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Relevance of Multiparametric Magnetic Resonance in the Evaluation of Patients with Prostate Cancer

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ABSTRACT

The relevance of the use of mpMRI (multiparameter prostate magnetic resonance imaging) to evaluate the prostate in the context of PCa diagnosis lies in its ability to visualize primarily high-grade cancerous lesions that may be missed in routine diagnostic biopsies. standard. In several studies, mpMRI has shown improved performance compared to clinical models in identifying candidates who will benefit most from different therapies such as SA. Although data on mpMRI of the prostate during follow-up in men undergoing SA are sparse, there is potential to significantly improve AS programs through more accurate selection of optimal candidates which could achieve more accurate identification of progression of prostate cancer. disease and a reduction in the number of biopsies that would be needed to retest patients.

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INTRODUCTION

Prostate cancer is a disease that develops mainly in elderly male patients. Ninety percent of cases are diagnosed in men older than 65 years, the median age being 75 years. It is the fourth most commonly diagnosed malignant neoplasm in the world, with an annual incidence rate of 7.3% equivalent to 1,414,259 persons per year, being the eighth cause of death in relation to both sexes and the fifth cause of death in the male population, with a rate of 6.8% equivalent to 375,304 persons, according to statistics.[1]

The determination of blood levels of prostate specific antigen, which is produced by the prostate gland and is found in elevated levels in those patients with prostate cancer, this test is not specific since it can be elevated in those who have other conditions, such as infection, prostatitis, benign prostatic hyperplasia or even previous manipulation of the prostate by a rectal examination.[1,2]

USE OF MRI

Multiparametric MRI has played a crucial role in the diagnosis of prostate cancer as it not only provides information on the anatomy of prostate tissue but also on its size, cellular composition and how much vascularization it has.The protocol for the use of MRI is broad, but three indispensable techniques are used to provide anatomical images of the prostate, such as the high resolution T2-weighted sequence (T2WI) and on the function of the prostate gland, evaluating the movement of water molecules, called water diffusion, and evaluating blood flow, called perfusion, which helps to determine which tissue is healthy and which is diseased and to approach the diagnosis in a more accurate way.[3]

Not only this, but in other of its modalities it adds the use of contrast for a phase called "dynamic" to have even more sensitivity. It has been described that the images obtained in T2WI sequence give a better visualization of the prostatic anatomical area and of the capsule that is used to locate, delimit and stage it.[3]

However, it must be taken into account that this sequence can be altered by any type of movement in the body, for which antiperistaltic drugs will be prescribed prior to the procedure. The individual use of the T2WI sequence is not recommended since some prostate lesions such as: prostatitis, hemorrhages, scars accompanied by atrophy, prostatic epithelial neoplasia can give us erroneous images that can lead us to an incorrect diagnosis. Therefore, although it is highly sensitive, it is not specific.[4]

They are known as dynamic sequences to the administration of gadolinium-based contrast as a way of staging the tumor based on its vascularization, this is done through gradient-echo sequences enhanced in T1W1 sequence, this will allow assessing the behavior of the tumor in different phases, whether early or late. Not only that, but it must be combined with different sequences since they must be differentiated from the aforementioned pathologies that can give an erroneous diagnosis. [5]

The diffusion sequence plays an extremely important role as it helps to calculate apparent diffusion coefficient maps making the information we obtain tell us the aggressiveness of the patient's prostate cancer.[5]

The diffusion coefficient map is commonly considered to reflect the cellularity of tumors, however, this is only a measure of water diffusivity which is determined by the intracellular and extracellular space and other associated characteristics of the cells of the tissue itself with suspected neoplasia.[6]

Likewise, it has been described that some prostate cancers can be subtle or difficult to diagnose so there are values that will help us to improve the visibility and detection of these tumors in early stages. It is recommended that the "B" value be at least 1200s/mm2 for visibility to be significantly better. However, studies mention that there is no benefit if it exceeds 2000s/mm2 since the quality of the images obtained will be compromised making the image look deteriorated. Diffusion-weighted imaging is an essential component for the multiparametric resonance study, making the assertiveness about the aggressiveness of the tumor quite high.[7]

RADIOLOGIC TECHNIQUE

Mp-MRI of the prostate requires high-resolution T2-weighted anatomical sequences, in addition to functional diffusion sequences (DWI) and dynamic contrast-enhanced sequences (DCE). T1-weighted sequences are also added to profile hematic content, nodal and bone metastases. In PI-RADS v2, a sequence considered dominant for the peripheral zone (DWI sequence) and a dominant sequence for the transition zone (T2-weighted sequence) are proposed.[8]

