中文題目：莫德納新冠肺炎疫苗的注射局部反應之超音波影像特徵

英文題目：Ultrasound image features of local reaction to Moderna mRNA COVID-19 vaccine

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Background: Vaccination is a key strategy to control the coronavirus disease 2019 (COVID-19). Local reactions, e.g. induration, pain, tenderness and erythema, at injection site are major side effects of Moderna mRNA COVID-19 vaccine. The image features and mechanism of local reactions are unknown and need to be investigated.

Methods: An ultrasound (US) system, Philips iu22, equipped with a 12 MHz linear transducer was used. Power Doppler (PD) settings were pulse repetition frequency 500Hz and wall filter 47 Hz. Four participants who experienced left deltoid pain, swelling or erythema after intramuscular injection of Moderna mRNA COVID-19 vaccine were enrolled.

Results: Case 1 was a 44 y/o male patient with hypertension who experienced left deltoid tender swelling 12 hours after the 1st dose of vaccine. US assessment at 19th hour showed hypoechoic change, loss of normal echotexture, and presence of PD flows in deltoid muscle. One month later he experienced left deltoid tender swelling 12 hours after the 2nd dose of vaccine, and US assessment showed same image abnormalities of deltoid muscle at 24th hour and then resolution of such image abnormalities at 96th hour. Case 2 was a 58 y/o female patient with palindromic rheumatism who experienced left deltoid erythema (COVID arm) 2 days after the 1st dose of vaccine. The erythema persisted for over one week. US assessment on day 7 showed an increased echogenicity, blurred echotexture and presence of PD flows in

the subcutaneous tissue. These image abnormalities were consistent with panniculitis. Case 3 was a 40 y/o female person without systemic disease who experienced left deltoid painful swelling 24 hours after the 2nd dose of vaccine. The deltoid pain and swelling did not subside in the following days, instead it got worse progressively. US assessment on day 8 showed an increased echogenicity with blurred echotexture in the deltoid muscle and an increased thickness of muscular fascia. These image abnormalities were similar to those seen in immune-mediated myositis. Case 4 was a 67 y/o man with rheumatoid arthritis who experienced persistent left deltoid pain for 20 days after the 1st dose of vaccine. Grossly the deltoid muscle was not swollen at OPD visit. US assessment on day 20 showed post-inflammatory calcifications in the deltoid muscle.

Conclusions: Moderna mRNA COVID-19 vaccine causes the injection-site muscle and subcutaneous tissue damages within 24 hours after shot. The mechanism is presumed to be a direct chemical injury to muscle and subcutaneous tissue by vaccine components. It usually resolves spontaneously. However, if the symptoms progressed over one week, delayed type (T cell-mediated) hypersensitivity would be considered since the US image features look like immune-mediated myositis and panniculitis. Muscle calcification is a sequela of prolonged muscle inflammation.

Keywords: COVID-19, local reaction, ultrasound, vaccine