Review

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We are Being Introduced to New Developments on the Imaging Field Day by Day

Serkan Arıbal, Hakan Önder, Recep Yılmaz Bayraktarlı

Department of Radiology, University of Health Sciences, Okmeydanı Training and Research Hospital, İstanbul, Turkey

Abstract

New developments are rapidly ongoing in the field of radiology. In this way, the interventional procedures can be performed more easily by using both imaging and images. Nowadays, 7 T magnetic resonance imaging (MRI) has been developed, and we are beginning to see the results. We started to use artificial intelligence in the field of radiology, and it appears to facilitate our job. Prostate cancer can be easily diagnosed and treated using multiparametric MRI.

Keywords: 7 T MRI, artificial intelligence, multiparametric MRI

The first 7 T magnetic resonance imaging (MRI) scanner for diagnostic imaging is designed by the medical industry for unprecedented breakthroughs in clinical care. The unique dual mode allows you to switch between clinical and research operations, with separate databases to distinguish between clinical and research scans. This advanced ultra-high field technology has the potential to keep you at the cutting edge of MRI, attract the brightest minds to your facility, sharpen your competitive edge, and strengthen your reputation. It unlocks your potential to publish new insights first and set the pace in diagnostic imaging (Figure 1. a-h.).

Discovering new ground in MRI can help you significantly enhance clinical knowledge. Imaging at 7 T offers more than double the SNR of 3 T to support higher resolution for greater detail. This is the first-ever 7 T MRI scanner that produces cross-sectional images of the head and knee for diagnostic imaging intended for patients >66 lbs (1, 2).

Welcome to a whole new world in MRI.

Artificial Intelligence in Radiology Practice

Who would say that there would be no need for doctors in the future? With the advancing technology, more and more machines have been used in the field of health sciences, and we hear these types of questions more often since artificial intelligence (AI) is becoming more familiar and popular in our lives. Surely, radiologists are not the only, or even the first, professionals to have their specialty modified by AI. Other areas of medicine have also been thus affected (3).

Artificial intelligence is a smart behavior performed by devices, which is called as intelligence when done by humans. The purpose of AI is to imitate the intelligence of a human, in this sense, to gain the ability of learning to the computers (4). In historical development, the primary method for this system is computer-assisted diagnosis system that allows detecting a certain lesion or probable pathological area in order to advise the radiologist for the lesion rather than to identify a specific diagnosis, whereas new methods of AI aim to present a specific diagnosis using the existing data pool.

Expert Systems (ES), Fuzzy Logic (FL), Artificial Neural Networks (ANN), and Genetic Algorithms (GA) are the main topics of AI. ES are a kind of computer-generated consultation system based on areas of expertise and have the steps of description, conceptualization, formulation, testing,

ORCID IDs of the authors:
S.A. 0000-0002-0338-2652;
H.Ö. 0000-0001-5207-3314;
R.Y.B. 0000-0001-6980-649X

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Corresponding Author:
Hakan Önder

