older has increased from 8 percent in 1950 to 11 percent in 2009 and the UN estimates that proportion will increase to 22 percent by 2050.[8]

Also, as elderly patients present unique imaging challenges, it is important to differentiate age related changes versus disease progression.[9] Elderly are to be treated as the whole persons with procedures especially adapted to them. Moreover, front-line minimally invasive therapeutic procedures that are alternatives or may serve as adjuncts to traditional surgical treatments are becoming all the more important in the curative or palliative management of elderly frail patients with manifold comorbid conditions.[10,11] Thus, it is essential to recognize that older adults are a different group of people who experience some frequent changes as they age. Older adults are not the same as younger adults, and the age-related changes that are present will affect the care provided. The numbers and percentages of older adults are continuing to rise[12]; they are now the core business of health care, using the majority of health care services. Being aware of age-related changes and various methods in interventional radiology will help health care professionals provide sensitive, effective age-appropriate, empathetic and quality care to the patients.[13]

Interventional Radiology, means administering various therapeutic options under image guidance and has evolved from angiography, a specialized X ray test done for evaluation of blood vessels.[14,15] Almost all diseases

of blood vessels can be treated with Interventional Radiology. This diversifying branch of medicine finds application in virtually all disciplines of modern medicine. It combines the most **modern technology** and **personnel expertise** and delivers the latest and the best to all the patients. Radiology plays an increasingly important role in primary care management of the elderly.[16,17] With an extension in this cohort of patients, radiology evolved and established itself fully for diagnostic and therapeutic procedures in the aged.[18] This article provides an overview of various techniques used in Interventional Radiology and its use in diagnosis and therapeutic procedures.[19,20]

Technological developments of imaging equipment coupled with the advanced engineering of pinhole therapeutic applicators and minuscule endovascular instruments have fuelled worldwide.[21] Volumetric spiral CT in the study of cardiovascular disease and CT virtual endoscopy are examples of such improvements, while MR imaging has opened new perspectives in the study of the central nervous system, particularly in the identification of cerebrovascular disease.[22,23] In addition, MR spectroscopy results have significantly improved the identification of early stage prostate tumors.[24] Interventional radiologists commonly perform both **Diagnostic** and **Therapeutic** procedures.

Diagnostic

An important consideration is that geriatric patients sometimes have to be maintained in uncomfortable positions for significant lengths of time during their imaging studies. However, significant progress in all areas of diagnostic imaging helps alleviate this concern.[25,26]

Chest Radiography: CT speed is critical even in the basic Chest Imaging of the elderly. The latest generation of CT scanners help address issues particular to imaging the chest. Because elderly patients are unable to hold their breath for long periods, speed in administering CT scan is essential to avoid motion artifacts.[27,28] In this scenario, chest imaging in these patients should be based on fast technical strategies such as chest radiography and CT that allow imagers to obtain information with few or no changes in positioning.[29,30]

Other considerations for chest imaging in elderly patients include frailty, immobility and the presence of co - morbidities such as previous surgery, hypertension, renal insufficiency and poor peripheral venous access.[31] Moreover, numerous anatomical and physiological changes occur during the aging process involving the chest wall, mediastinum and lung parenchyma.[32]

An elderly patient's heart and aorta are characterized by several major involutions, including lengthening and dilation of the aorta—factors responsible for enlargement of the mediastinal contour in chest radiograph frontal projection. Aortic atheromatic calcification is frequent but not always related to the gravity of the clinical situation.[33,34]

In the lungs, physiologic aging of the lung parenchyma characterized by macroscopic, microscopic and vascular modifications translates into the "elderly lung." One manifestation is "barrel chest," a result of ribcage deformity with an increased bilateral hyperlucency and homogeneous reduction of vascularization often associated with bronchial wall thickening and air bubbles.[35] The changes are marked by a reticular pattern on CT scans with a thickening of interlobular and intralobular septa, cysts, bronchial dilatation and bronchial wall thickening.[36]

In this context, the correlation of the extent of fibrotic changes with clinical history and other pulmonary and extrapulmonary findings is crucial to differentiate these moderate basal fibrosis related to the aging process with those of interstitial lung disease[37], such as usual interstitial pneumonia and non-specific interstitial pneumonia.

Radiologists have to be aware of the numerous changes in the chest that occur in the aging process and to implement a rigorous method for evaluating all of the subcomponents. By doing this, radiologists can more readily identify the signs of the onset of disease.[38,39] Chest imaging findings should be always associated with the clinical context and previous examinations; whenever necessary a follow-up exam must be requested.[40]

Angiography: It is the imaging of the blood vessels to look for abnormalities with the use of various contrast media including Iodinated contrast, Gadolinium based agents and CO_2 gas.[41] Besides this doppler ultrasound is a quick and non-invasive method of diagnosing carotid atherosclerosis after transient ischaemic attacks (TIA). Computed tomography angiography (CTA) and magnetic resonance angiography (MRA) are other alternative methods for imaging carotid arteries.[42,43]

