

Diagnostic and interventional radiology: an update

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In recent years, radiology has undergone revolutionary changes in all aspects of the discipline (1-10). The progressive and rapid innovation of technology has led on the one hand to ever more significant and new applications in the diagnostic field; on the other hand, it has opened up to interventional radiology therapeutic possibilities that are radically changing the clinical approach to numerous pathologies (11-15). Furthermore, the advent of artificial intelligence is unveiling a new scenario with which the radiologist of the future will have to confront, and which will undoubtedly lead to important implications in the conception of radiology (16-18). In this context of innovation, the clinical and - above all - global approach of radiology remains fundamental (19-21); it is for this reason that with this Special Issue entitled “Diagnostic and interventional radiology: an update” we wanted to deal with some focuses that summarized the foundations of diagnostic and interventional radiology topics in light of the relative “state of the art”.

In the first part of the volume, dedicated to abdominal imaging (22-24), the first two articles, “Hepatic tumors: pitfalls in diagnostic imaging” and “The role of imaging in surgical planning for liver resection” represent a guide to the radiologist who have to integrate the different and multimodal diagnostic techniques, to confront and being a point of reference for the clinicians and the surgeons in the patient’s therapeutic management (25-27).

The third article by Reginelli et al., “MRI of perianal fistulas in Chron’s disease”, also deals with a very frequent pathology, for which a precise and therapy-oriented imaging diagnosis is fundamental. In particu-

lar, the authors provide valuable notions of anatomy and study technique, essential for the formulation of an exhaustive diagnosis (28).

Another contribution by Reginelli et al., “Extranodal lymphomas: a pictorial review for CT and MRI classification”, focuses on the study of the imaging classification of a pathology in which staging and treatment are primarily clinical, but supported by careful imaging study.

In the second section, we focused on thoracic and cardiovascular radiology topics (29-31). The article “Anterior chest wall non-traumatic diseases: a road map for the radiologist” is an accurate focus on the pathology of the chest wall, a topic for which the radiologist can often find difficulties about the information to provide to the clinician, and for which knowledge of anatomy and possible pathological pictures is of fundamental importance.

Following the recent tragic pandemic outbreak of Coronavirus pneumonia, Floridi et al. discuss, with a “practical guide”, the fundamental role of diagnostic imaging in the approach and management of patients with COVID-19.

The last article of the thoracic section is the contribution of Pradella et al., “Masses in right side of the heart: spectrum of imaging findings”, dedicated to cardiac radiology, in which the authors provide an overview of the radiological characteristics - either with coronary CT and with cardiac MRI - of cardiac tumors and masses.

The next section is dedicated to the great chapter of interventional radiology, of which we have collected some insights. The work by Ierardi et al., “Basic em-

bolization techniques: tips and tricks” is a handy guide to the interventional radiologist, more or less expert, providing practical indications on the techniques and materials for one of the leading and most crucial interventional radiology endovascular procedures (32).

Another technique for which interventional radiology has become a fundamental prerogative is biopsy. Pagnini et al. discuss about it in their contribution “Imaging guided percutaneous renal biopsy”, underlining the importance of the knowledge of imaging in such a demanding approach as that of renal biopsy.

Turning to extravascular interventional neuroradiology, Negro et al., in their article “Predictive factors of volumetric reduction in lumbar disc herniation treated by O2-O3 chemiodiscolysis”, present an original study dealing with a popular, effective and minimally invasive technique for the treatment of low back pain (33, 34).

The recent innovations applied to diagnostic and interventional radiology have led to significant changes also in the field of musculoskeletal radiology (35-39). In the article “Advanced diagnostic imaging and intervention in tendon diseases”, Bruno et al. describe the application of advanced MRI and US techniques in the study of degenerative tendon pathology, together with the description of the main imaging-guided interventional techniques (40).

More focused on diagnostics, the contribution of Acanfora et al. on the spectrum of synovial pathology describes the most frequent inflammatory, degenerative, and pseudotumoral pathology (41, 42).