E-mail:
drhakanonder@hotmail.com

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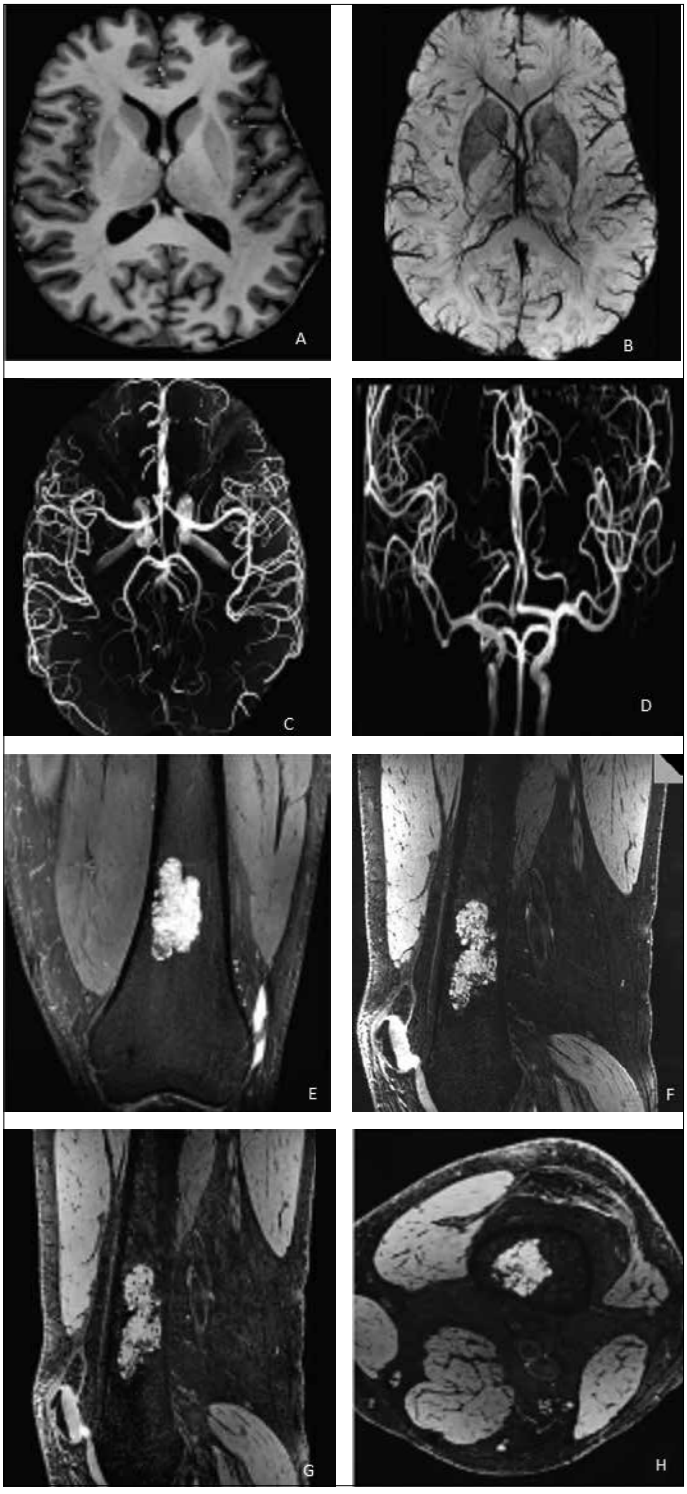

Figure 1. a-h. Clear identification of anatomical structures with increased tissue contrast and high resolution at 7T (a-d); Fine structure visible in the lesion with different contrasis (e-h)

and evaluation, respectively (5). The main difference between FL and ES is the addition of experience as well as knowledge to all stages in FL. In other words, experiences are used effectively in FL. Owing to this feature, FL is an algorithm that considers the flexible and variable structure of human thought (6). ANN collect information about the samples, make generalizations, and then make a decision when encountering the examples never seen by using the information learned (7). GA are the intuitive methods that can be used in cases that cannot be solved by traditional solution techniques or problems that are difficult to solve (Figure 2) (8).

The impact of AI on the routine of the radiologist will probably occur gradually. The main contribution of the radiologist is not simply to provide this information but to integrate it with the clinical data, contributing in a more holistic way to the diagnosis and individualized treatment of the patient. The ones who adapt and use these technological tools and systems would have advantages over those who resist it. In addition, radiologists who have not adapted to the changes and have not learned the new techniques have more difficulty in the current job market (3, 9).

Brief Overview of Multiparametric MRI and MR-Guided Fusion Biopsy of Prostate Cancer

Multiparametric MRI (mp-MRI), which has become available in recent years, is used to inform about the prostate tissue, detecting prostate cancer, its localization, and spread (10-12).

