FDG Uptakes at Unilateral Axillary and Supraclavicular Lymph Nodes and Deltoid Muscle on [¹⁸F] FDG PET/CT After COVID-19 Vaccination: A Potential Pitfall for Metastatic Lymph Nodes in Colon Cancer Patient

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Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has caused the ongoing global pandemic. It can manifest a wide range of complications depending upon the severity of infection and comorbidities of the patient. Vaccines are very important measure to provide protection against COVID-19. We report a case of 73-year-old female who underwent [¹⁸F]F-2-fluoro-2-deoxy-d-glucose (FDG) positron emission tomography/computed tomography (PET/CT) and contrast-enhanced CT for staging of her rectosigmoid colon cancer and was found to have hypermetabolic uptakes in the deltoid muscle of the left shoulder and hypermetabolic left axillary and supraclavicular lymph nodes due to adenovirus vectored vaccine (ChAdOx1 nCoV-19, AstraZeneca) administered 18 days ago prior to PET/CT scan.

Keywords: Lymphadenopathy; Positron-emission tomography; Vaccination; Pitfall

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is an enveloped RNA beta coronavirus that emerged in Wuhan, China, in December of 2019 (1). It causes the novel coronavirus disease (COVID-19), a global pandemic and has resulted in more than 175 million infections and more than 3.8 million deaths according to the World Health Organization (2).

COVID-19 vaccination drive in Korea began on the

10 February 2021 and vaccines are currently offered to frontline health and social care workers, care home residents and staff, people with chronic conditions, and older adults. As of June 13, 2021, approximately 14 million Korean populations have been inoculated the first round of vaccination. Two-thirds of those populations received AstraZeneca vaccine and the remaining one-third received Pfizer-BioNTech vaccine (3).

Whole-body [¹⁸F]F-2-fluoro-2-deoxy-d-glucose (FDG) positron emission tomography/computed tomography

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(PET/CT) combines functional and anatomical imaging. It has major roles in oncology for staging and post-treatment follow up of many cancers. Therefore, it is important for the reporting nuclear medicine physicians and radiologists to accurately interpret and recognize potential imaging challenges and pitfalls of false-positive FDG avidity.

Vaccinations and injections are known to cause diagnostic dilemma due to false-positive uptake locally on FDG PET/CT (4, 5). Such dilemma can be critical for oncologic patients who might lose a chance of curative surgery due to false-positive FDG uptake at distant sites. Several case reports of lymphadenopathy post-COVID-19 vaccination have been published recently (5-8). In this case report, we present the case of axillary and supraclavicular lymphadenopathies detected on FDG PET/CT during a staging work-up for rectosigmoid colon cancer.

Case Report

A 73-year-old woman visited our hospital for further work-up of positive stool occult blood test. Colonoscopy revealed a 5cm ulceroinfiltrative mass in the rectosigmoid junction (Fig.1). Biopsy confirmed well-differentiated adenocarcinoma. She underwent contrast-enhanced CT and [^{18}F] FDG PET/CT for staging work-up. On contrast-enhanced CT, there is an enhancing wall thickening in the rectosigmoid junction colon and adjacent pericolic lymph node (LN) enlargement. Left distal ureter was encased by the enlarged LN, leading to left hydronephrosis. On FDG PET/CT images, colon wall thickening and adjacent enlarged LN showed strong FDG uptake suggesting rectosigmoid junction cancer with pericolic metastatic LNs. On FDG PET/CT image at thoracic level, there were several FDG-avid LNs at left axilla area and left supraclavicular area (Fig.1). Nuclear medicine physician initially interpreted these LNs as metastatic LNs. Therefore, palliative chemotherapy was planned. However, after a thorough image review for multi-disciplinary team (MDT) discussion by a dedicated gastrointestinal radiologist, the radiologist circumspectly noticed that there was a FDG avid lesion at left deltoid area and suggested the possibility of reactive FDG uptake after COVID-19 vaccination. After MDT conference, clinicians confirmed that the patient received COVID-19 vaccination using AstraZeneca vaccine 18 days before FDG PET/CT imaging. Therefore, management plan

for the patient was changed to radical colon surgery.

Discussion

An identification of potential false-positive results on PET/CT is vital to ensure an accurate interpretation during oncologic image reporting by taking into account the clinical context because many inflammatory and reactive phenomena are known to cause false-positive avidity (9). In our case, FDG-avid LNs at axillary and supraclavicular areas were initially interpreted as distant metastatic LNs. Therefore, clinicians including oncologists and colorectal surgeons planned palliative chemotherapy for the patient as they regarded patients as having stage IV colon cancer. However, our radiologist meticulously observed an elongated FDG uptake at left deltoid muscle and correctly diagnosed FDG-avid LNs at axillary and supraclavicular areas as reactive LNs due to COVID-19 vaccination. Subsequently, the patient did not lose a critical chance of curative resection for rectosigmoid colon cancer.