FUNCTIONAL SEQUENCES

Diffusion: for a clear differentiation between non-neoplastic and neoplastic tissue to be obtained, at least a high diffusion B-value is required, which in PI-RADS v2 was set as a minimum of 1,400. A retrospective study performed in 2016 by Rosenkrantz et al. showed that b-values between 1. 500 and 2,500 are optimal for cancer detection, as these values are able to differentiate inflammatory or fibrotic lesions, which are "turned off with high B values," from those neoplastic lesions. Since very high B values are required, the problem of the low signal to noise ratio (SNR) in these sequences arises and it is for this reason that in order to perform a good MRI-mp of the prostate, equipment with a magnetic resolution of 1.5 to 3 teslas is required.[9]

MR imaging of prostate cancer the T1-weighted sequences

T1-weighted sequences show an intermediate signal of the prostate gland and seminal vesicles that can be differentiated from the hypersignal of the peri-prostatic fat. At the same time, the T1 sequence allows us to assess the existence of post glandular biopsy hemorrhage, pelvic adenopathies and bone metastases. To avoid MR images that may simulate carcinoma it is essential to perform the MR study in a period of no less than 3 weeks and in the case of a spectroscopy study, it is necessary to wait an interval of time between 6-8 weeks post biopsy.[10]

Dynamic contrast-enhanced sequences (DCE): T2-weighted sequences allow an evaluation of the zonal anatomy of the prostate. The MR signal of the peripheral gland in T2-weighted sequences is hyperintense and homogeneous. The central gland is hypointense and heterogeneous; compressing the peripheral gland in case of hypertrophy. The seminal vesicles show hyper signal on MRI with cystic multilocular appearance with hypointense thin walls. Most prostate tumors originate in the peripheral gland, showing that it is limited to the peripheral zone. When positive, borderline lesions (PI-RADS 3) in DWI are re-categorized as PI-RADS 4 when diffusion is degraded by artifacts or presents a suboptimal SNR.[10]

Dominant Sequence: The dominant sequence was validated in 2017 in a prospective work by Greer et al, involving 9 radiologists from around the world. The MRI-mp features of 654 lesions and their correlation with anatomopathologic findings of radical prostatectomy were reviewed. This work showed a better performance of the T2-weighted sequence in the transition zone than in the peripheral zone, while in the peripheral zone the DWI sequence outperforms the T2 sequence. The DCE showed utility in the peripheral zone and demonstrated that its positivity increases the probability of cancer. In this work we also calculated the probability of cancer for each PI-RADS category. Of note is the non-negligible percentage (15.7%) of probability of CS lesions in those classified as PI RADS 2.[10]

Analysis of results, recommendations and report

The correct interpretation of mp-MRI findings requires a high degree of expertise. In a consensus made in 2013, it was agreed that radiologists reporting prostate MRI should report at least 50 examinations per year and frequently attend anatomo-pathological correlation meetings, as it is considered that a high degree of interpretation skill is required.

In view of the above, the following topics are worth mentioning: It is extremely important that radiologists interpreting and reporting prostate MRI studies be familiar with current terminology.[11]

EXTENSION CRITERIA

Criteria used to consider extracapsular extension of prostatic tumor on MRI include: focal irregular-spicular protrusion of the capsule, loss of the normal capsule hyposignal, obliteration of the rectoprostatic angle, asymmetry and involvement of the Neurovacular plexus, and extension of the tumor to seminal vesicles. Invasion of the seminal vesicle is demonstrated by the presence of hyposignal within the vesicles. In order to obtain maximum efficiency in the staging of prostate cancer in MRI it is essential to use an endorectal coil or, failing that, an endorectal coil.[12]

endorectal coil or, failing that, a multichannel 1,006 pelvis coil, in order to obtain high-resolution pelvic high resolution studies of the pelvis.[12]

It is important to know that after the biopsy, capsular irregularity may be observed, without this being indicative of capsular extension. It is difficult to objectively evaluate the published results on the reliability of MRI in the local staging of prostate cancer, due to the different techniques and methods used. [12]

However, according to a meta-analysis of 74 published studies on prostate cancer staging, it is concluded that the best results are obtained by performing MRI examination of the prostate with high-resolution sequences in multiple planes using endorectal coil. The most specific criterion for extracapsular extension (EEC) is asymmetry of the neurovascular plexus (sensitivity 38%, specificity 95%) and the most sensitive is the global assessment of all EEC criteria (sensitivity 68%, specificity 72%).[12]