Dual-energy technology in CT imaging has been introduced recently (43); one of the most interesting and useful applications is the study of joint gouty crystals, described by Carotti et al. in the work “Clinical utility of Dual energy Computed Tomography in gout: current concepts and applications”.

The last two articles of the volume are dedicated to neuroradiology (44-48). The contribution of Palumbo et al. is a comprehensive review of the clinical, diagnostic, and therapeutic features of spondylodiscitis. In the article “Diagnosis and management of intralabyrinthine schwannoma: case series and review of the literature”, Di Lullo et al. integrate the clinical and imaging aspects of this pathology, with the consequent implications in therapeutic management.

Despite the difficulty in the exhaustive treatment of such vast and complex topics, we believe that the proposed works can be essential and useful targeted insights for radiologists of different subspecialties.

A heartfelt thanks to all the authors who made the realization of this project possible.

Conflict of interest: Authors declare that they have no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

References

1. Barile A, Bruno F, Arrigoni F, et al. Emergency and Trauma of the Ankle. *Semin Musculoskelet Radiol* 2017; 21: 282- 89.
2. Barile A, Conti L, Lanni G, et al. Evaluation of medial meniscus tears and meniscal stability: weight-bearing MRI vs arthroscopy. *Eur J Radiol* 2013; 82(4): 633-9.
3. Floridi C, Radaelli A, Pesapane F, et al. Clinical impact of cone beam computed tomography on iterative treatment planning during ultrasound-guided percutaneous ablation of liver malignancies. *Medical oncology* 2017; 34: art n° 113
4. Di Geso L, Zardi EM, Afeltra A, et al. Comparison between conventional and automated software-guided ultrasound assessment of bilateral common carotids intima-media thickness in patients with rheumatic diseases. *Clin Rheumatol* 2012; 31: 881-4.
5. Manetta R, Palumbo P, Gianneramo C, et al. Correlation between ADC values and Gleason score in evaluation of prostate cancer: multicentre experience and review of the literature. *Gland Surg* 2019; 8: S216-s22.
6. Cortellini A, Bozzetti F, Palumbo P, et al. Weighing the role of skeletal muscle mass and muscle density in cancer patients receiving PD-1/PD-L1 checkpoint inhibitors: a multicenter real-life study. *Sci Rep* 2020; 10: 1456.
7. Mungai F, Pasquinelli F, Mazzoni LN, et al. Diffusion-weighted magnetic resonance imaging in the prediction and assessment of chemotherapy outcome in liver metastases. *Radiol Med* 2014; 119: 625-33
8. Agostini A, Kircher MF, Do R, et al. Magnetic Resonance Imaging of the Liver (Including Biliary Contrast Agents) Part 1: Technical Considerations and Contrast Materials. *Seminars in roentgenology* 2016; 51: 308-316
9. Salvati F, Rossi F, Limbucci N, et al. Mucoïd metaplastic-degeneration of anterior cruciate ligament. *The Journal of sports medicine and physical fitness* 2008; 48: 483-487.
10. Barile A, Bruno F, Mariani S, et al. What can be seen after rotator cuff repair: a brief review of diagnostic imaging findings. *Musculoskelet Surg* 2017; 101: (Suppl1): 3-14
11. Masciocchi C, Arrigoni F, Ferrari F, et al. Uterine fibroid therapy using interventional radiology mini-invasive treatments: current perspective. *Med Oncol* 2017; 34: 52.