Vaccination can cause transient inflammation of LNs which demonstrates increased FDG avidity through macrophage accumulation (10). Indeed, vaccine-related increased metabolic activity at injection site, draining LNs, systemic inflammatory response at various sites in different patterns has been reported post-vaccination for COVID-19 vaccines (5-8). According to Schroeder DG et al., positive axillary LN uptake was observed in approximately 10% of patients on FDG PET examinations and extra-axillary LN uptake was observed only in one patient (10). However, the previous study was performed in USA which accepted vaccines only from Pfizer, Moderna, and Yanssen pharmaceutical companies. Therefore, studies regarding FDG PET/CT after vaccination of AstraZeneca company is lacking.

An approach to the performance and interpretation of FDG PET/CT after COVID-19 vaccination should seek to provide accurate interpretations while avoiding treatment delays, additional patient anxiety, excessive follow-up imaging studies, and unnecessary biopsies. Additional imaging and tissue sampling should be cautiously suggested only when necessary. Clues towards reactive LNs include a history of recent vaccination, normal size and benign morphology of LN on CT. Further, a comparison with baseline imaging can also be helpful and if there is

Fig. 1. A 73-year-old female with rectosigmoid junction cancer.

A. On a colonoscopic image, there is a 5 cm ulceroinfiltrative mass (arrows) in the rectosigmoid junction. Colonoscopic biopsy confirmed well-differentiated adenocarcinoma (not shown). **B, C.** Axial (**B**) and coronal (**C**) contrast-enhanced CT images showed well-enhancing wall thickening in the rectosigmoid junction colon (arrow) and adjacent pericolic lymph node (LN) enlargement (arrowhead). Left distal ureter was encased by the enlarged LN, leading to left hydronephrosis (*). **D.** On a [^{18}F]F-fluorodeoxyglucose (FDG) positron emission tomography/computed tomography (PET/CT) image, colon wall thickening (arrow) and adjacent enlarged LN (arrowhead) showed strong FDG uptake suggesting rectosigmoid junction cancer with pericolic metastatic LN. **E, F.** On FDG PET/CT images at thoracic level, there were several FDG-avid LNs (arrows) at left axilla area (arrows) and left supraclavicular area (arrowhead). Nuclear medicine doctor interpreted these LNs as metastatic LNs. Therefore, palliative chemotherapy was planned.

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Fig. 1. G. However, after a thorough image review including coronal PET/CT image for multidisciplinary team discussion by a dedicated gastrointestinal radiologist, the radiologist circumspectly noticed that there was a flat FDG avid lesion at left deltoid area (thin arrows) and suggested the possibility of reactive FDG uptake after COVID-19 vaccination. Note strong hot uptakes at primary colon mass (arrow) and left axillary LN (arrowhead). The patient received COVID-19 vaccination using AstraZeneca vaccine 18 days before FDG PET imaging.

any doubt clinically, serial imaging, discussion in a MDT setting or tissue sampling through biopsy can be helpful in our case. Delaying scans for two to four weeks post-vaccination has been suggested; however, we feel that this may be practically difficult in oncology patients and may cause unnecessary delays.

In conclusion, we hope that this case report will alert radiologists as well as nuclear medicine physicians towards the potential pitfall of reporting LN uptake on [^{18}F] FDG PET/CT in this current vaccination drive and provides a clear illustration of the main patterns of post-vaccine uptake which the reporting physicians or radiologists should be aware of.

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대장암 환자에서 원격 림프절 전이로 오인된 코로나바이러스감염증 2019 백신 접종 후 FDG PET/CT에서 어깨삼각근 및 동측 액와부와 쇄골위 림프절 FDG 섭취 증가

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초 록

코로나바이러스감염증 2019 (COVID-19)는 코로나바이러스-2 감염에 의해 유발되는 중증 급성 호흡증으로 세계적 대유행 중이다. 감염의 정도와 환자의 동반질환에 따라 다양한 합병증이 나타날 수 있고, 백신은 COVID-19에 대응하는 매우 중요한 조치이다. 본 증례보고는 대장암으로 진단된 환자에서 병기결정을 위해 시행한 FDG 양전자방출단층촬영/컴퓨터단층촬영 (PET/CT)에서 왼쪽 액와부와 쇄골위 림프절에서 FDG 섭취가 증가되어 원격 림프절 전이로 오인하였으나, 동측 어깨삼각근에 비슷한 정도의 FDG 섭취가 관찰되어 백신에 의한 이차적인 림프절 비대 및 FDG 섭취로 최종 진단하였던 73세 여자의 영상소견을 보고하고자 한다. 본 환자는 PET/CT 촬영 18일 전에 AstraZeneca 백신을 1회 접종 받은 기왕력이 확인되었다.