USE OF BIOPSY

Obtaining these initial parameters, the diagnosis of prostate cancer is based on the microscopic evaluation, by multiple ways, of prostate tissue obtained through a needle, this procedure is performed by transrectal ultrasound, obtaining 10 to 12 samples from different areas of the gland, staging it later in a primary Gleason grade to determine the histology and a secondary one to stage the scale according to its microscopic architecture.[13]

Systematic transrectal ultrasound-guided biopsy has many advantages over other modalities previously employed, in addition to not using radiation, being cheaper, being able to see the images in real time and has become a safe diagnostic method. There are several indications but most are based on clinical (abnormal touch) or laboratory findings (elevated prostate specific antigen). And even today the multiparametric resonance study and the PIRADS classification is an indication for biopsy. [13]

Other risk factors to consider are family history, race, PSA density and velocity, comorbidities and other markers such as blood kallikrein levels, PCA3 and TMPRSS2-ERG as decision aids for prostate biopsy.[14]

Elevated levels of prostate antigen in blood and abnormal transrectal imaging examination justifies ultrasound-directed biopsy, although this study has a sensitivity of 39% to 52% for prostate cancer detection nowadays. Currently, the preliminary study with multiparametric magnetic resonance imaging is used to detect, localize and stage the malignant prostatic tumor. This initial method and the performance of subsequent ultrasound-guided biopsy improves the sensitivity of the diagnosis by up to an additional 15% compared to the exclusive use of ultrasound and laboratory examinations, as was previously done.[14]

CONCLUSIONS

Prostate cancer is the second most common cancer affecting men in the world. Its traditional diagnostic method based on PSA measurement and randomized prostate biopsy suffers from major problems. Prostate MRI-mp, together with the PI RADS v2, have shown to have high sensitivity and moderate specificity in the diagnosis of CS lesions when performed under optimal technical conditions and interpreted by trained radiologists, so it currently plays a leading role in the diagnosis of prostate cancer. Thus, the 2019 European Clinical Guidelines on prostate cancer already recommend its use prior to any prostate biopsy, so a substantial increase in the performance of this type of examination is only expected in the following years.

REFERENCES

I. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Estadísticas mundiales de cáncer 2020: estimaciones de GLOBOCAN de incidencia y mortalidad en todo el mundo para 36 cánceres en 185 países. CA Cáncer J Clin [Internet]. 2022;71(3):209–49. Disponible en: http://dx.doi.org/10.3322/caac.2166

II. Ahmed HU, El-Shater Bosaily A, Brown LC, Gabe R, Kaplan R, Parmar MK, et al. Precisión diagnóstica de la resonancia magnética multiparamétrica y la biopsia TRUS en el cáncer de próstata (PROMIS): un estudio confirmatorio de validación emparejado. Lancet 2017 ;389 (10071):815–22. Disponible en: http://dx.doi.org/10.1016/s0140-6736(16)32401-1

III. Deep learning reconstruction can lead to better image quality and increased detection of prostate cancer [Internet]. Rsna. org. Disponible en: https:// www.rsna.org/news/2022/may/Detection-Of-Prostate-Cancer. Radiological Society of North America (RSNA), College of Radiology (ACR). RMN de la próstata. Radiologyinfo.org. Disponible en: https://www.radiologyinfo.org/es/info/mr_prostate

IV. Barentsz JO, Richenberg J, Clements R, Choyke P, Verma S, Villeirs G, et al. ESUR prostate MR guidelines 2012. Eur Radiol [Internet]. 2012;22(4):746–57. Disponible en: http://dx.doi.org/10.1007/s00330-011-2377-y

V. Lim HK, Kim JK, Kim KA, Cho KS. Cáncer de próstata: mapa de coeficiente de difusión aparente con imágenes ponderadas en T2 para la detección: un estudio de múltiples lectores. Radiología. 2009; 250 :145–151. doi: 10.1148/radiol.2501080207. [PubMed] [CrossRef] [Google Académico]

VI. Litwin MS, Tan H-J. The diagnosis and treatment of prostate cancer: A review: A review. JAMA [Internet]. 2017;317(24):2532–42. Disponible en: http://dx.doi.org/10.1001/jama.2017.7248

VII. Mohler JL, Armstrong AJ, Bahnson RR, et al. Prostate cancer, version 1.2016.J Natl Compr Canc Netw. 2016;14(1):19-30.