The high-resolution T2A sequences found in mp-MRI are used to evaluate the anatomy and tumor localization of the prostate, diffusion-weighted imaging and MR spectroscopy are used to characterize the lesion, and contrast enhancement of the lesion is evaluated by dynamic contrast-enhanced sequences, thus achieving high sensitivity in the detection of cancer (13-15).

Prostate biopsy is applied to men who have a high level of serum prostate-specific antigen (PSA) and/or who have suspected cancer in rectal finger examination.

Transrectal ultrasound (TRUS)-guided systematic 12-core biopsy is still widely used and is the first method of choice due to its short application time, lower costs, being easier to learn and, not requiring special equipment. Additionally, the equipment is reusable.

MR-assisted prostate biopsies are more frequently used in patients with persistently high PSA, with suspected lesion in MRI, whose first biopsies were negative, or where biopsy was not applied before, and in cases with biochemical recurrence after active observation and radiotherapy.

It is reported that the rate of detecting cancer in randomized biopsies is 22%-29%, whereas it is 38%-59% in transrectal MR-guided biopsies with applied 1.5 T MR.

The different methods in prostate biopsies with MRI are as follows:

1. **Cognitive Fusion Biopsy:** It is a method where US-guided standard TRUS biopsy is applied in another location to the lesion that is detected by MRI.
2. **Direct MR-Guided Biopsy (In-Bore):** After a suspected area in mp-MRI is signed with a needle, a sample is obtained again with MRI in MR. MRI-guided biopsy takes a long time and is expensive. However, it is seen that MRI-guided biopsies are 20% more effective than TRUS in detecting clinically important prostate cancer.
3. **MRI/TRUS Fusion Biopsy:** The images obtained by mp-MRI are integrated into the biopsy device to form fused images, and the location of cancer in the prostate is marked three