CTA might be useful for detecting stenosis in patients with low or intermediate pretest probability for severe stenotic diseases.[44] These tests are particularly important in acute and subacute presentation of stroke and CT is particularly important in acute change in neurologic status and in dementia.[45]

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 peripheral vascular disease, technological advances have increased the sensitivity and specificity of CTA and MRA to acceptable levels for diagnosis.[46-47]

Musculoskeletal disease: Degenerative diseases and arthritis are highly prevalent in the elderly population. CT and MRI offer much better characterization of most

of the musculoskeletal diseases.[48] CT imaging provides superior visualization of the suspected bony lesions and occult fractures while MRI should be employed for suspected soft tissue mass or invasion.[49]

Gastrointestinal disease: All patients of acute abdomen benefit from CT abdomen. In a recent study CT was diagnostic for acute abdominal pain in 57% of the elderly patients and in 85% of the patients requiring surgical intervention.[50]

Cholangiography: Imaging the bile ducts within the liver to look for areas of blockage is routinely done.[51]

Biopsy: Taking of a tissue sample from the area of interest for pathological examination is routinely done by a percutaneous or transvenous approach. Ultrasound or CT guided biopsies are commonly performed for the liver, kidneys, lungs, musculoskeletal and genitourinary and retroperitoneal masses.[52-53]

Therapeutic

- **Vascular**

a. **Balloon angioplasty/stent:** Opening of narrow or blocked blood vessels using a balloon, with or without placement of metallic stents as aid to keep vessels patent[54]
b. **Endovascular aneurysm repair:** placement of endovascular stent-graft across an aneurysm, in order to prevent expansion or progression of the defective vessel[55]
c. **Embolization:** Placement of a metallic coil or embolic substance[56] (gel-foam, poly-vinyl alcohol) to block blood through to a blood vessel, either to stop bleeding or decrease blood flow to a target organ or tissue[57] eg. Uterine artery embolization (UAE) or uterine fibroid embolization (UFE) and Prostate artery embolization (PAE).
d. **Thrombolysis:** Catheter-directed technique for dissolving blood clots, such as pulmonary embolism and deep venous thrombosis with either pharmaceutical (TPA) or mechanical means[58]
e. **IVC filters:** Metallic filters placed in the inferior vena cava to prevent propagation of deep venous thrombus to capture venous emboli en route to lungs[59]
f. **Dialysis related interventions:** Placement of tunneled hemodialysis catheters, peritoneal dialysis catheters[60]
g. **Revision/Thrombolysis** of poorly functioning surgically placed AV fistulas and grafts are important therapeutic vascular interventions.[61]

- **Central venous access for Antibiotics, Chemotherapy and Dialysis:** Geriatric patients often require long term venous access for medication or dialysis. Intermediate term access for antibiotics or total parentral nutrition (TPN) is best accomplished through a peripherally inserted central catheter line for treatments lasting between 2 weeks and 6 months.[62-65] Longer term access is usually managed through tunneled catheters such as Hickman or Broviac lines. Tunneled catheters greatly reduce the risk of infection and can often be used for upto 3 years.[66-67]

- **Others**

TIPS: Placement of a Transjugular Intrahepatic Porto-systemic Shunt (TIPS) is done for select indications in patients with critical end-stage liver disease and portal hypertension.[67-68]

Endovenous laser treatment of varicose veins: Placement of thin laser fiber in varicose veins is an established non-surgical treatment of venous insufficiency.[69]

Biliary intervention: It includes the placement of catheters and permanent indwelling biliary stents in the biliary system to bypass biliary obstructions to decompress the biliary system.[70-71]

Cholecystostomy: Placement of a tube into the gall bladder to remove infected bile in patients with cholecystitis, an inflammation of the gallbladder, who are too frail or too sick to undergo surgery.[72-73]

Catheter placement: Central venous catheter placement includes vascular access and management by intravenous devices.[74] It includes both tunneled and non-tunneled catheters (e.g. PIC, Hickman, port catheters, hemodialysis catheters, translumbar and transhepatic venous lines).

Drainage catheter placement: It is the placement of tubes to drain pathologic fluid collections (e.g., abscess, pleural effusion).[75] This may be achieved by percutaneous, trans-rectal or trans-vaginal approach. Exchange or repositioning of indwelling catheters is achieved over a guidewire under image guidance.[76,77]

Radiologically inserted gastrostomy or jejunostomy: It is the placement of a feeding tube percutaneously into the stomach and/or jejunum.[78,79]

Total Parentral Nutrition: Peipherally inserted central catheter lines and tunneled catheters are used for total parentral nutrition.[80]

- **Ablative intervention radiology**

Chemo-embolization: It is the combined injection of chemotherapeutic and embolic agents into the arterial blood supply of a tumor, with the goal of both local administration of chemotherapy, slowing "washout" of the chemotherapy drugs and also decreasing tumor arterial supply.[81-82]

Radio-embolization: Is the combined injection of radioactive glass or plastic beads and embolic agents into the arterial blood supply of a tumor, with the goal of both

local administration of radiotherapy, slowing "washout" of the radioactive substance, and also decreasing tumor arterial supply.[83-84]

