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EDITORIAL

Perceived risk and decision-making: navigating uncertainty in clinical practice

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Human decisions are influenced by perceived risk, but often we only consider certain aspects of it. Typically, risk—defined as "a measure of the extent to which an entity is threatened by a potential circumstance or event"—is a function of (i) the adverse impacts that would arise if the circumstance or event occurs and (ii) the likelihood of its occurrence (source: https://csrc.nist.gov/glossary/term/risk). People tend to overlook the low probability of an event happening, yet they are hypersensitive to the severity of the event itself. Moreover, some activities are deemed low-risk due to immediate benefits, even though harmful effects may be delayed over time. The higher the risk, especially if it can be visualized concretely, the more formidable it appears to people [1].

While clinical guidelines and recommendations are evidence-based, decisions and actions in daily practice are influenced by perceived risk, emotions, skills, expertise, and past experiences. Imaging specialists often base their reports on personal judgment. Although guidelines provide indications, protocols for patient preparation and acquisition, and reporting instructions, they typically lack unequivocal criteria for decision-making, resulting in personal opinions shaping the final judgment.

Numerous philosophers and psychologists have emphasized the significance of disconfirmation in reasoning, suggesting that people tend to test cases expected to exhibit the property of interest, rather than those expected to lack it. While the positive test strategy can be effective for testing hypotheses under realistic conditions [1], as demonstrated by Klayman and Ha [2], it can lead to systematic errors or inefficiencies. Numerous instances of over-intervention have been reported in the literature. However, in nuclear medicine practice, PSMA-targeting imaging, particularly with [^{18}F]PSMA-1007, has likely caused the highest rate of false-positive bone findings in recent years (up to 72% [3]). Concurrently, as new tracers are developed and the phenomenon underlying unspecific PSMA-bone uptake is better understood, routine use and awareness of potential pitfalls should contribute to an improved learning curve and reduced misdiagnosis.

Conversely, a "defensive medicine" approach remains prevalent in clinical practice. Many instances of PSMA-bone uptake are described as (potential) metastases, adding to patient management burdens and escalating healthcare costs. This tendency is not surprising, as one correct prediction garners more attention than numerous missed predictions (known as one-sided events) [1]. Furthermore, the rare possibility that PSMA-bone uptake, even without associated radiological alterations, might indicate metastasis, cannot be ignored [4]. In prostate cancer imaging, elevated PSA levels further support the positive hypothesis (i.e., presence of disease). Both these factors may influence imagers' decisions more than the objective risk evaluation.

It is evident that, in many cases, a false negative is preferable to a false positive, as avoiding a poor outcome should take precedence over inadvertently harming patients. Over-medicalization fails to acknowledge potential risks such as patient anxiety, radiation exposure, and invasive testing [5], as illustrated in Fig. 1. On the other hand, various factors, including (social) media, healthcare system-based working conditions, and physicians' tolerance for uncertainty, have been cited as sources of pressure on general practitioners, fostering a defensive medicine attitude [6]. Other identified sources of defensive medicine include the fear of malpractice litigation, overlooking a serious diagnosis, patient dissatisfaction, and negative publicity [7].

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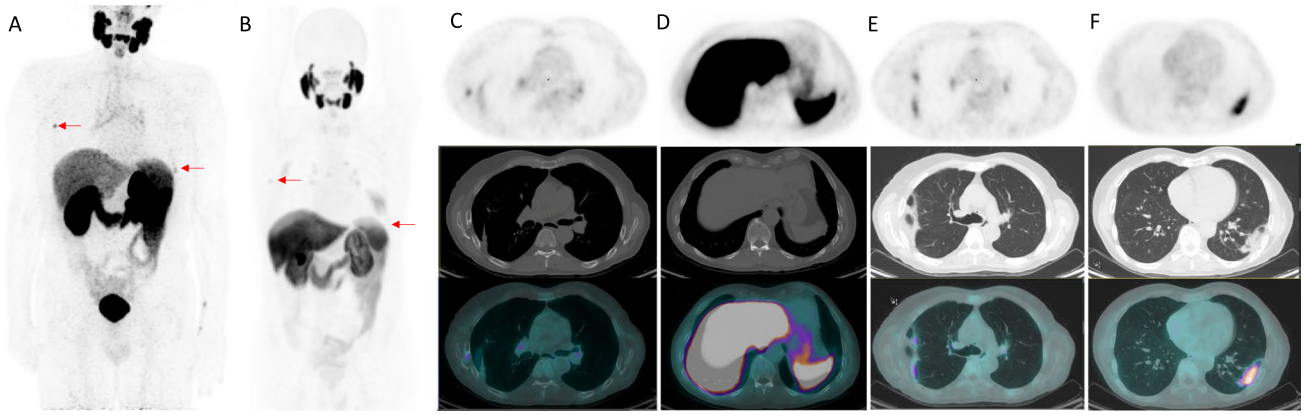