12. Zoccali C, Rossi B, Zoccali G, et al. A new technique for biopsy of soft tissue neoplasms: a preliminary experience using MRI to evaluate bleeding. *Minerva Med* 2015; 106: 117-120.
13. Carrafiello G, D'Ambrosio A, Mangini M, et al. Percutaneous cholecystostomy as the sole treatment in critically ill and elderly patients. *Radiol Med* 2012; 117: 772-9.
14. Ierardi AM, Tsetis D, Ioannou C, et al. Ultra-low profil polymer-filled stent graft for abdominal aortic aneurysm treatment: a two-year follow-up. *Radiol Med* 2015; 120: 542-8.
15. Dialetto G, Reginelli A, Cerrato M, et al. Endovascular stent graft treatment of thoracic aortic syndromes: a 7-year experience. *European journal of radiology* 2007; 64 (1): 65-72.
16. Nardone V, Reginelli A, Guida C, et al. Delta-radiomics increases multicentre reproducibility: a phantom study. *Med Oncol* 2020; 37: 28.
17. Grassi R, Miele V, Giovagnoni A. Artificial intelligence: a challenge for third millennium radiologist. *Radiol Med* 2019; 124: 241-42.
18. Neri, E., Coppola, F., Miele, V. et al. Artificial intelligence: Who is responsible for the diagnosis?. *Radiol med* 2020 125, 517-521
19. Mariani S, La Marra A, Arrigoni F, et al. Dynamic measurement of patello-femoral joint alignment using weight-bearing magnetic resonance imaging (WB-MRI). *European journal of radiology* 2015; 84: 2571-8
20. Scaglione M, Salvolini L, Casciani E, Giovagnoni A, Mazzei MA, Volterrani L. The many faces of aortic dissections: Beware of unusual presentations. *Eur J Radiol* 2008;65: 359-64.
21. Mascalchi M, Maddau C, Sali L, et al. Circulating tumor cells and microemboli can differentiate malignant and benign pulmonary lesions. *Journal of Cancer* 2017; 8: 2223-2230.
22. Pinto A, Lanza C, Pinto F, et al. Role of plain radiography in the assessment of ingested foreign bodies in the pediatric patients. *Semin Ultrasound CT MR* 2015; 36: 21-7.
23. Reginelli A, Capasso R, Ciccone V, et al. Usefulness of triphasic CT aortic angiography in acute and surveillance: Our experience in the assessment of acute aortic dissection and endoleak. *Int J Surg* 2016; 33 Suppl 1: S76-84
24. Reginelli A, Russo A, Iasiello F, et al. [Role of diagnostic imaging in the diagnosis of acute appendicitis: a comparison between ultrasound and computed tomography]. *Recenti Prog Med* 2013; 104: 597-600.
25. Panfili E, Nicolini D, Polverini V, Agostini A, Vivarelli M, Giovagnoni A. Importance of radiological detection of early pulmonary acute complications of liver transplantation: analysis of 259 cases. *Radiol Med* 2015; 120: 413-20.
26. Borgheresi A, Gonzalez-Aguirre A, Brown KT, et al. Does Enhancement or Perfusion on Preprocedure CT Predict Outcomes After Embolization of Hepatocellular Carcinoma? *Acad Radiol* 2018; 25: 1588-94.
27. Mungai F, Pasquinelli F, Mazzoni LN, et al. Diffusion-weighted magnetic resonance imaging in the prediction and assessment of chemotherapy outcome in liver metastases. *Radiol Med* 2014; 119: 625-33.
28. Iacobellis F, Berritto D, Fleischmann D, et al. CT findings in acute, subacute, and chronic ischemic colitis: suggestions for diagnosis. *Biomed Res Int* 2014; 2014: 895248.
29. Agliata G, Schicchi N, Agostini A, et al. Radiation exposure related to cardiovascular CT examination: comparison between conventional 64-MDCT and third-generation dual-source MDCT. *Radiol Med* 2019; 124: 753-61.
30. Di Cesare E, Patriarca L, Panebianco L, et al. Coronary computed tomography angiography in the evaluation of intermediate risk asymptomatic individuals. *Radiol Med* 2018; 123: 686-94.
31. Pescarolo M, Sverzellati N, Verduri A, et al. How much do GOLD stages reflect CT abnormalities in COPD patients? *Radiol Med* 2008; 113: 817-29.
32. Ierardi AM, Piacentino F, Fontana F, et al. The role of endovascular treatment of pelvic fracture bleeding in emergency settings. *Eur Radiol* 2015; 25: 1854-64.
33. Perri M, Grattacaso G, di Tunno V, et al. T2 shine-through phenomena in diffusion-weighted MR imaging of lumbar discs after oxygen-ozone discolysis: a randomized, double-blind trial with steroid and O2-O3 discolysis versus steroid only. *Radiol Med* 2015; 120: 941-50.
34. Patriarca L, Letteriello M, Di Cesare E, Barile A, Gallucci M, Splendiani A. Does evaluator experience have an impact on the diagnosis of lumbar spine instability in dynamic MRI? Interobserver agreement study. *Neuroradiol J* 2015; 28: 341-6.
35. Masciocchi C, Arrigoni F, La Marra A, Mariani S, Zugaro L, Barile A. Treatment of focal benign lesions of the bone: MRgFUS and RFA. *Br J Radiol* 2016; 89: 20150356.
36. Zoccali C, Arrigoni F, Mariani S, Bruno F, Barile A, Masciocchi C. An unusual localization of chondroblastoma: The triradiate cartilage; from a case report a reconstructive technique proposal with imaging evolution. *J Clin Orthop Trauma* 2017; 8: S48-s52.
37. De Filippo M, Pesce A, Barile A, et al. Imaging of postoperative shoulder instability. *Musculoskelet Surg* 2017; 101: 15-22.
38. Pogliacomì F, De Filippo M, Paraskevopoulos A, Alesci M, Marengi P, Ceccarelli F. Mini-incision direct lateral approach versus anterior mini-invasive approach in total hip replacement: results 1 year after surgery. *Acta Biomed* 2012; 83: 114-21.
39. Barile A, Arrigoni F, Bruno F, et al. Present role and future perspectives of interventional radiology in the treatment of painful bone lesions. *Future Oncol* 2018; 14: 2945-55.
40. Arrigoni F, Napoli A, Bazzocchi A, et al. Magnetic-resonance-guided focused ultrasound treatment of non-spinal osteoid osteoma in children: multicentre experience. *Pediatr Radiol* 2019; 49: 1209-16.
41. Carotti M, Salaffi F, Di Carlo M, Giovagnoni A. Relationship between magnetic resonance imaging findings, radiological grading, psychological distress and pain in patients with symptomatic knee osteoarthritis. *Radiol Med* 2017; 122: 934-43.

