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EDITORIAL

Medical imaging in times of pandemic: focus on the cornerstones of successful imaging

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In 2020, the infection by COVID-19 virus (also named "severe acute respiratory syndrome coronavirus 2" or SARS-CoV-2) has become the first global pandemic of the new millennium [1]. The World Health Organization (WHO) declared coronavirus disease-19 (COVID-19) a global pandemic the 11th of March 2020, unfolding a world crisis with severe consequences in public health and the economy. In particular, the impact of the pandemic on nuclear medicine departments and the guidance during pandemic has been well established [2, 3]. The race for the development of a vaccine against SARS-CoV-2 has evidenced both the great technological advances in the field of medicine and biotechnology and the incredible efficacy of international science and industry when working together with a common interest. The first vaccines approved by international medical agencies for administration to the general population became available in December 2020, initiating vaccinations in several European countries, the USA, Russia and China. In Israel, a nationwide mass vaccination using the Pfizer BNT162b2 mRNA vaccine against COVID-19 [4] was initiated on December 20, 2020 [5].

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In this context, medical imaging has reported findings related to the infection by SARS-CoV-2 [1, 6]. A recent meta-analysis evaluated the role of 2-[^{18}F]FDG PET/CT in patients with SARS-CoV-2 infection or COVID-19 [7]. It concluded that "2-[^{18}F]FDG PET/CT cannot substitute or integrate high-resolution CT to diagnose suspicious SARS-CoV-2 infection or COVID-19 or for disease monitoring, but it can only be useful to incidentally detect suspicious COVID-19 lesions in patients performing this imaging method for standard oncological and non-oncological indications."

On the other hand, now that the proportion of the population having received the vaccine is rapidly increasing, several diagnostic techniques are reporting findings related to the vaccination. Hyperplastic axillary nodes can be seen on ultrasound after any vaccination, but are more common after a vaccine that evokes a strong immune response, such as the COVID-19 vaccine [8]. 2-[^{18}F]FDG PET/CT is also affected by this vaccine, as is shown in the study by Cohen et al. [9]. The aim was to determine the overall incidence of vaccine-associated hypermetabolic lymphadenopathy (VAHL) in axillary or supraclavicular lymph nodes (ASLN) ipsilateral to the vaccination site after BNT162b2 vaccination, and also its relevance to 2-[^{18}F]FDG PET/CT [9]. This study analysed 951 consecutive patients who underwent 2-[^{18}F]FDG PET/CT, 728 having received one dose ($n = 346$) or both doses ($n = 382$) of the vaccine. VAHL was reported in 80.1% of vaccinated patients with hypermetabolic lymphadenopathies (HLN). Lower incidences of VAHL were found during the first 5 days or in the third week after the first vaccine, and beyond 20 days after the booster dose. In 49 of 332 (14.8%) vaccinated patients, HLN remained equivocal, most of them in breast cancer and lymphoma patients. They concluded that VAHL is frequently observed after BNT162b2 administration, more commonly and with higher intensity following the booster dose. To minimize false and equivocal reports in oncological patients, timing of 2-[^{18}F]FDG PET/CT should be based on the time intervals found to have lower incidence of VAHL, and choice of vaccine injection site should be advised, mainly in patients where ASLN are a relevant site of tumour involvement [9].

We have become accustomed to continuous and fast technological advancement in medicine, and especially in the field of medical imaging. Each year, new medical equipment provides images with higher resolution, in less time and with less radiation burden for the patient, improving patient care. However, the classical pillars of medicine remain the same, anamnesis being a common point of initiation of patient care. Nowadays, electronic clinical history makes access to clinical information much easier and, because of this, this critical step should not be forgotten. Moreover, anamnesis should also be considered as essential, directing the interest towards issues related to the vaccination, as they may not be easily accessible in the clinical history. When focusing on the cornerstones of successful imaging, the European Association of Nuclear Medicine (EANM) 2-[^{18}F]FDG PET/CT in oncology guidelines [10] may be cited "The medical record should be reviewed with a special focus on the diagnosis, oncological history and relevant comorbidity (especially infection/ inflammation and diabetes mellitus). A short interview with the patient and/or family can help clarify some of these issues." In this regard, in the current pandemic aspects related to having received or not the vaccine, the vaccine injection site and dates of the first and second doses, are key for an adequate scheduling, performing and interpreting 2-[^{18}F]FDG PET/CT.

Regarding scheduling 2-[^{18}F]FDG PET/CT, the time intervals between the vaccination and the imaging procedure should ideally be scheduled during the periods in which the inflammatory response to the vaccine is lower. Cohen et al. [9] suggest performing 2-[^{18}F]FDG PET/CT either during the first 5 days after the first vaccine dose, during the third week after the first vaccine (before booster dose is administered), or at least three weeks after the booster vaccine dose.

Vaccination protocols must take into account issues regarding the choice of vaccination site, especially in oncological patients and, in particular, in those tumours that can present lymphadenopathies in lymph node basins that can be affected after vaccination, such as the axillary region. Breast cancer is an example of this, a clinical context in which the key to success is a multidisciplinary approach that must be implemented all along with patient care [11], from screening, to diagnosis, treatment and follow-up, also incorporating issues such as vaccination protocols. With regard to medical imaging specialists, recent COVID-19 vaccination history should also be considered as a possible differential diagnosis for patients with unilateral axillary adenopathy.

Declarations

Ethical approval Institutional review board approval was not required because the paper is an Editorial.

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Conflict of interest The authors declare no competing interests.

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