VIII. Epstein JI, Zelefsky MJ, Sjoberg DD, et al. A contemporary prostate cancer grading system: a validated alternative to the Gleason score. Eur Urol. 2016;69(3):428-435.

IX. Cooperberg MR, Pasta DJ, Elkin EP, et al. The University of California, San Francisco Cancer of the Prostate Risk Assessment score: a straightforward and reliable preoperative predictor of disease recurrence after radical prostatectomy. J Urol. 2005;173(6):1938-1942.

X. Epstein JI, Egevad L, Amin MB, Delahunt B, Srigley JR, Humphrey PA; Grading Committee. The 2014 International Society of Urological Pathology (ISUP) consensus conference on Gleason grading of prostatic carcinoma: definition of grading patterns and proposal for a new grading system. Am J Surg Pathol. 2016;40(2):244-252

XI. A meta-analysis of use of prostate imaging reporting and data system version 2 (PI-RADS V2) with multi parametric MR imagine for the detection of prostate cancer. European Radiology. 2017 december; 27(2): 5204-5214. 13. Daniel T., Oberlin DD., Casalin FH., Miller RS., Matulewicz Kent T., 12.Perry RB., Nadler SK, William J. Catalona JJ. Meeks. Diagnostic Value of GuidedBiopsies: Fusion and Cognitive-registration Magnetic Resonance Imaging Versus Conventional Ultrasound Biopsy of the Prostate

XII. Le JD, Tan N, Shkolyar E et al (2015) cáncer de próstata La multifocalidady detección por imágenes de resonancia magnética multiparamétrico:correlación con todo el montaje histopatología. Eur Urol 67: 569 - 576

XIII. Hambrock T, Hoeks C, Hulsbergen-van de Kaa C et al (2012) la evaluación prospectiva de la agresividad del cáncer de próstata usando biopsias guiada por imagen de resonancia magnética ponderadas en difusión 3T frente a un 10-core sistemática transrectal ultrasonido de próstata biopsia cohorte. Eur Urol 61:177-184

XIV. Kobus T, Hambrock T, Hulsbergen-van de Kaa CA et al (2011) In vivo evaluación de cáncer de próstata agresividad usando imágenes espectroscópicas de resonancia magnética a 3 T con un endorrectal bobina. Eur Urol 60: 1074 -1080

XV. Barentsz JO, Weinreb JC, Verma S et al (2016) Synopsis of the PIRADS v2 guidelines for multiparametric prostate magnetic resonance imaging and recommendations for use. Eur Urol 69:41–49.

XVI. American College of Radiology. PI-RADS V 2: Prostate Imaging Reporting and Data System version 2.0. American College of Radiology. website www.acr.org/ Quality-Safety/Resources/PIRADS. Published 2015. Accessed January 24, 2023.

XVII. Woo S, Suh CH, Kim SY, Cho JY, Kim SH (2016) Diagnostic performance of prostate imaging reportinganddatasystem version 2 for detection of prostate cancer: a systematic reviewanddiagnostic meta-analysis. Eur Urol 72:177–188. 20. UROLOGY 2016; 92: 75-79.

XVIII. Wegelin O, et al. The FUTURE Trial: A Multicenter Randomised Controlled Trial on Target Biopsy Techniques Based on Magnetic Resonance Imaging.

The value of mpMRI has been recognized due to its high negative predictive value (NPV) value for lesion upgrading in low-risk PCa patients. The improvement in imaging detection, and precise diagnosis with mpMRI could reduce misclassifications at initial diagnosis and during follow-up, reducing the number of biopsies.

mp-MRI should always be performed before RT when a recurrence is suspected. New scenarios can be opened considering the role of diffusion weighted imaging for PSA≤0.5ng/ml.

Bibliography

I. **J**. Gómez Rivas, D.M. Carrion, T. Chandrasekar, M. Álvarez-Maestro, D. Enikeev, L. Martínez-Piñeiro, E. Barret. April, 2021. The role of multiparametric magnetic resonance imaging in the selection and follow-up of patients undergoing active surveillance for prostate cancer. An European Section of Uro-Technology (ESUT) review .

II. E. Faiella D. Santucci, D. Vertulli, F. Esperto, L. Messina, G. Castiello, R. Papalia, G. Flammia, R.M. Scarpa, M. Fiore, L.E. Trodella, S. Ramella, R.F. Grasso, B. Beomonte Zobel. Dec 2021. The role of multiparametric magnetic resonance imaging in the diagnosis of local recurrence after radical prostatectomy and before salvage radiotherapy