42. Bruno F, Arrigoni F, Palumbo P, et al. New advances in MRI diagnosis of degenerative osteoarthropathy of the peripheral joints. *Radiol Med* 2019; 124: 1121-27.
43. Agostini A, Mari A, Lanza C, et al. Trends in radiation dose and image quality for pediatric patients with a multidetector CT and a third-generation dual-source dual-energy CT. *Radiol Med* 2019; 124: 745-52.
44. Paonessa A, Limbucci N, Tozzi E, et al. Radiological strategy in acute stroke in children. *Eur J Radiol* 2010; 74: 77-85
45. Tamburrini S, Solazzo A, Sagnelli A, et al. Amyotrophic lateral sclerosis: sonographic evaluation of dysphagia. *Radiol Med* 2010; 115: 784-93.
46. Varrassi M, Cobiachi Bellisari F, Bruno F, et al. High-resolution magnetic resonance imaging at 3T of pituitary gland: advantages and pitfalls. *Gland Surg* 2019; 8: S208-s15.
47. D'Orazio F, Splendiani A, Gallucci M. 320-Row Detector Dynamic 4D-CTA for the Assessment of Brain and Spinal Cord Vascular Shunting Malformations. A Technical Note. *Neuroradiol J* 2014; 27: 710-7.
48. Scoccianti S, Simontacchi G, Greto D, et al. Dosimetric Predictors of Acute and Chronic Alopecia in Primary Brain Cancer Patients Treated With Volumetric Modulated Arc Therapy. *Front Oncol* 2020; 10: 467.
49. Michelini G, Corridore A, Torlone S, et al. Dynamic MRI in the evaluation of the spine: state of the art. *Acta Biomed* 2018; 89: 89-101
50. Perri M, Grattacaso G, Di Tunno V, et al. MRI DWI/ADC signal predicts shrinkage of lumbar disc herniation after O2- O3 discolysis. *Neuroradiol J* 2015; 28: 198-204
51. Splendiani A, Bruno F, Patriarca L, et al. Thoracic spine trauma: advanced imaging modality. *Radiol Med* 2016; 121: 780-92.

Received: 20 May

Accepted: 10 June

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