Original Investigation

Lymphadenopathy Following COVID-19 Vaccination: Imaging Findings Review

Pedram Keshavarz, MD, Fereshteh Yazdanpanah, MD, Faranak Rafiee, MD, Malkhaz Mizandari, MD, PhD

Rationale and Objectives: Despite all the benefits and effectiveness of the coronavirus disease 2019 (COVID-19) vaccines mentioned in recent clinical trials, some post-vaccination side effects such as lymphadenopathy (LAP) were observed. The present study reviewed all studies with imaging findings presentation of LAP after COVID-19 vaccination.

Materials and Methods: We conducted a literature search in online databases, including Scopus, Medline (PubMed), Web of Science, Embase (Elsevier), Cochrane library, and Google Scholar.

Results: A total of 19 studies (68 cases), including 60 (88.2%) females and eight (11.8%) males with a presentation of LAP after COVID-19 vaccination, were reviewed. LAP was identified after first or second dosages of three types of COVID-19 vaccines, including Pfizer-BioNTech ($n = 30$, 44.1%), Moderna ($n = 17$, 25%), and Oxford-AstraZeneca ($n = 1$, 1.5%). In 20 (29.4%) cases, vaccine type was not reported or only reported as mRNA COVID-19 vaccine. The median days of LAP presentation after the first and second dosages of COVID-19 vaccination, were 12 and 5 days, respectively. Most of the LAP imaging findings related to COVID-19 vaccination ($n = 66$, 97%) were seen from first day to 4 weeks after vaccination. However, LAP remained after 5 and 6 weeks of the first and second dosages of COVID-19 vaccination with decreased lymph nodes' size and residual cortical thickening in two cases.

Conclusion: This review study of cases with LAP-associated COVID-19 vaccination guides radiologists and physicians to rely on patient's clinical context and updated resources to prevent potential disease upstaging and change in therapy.

Key Words: Coronavirus; SARS-CoV-2; Vaccination; Pfizer-BioNTech; Moderna; Oxford-AstraZeneca; Adenopathy; Radiology.

Abbreviations: COVID-19 Coronavirus disease 2019, **LAP** Lymphadenopathy, **LN** Lymph node, BC, Breast cancer, **EUA** Emergency use authorization, **FDA** Food and Drug Administration, **CDC** Centers for Disease Control and Prevention, **BIRADS** Breast Imaging Reporting and Data System

INTRODUCTION

Since December 2019, coronavirus disease 2019 (COVID-19) has faced the world with a considerable challenge affected many other items besides health (1). According to the World Health Organization (WHO) statistics, as of March 27, 2021, more than 125 million people worldwide have been infected, and more than 2.700.000 have died (2). After implementing various methods to deal with the destructive effects of the virus, efforts to develop an effective vaccine as the final solution accelerated (3,4).

Since December 2020, various vaccines with mRNA, vector, and protein subunit mechanisms marketed over time. Pfizer-BioNTech and Moderna are among the first vaccines approved emergency use authorization (EUA) from the United States Food and Drug Administration (FDA) (5–7). Vaccination began immediately in the United States, and until March 27, 2021, more than 91 million (27.6%) of the USA population have received one or more doses (8). In the latest update, the FDA issued EUA for the Janssen vaccine on February 27, 2021 (9).

Despite all the vaccines' benefits and effectiveness, as mentioned previously, mild and negligible side effects have been observed. Some of them include local pain at the injection site, fatigue, headache, muscle or joint pain, fever, and chills. Furthermore, some severe adverse effects were noted in physical exams, including lymphadenopathy (LAP), which was

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From the Department of Diagnostic & Interventional Radiology of New Hospitals LTD, 12 Krtsanisi, 0114 Tbilisi, Georgia (P.K., M.M.); Department of Radiology, Tbilisi State Medical University (TSMU), Tbilisi, Georgia (P.K., M.M.); Network of Immunity in Infection, Malignancy and Autoimmunity (NIIMA), Universal Scientific Education and Research Network (USERN), Tabriz, Iran (F.Y.); Department of Radiology, Medical Imaging Research Center, Shiraz University of Medical Sciences, Shiraz, Iran (F.R.). Received March 10, 2021; revised April 9, 2021; accepted April 12, 2021. **Address correspondence to:** M.M. e-mail: mgmizandari@gmail.com

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