Fig. 1 Example of side effect associated with over-medicalization. The case involves a 62-year-old patient who underwent radical prostatectomy and extended pelvic lymph node dissection, diagnosed with acinar prostate adenocarcinoma Gleason score 4 + 3, pT3bpN1R0 (initial PSA = 5.7 ng/mL). About 1 year after surgery, biochemical recurrence occurred, leading to prostatic lodge salvage radiotherapy and androgen deprivation therapy. After discontinuation of hormonal treatment, follow-up remained negative until PSA increased to 0.93 ng/mL, prompting a PSMA PET scan. PET/MRI images (MIP in **A**) revealed [^{68} Ga]Ga-PSMA-11 uptake in two ribs (the fifth on the right and the VIII on the left, red arrows). The patient received stereotactic radiotherapy on the ribs and resumed androgen deprivation therapy, subsequently experiencing bilateral radiation pneumonitis. Approximately 6 months after discontinuation of androgen deprivation therapy, PSA increased to 0.25 ng/mL. A PSMA scan with a digital PET/CT showed [^{18}F]PSMA-1007 uptake in the V right and VIII left ribs (**C** and **D**), along with both lungs (**E** and **F**), indicating bilateral radiation-induced pneumonitis. No other abnormal [^{18}F]PSMA-1007 uptake was observed (MIP in **B**), and the patient restarted androgen deprivation therapy. This example illustrates that (i) treating non-metastatic bone PSMA-positive findings inadvertently caused radiation-induced pneumonitis; (ii) non-metastatic bone uptake can occur with any PSMA-targeting radiopharmaceuticals, more frequently with [^{18}F]PSMA-1007; and (iii) despite advanced technology, some cases remain unresolved, as neither PET/MRI nor last-generation PET/CT can visualize sites of (microscopic) disease

While individuals, especially physicians, are inherently motivated to ensure accuracy, the immediate benefits derived from the positive test strategy and the inclination towards confirmation often play a decisive role in testing hypotheses and subsequently making final decisions [1]. Consequently, doctors should adopt a scientific approach in daily practice, meticulously considering the advantages and disadvantages associated with these processes. This approach may prove to be the most effective way to reduce potential errors.

Data availability Not applicable.

Declarations

Ethics approval Not applicable to this Editorial.

Consent to participate Informed consent from the patient was obtained for the clinical procedures and scientific use of anonymized data.

Conflict of interest The authors declare no competing interests.

References

1. Girotto V. Introduzione alla Psicologia del Pensiero. 1st ed. Il Mulino; 2013.
2. Klayman J, Ha YW. Confirmation, disconfirmation, and information in hypothesis testing. Psychol Rev. 1987;94:211–28.
3. Hoberück S, Löck S, Borkowetz A, Sommer U, Winzer R, Zöphel K, et al. Intraindividual comparison of [^68Ga]-Ga-PSMA-11 and [^18F]-F-PSMA-1007 in prostate cancer patients: a retrospective single-center analysis. EJNMMI Res. 2021;11:109.
4. Vollnberg B, Alberts I, Genitsch V, Rominger A, Afshar-Oromieh A. Assessment of malignancy and PSMA expression of uncertain bone foci in [^18F]PSMA-1007 PET/CT for prostate cancer—a single-center experience of PET-guided biopsies. Eur J Nucl Med Mol Imaging. 2022;49:3910–6.
5. Thumbe A. Defensive medicine is a driver of overmedicalization. BMJ. 2023;381: p1377.
6. Strobel CJ, Oldenburg D, Steinhäuser J. Factors influencing defensive medicine-based decision-making in primary care: a scoping review. J Eval Clin Pract. 2023;29:529–38.
7. Baungaard N, Skovvang PL, Assing Hvidt E, Gerbild H, Kirstine Andersen M, Lykkegaard J. Original research: how defensive medicine is defined in European medical literature: a systematic review. BMJ Open. 2022;12:57169.