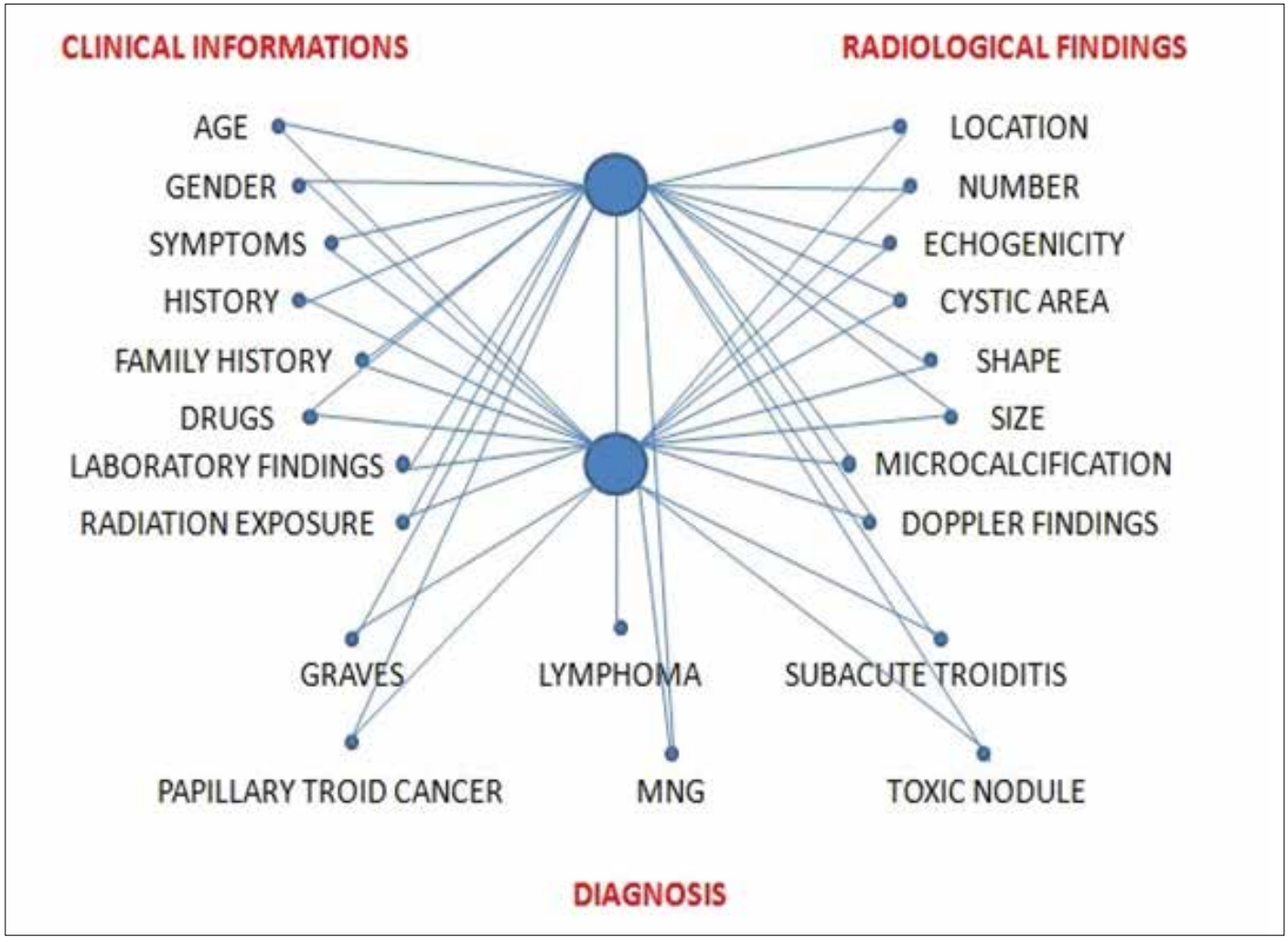

Figure 2. A basic example of an artificial intelligence desing in problem solving and diagnosis

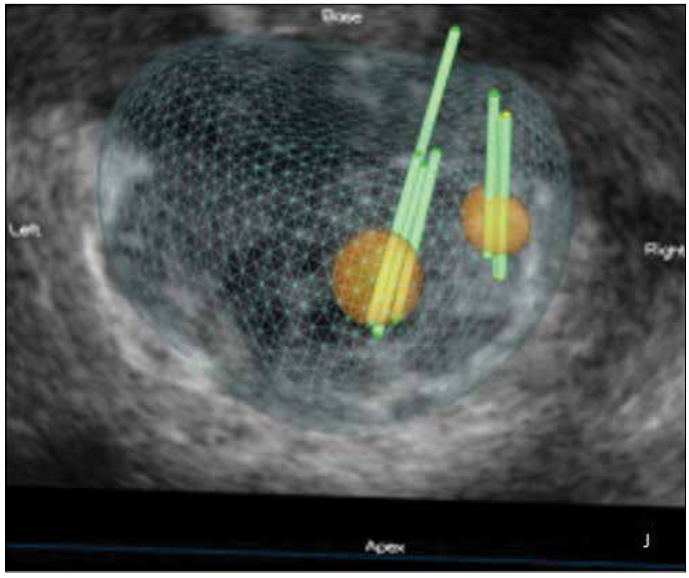

Figure 3. Mp-MRI for prostate cancer localization in the apex and in the right zone in a 60-year-old man. After these lesions were marked in fusion images, targeted biopsy was performed with exact accuracy

dimensional. During the procedure, the points, where the biopsy will be performed by motion and angle sensors with a semi-robotic arm, are determined, and the biopsy is performed directly from the identified areas. Thus, the biopsies will be more targeted, and less number of them needs to be obtained. For this purpose, Philips/UroNav, Eigen/Artemis, Koelis/Urostatin, Hitachi/HI-RVS, and GeoScan/BioJet systems have been developed and put into use. These devices were developed due to the difficulty of performing biopsy under direct MRI (Figure 3).

CONCLUSION

Radiology is developing rapidly. In the near future technological advances in diagnostic radiology, minimal invasive radiology and artificial intelligence will benefit the radiologists and patients alike.

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