Radiofrequency ablation (RF/RFA): It is the local treatment which uses a special catheter to destroy tissue by using heat generated by medium frequency alternating currents.[85]

Cryoablation: local treatment which uses a special catheter to destroy tissue by using cold temperature generated by rapid expansion of compressed argon gas.[86-87] This technique is mostly used for the treatment of small renal cancers and for the palliation of painful bone lesions.[88]

Microwave ablation: A local treatment which uses a special catheter to destroy tissue by using heat generated by microwaves.[89]

- **Genitourinary**

Percutaneous nephrostomy or nephroureteral stent placement: Placement of a catheter through the skin, directly into the kidney in order to drain from the collecting system. This is typically done to treat a downstream obstruction of urine.[90-91]

Ureteral stent exchange: They are indwelling double-J type ureteral stents, typically placed by urologist using cystoscopy, may be exchanged in retrograde fashion through the female urethra. The Intervention Radiologist uses a thin wire snare under fluoroscopy to capture the distal portion of the stent.[92] After partially extracting the distalmost stent, exchange for a new stent can be accomplished over a guidewire.[93]

- **Pain Management**

Vertebroplasty: Percutaneous injection of biocompatible bone cement inside a fractured spinal vertebrae is done to restore vertebral body height and relieve pain.[94]

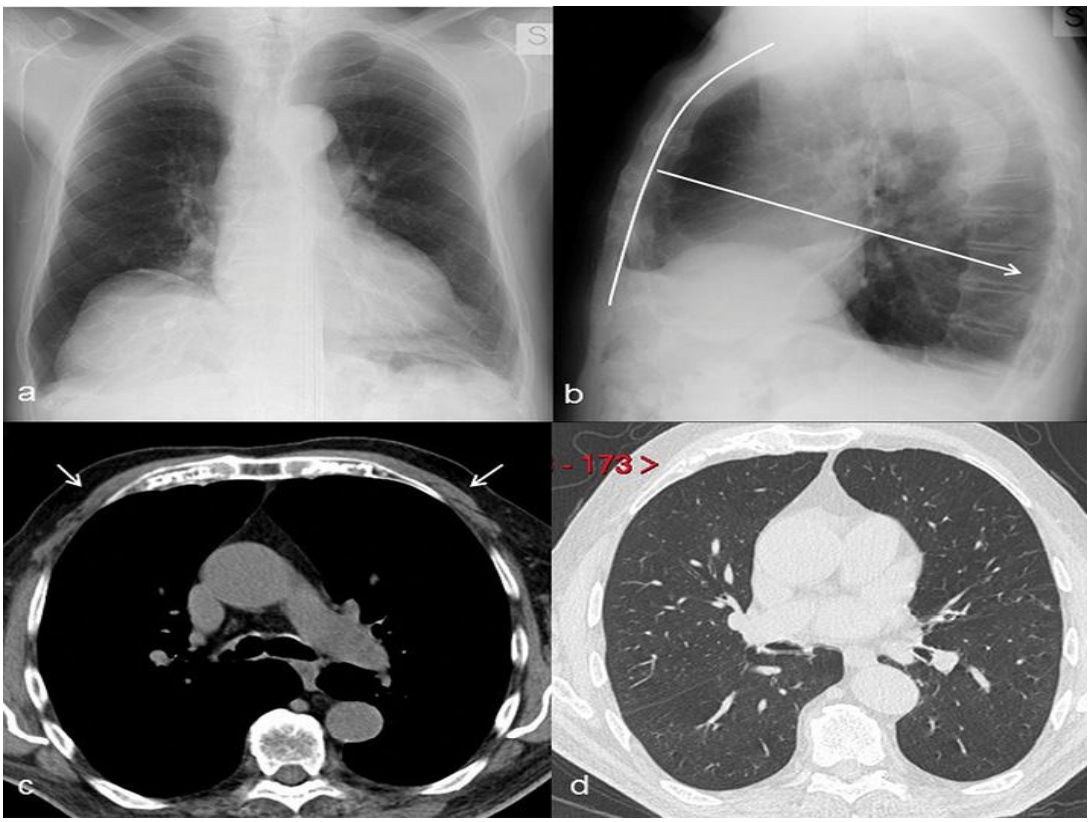

Fig. Chest imaging in elderly patients presents special considerations for radiologists. Above: Frontal (a) and lateral chest X-ray (b) of a 78-year-old man show a "barrel chest" deformity with increase in the antero-posterior diameter (white arrows in b) with an apparent increase in lung transparency and hyperelevation of the right hemidiaphragm. Subsequent CT scans show atrophy of pectoral muscles (white arrows in c) partially responsible for the hyperluncency of lung parenchyma. Signs of pulmonary emphysema are not on CT (d). Hyperelevation of the right hemidiaphragm is due to muscle dyskinesia.

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. Radiologist are facing unique challenges in imaging the rapidly growing population of elderly patients.

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