

A survey of adverse reactions to COVID-19 vaccines and swab complications in 120 peer-reviewed papers

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1 Introduction

This paper presents a non-exhaustive survey of adverse reactions to COVID-19 vaccines and swab complications, as observed and reported by physicians in peer-reviewed papers.

2 Vaccine adverse reactions

A growing number of adolescents are being diagnosed with acute myocarditis following mRNA COVID-19 vaccinations[1].

Epidemiology of Acute Myocarditis/Pericarditis in Hong Kong Adolescents: there is a significant increase in the risk of acute myocarditis/pericarditis following Comirnaty vaccination among male adolescents, especially after the second dose[2].

Myocarditis-induced sudden death after BNT162b2 mRNA COVID-19 vaccination in Korea: Case report focusing on histopathological findings[3]. A 22-year-old man developed chest pain 5 days after the first dose of the BNT162b2 mRNA vaccine and died 7 hours later. The primary cause of death was determined to be myocarditis, causally-associated with the BNT162b2 vaccine.

Autopsy Histopathologic Cardiac Findings in Two Adolescents Following the Second COVID-19 Vaccine Dose[4, 5]. The results of autopsies for 2 teenage boys who were found dead in bed 3 and 4 days after receiving the second dose of the Pfizer-BioNTech COVID-19 vaccine are presented. Both boys were pronounced dead at home without attempted resuscitation. Boy A complained of a headache and gastric upset but felt better by postvaccine day 3. Boy B had no complaints, prior health issues. The autopsies were unremarkable except for obesity in one boy and the cardiac findings. Unique cardiac findings in boy A included myocardial fibrosis and in boy B cardiac hypertrophy.

Autopsy-based histopathological characterization of myocarditis after anti SARS-CoV-2 vaccination[6]. Standardized autopsies were performed on 25 persons who had died unexpectedly and within 20 days after anti-SARS-CoV-2 vaccination. Overall, autopsy findings indicated death due to acute arrhythmogenic cardiac failure. Thus, myocarditis can be a potentially lethal complication following mRNA-based anti-SARS-CoV-2 vaccination.

Persistent Cardiac MRI Findings in a Cohort of Adolescents with post COVID-19 mRNA vaccine myopericarditis[7]. Takotsubo Cardiomyopathy After mRNA COVID-19 Vaccination[8]. Shedding the Light on Post-Vaccine Myocarditis and Pericarditis[9].

SARS-CoV-2 Vaccination and Myocarditis in a Nordic Cohort Study of 23 Million Residents[10]. Results of this large cohort study indicated that both first and second doses of mRNA vaccines were associated with increased risk of myocarditis and pericarditis.

Sudden cardiorespiratory collapse in a healthy male after coronavirus disease 2019 vaccination at a vaccination center[11]. A previously healthy young male who had a cardiopulmonary arrest 2 min after receiving the Oxford- AstraZeneca vaccination.

Clinical Features of Vaccine-Induced Immune Thrombocytopenia and Thrombosis[12]. Vaccine-induced immune thrombocytopenia and thrombosis (VITT) is a new syndrome associated with the ChAdOx1 nCoV-19 adenoviral vector vaccine against severe acute respiratory syndrome coronavirus 2.

Intracerebral hemorrhage associated with vaccine-induced thrombotic thrombocytopenia following ChAdOx1 nCOVID-19 vaccine in a pregnant woman[13].

Intracerebral Hemorrhage due to Thrombosis with Thrombocytopenia Syndrome after Vaccination against COVID-19: the First Fatal Case in Korea[14].

A 59-year-old woman with extensive deep vein thrombosis and pulmonary thromboembolism 7 days following a first dose of the Pfizer-BioNTech BNT162b2 mRNA COVID-19 vaccine[15].

Organ Donation From a Brain Dead Donor With Vaccine-induced Immune Thrombotic Thrombocytopenia After Ad26.COV2.S: The Risk of Organ Microthrombi[16].

A case of acute demyelinating polyradiculoneuropathy with bilateral facial palsy after ChAdOx1 nCoV-19 vaccine[17].

Aphasia seven days after second dose of an mRNA-based SARS-CoV-2 vaccine[18].

Gastroparesis After Pfizer-BioNTech COVID-19 Vaccination has been identified[19].

Acute Retinal Necrosis from Reactivation of Varicella Zoster Virus following BNT162b2 mRNA COVID-19 Vaccination[20].

Observational Findings of PULS Cardiac Test Findings for Inflammatory Markers in Patients Receiving mRNA Vaccines[21]. The mRNA vacs numerically increase the markers IL-16, Fas, and HGF, all markers previously described by others for denoting inflammation on the endothelium and T cell infiltration of cardiac muscle.

Immune-mediated hepatitis with the Moderna vaccine, no longer a coincidence but confirmed[22].

Liver transplantation following severe acute respiratory syndrome-coronavirus-2 vaccination-induced liver failure[23].

COVID-19 vaccine and autoimmunity. A new case of autoimmune hepatitis and review of the literature[24].

SARS-CoV-2 vaccination can elicit a CD8 T-cell dominant hepatitis[25].

Severe de novo liver injury after Moderna vaccination—not always autoimmune hepatitis[26].

Autoimmune hepatitis developing after COVID 19 vaccine[27]. Three cases of 80, 73 and 68 years old women who developed severe AIH after COVID 19 vaccination with no history of auto-immune disease. The first case received two doses of Pfizer-BioNTech, the second one dose of Moderna and the third one dose of AstraZeneca Covid 19 vaccine. AIH onset was rapid, with diagnosis of hepatitis, 10, 21 and 20 days after vaccination, respectively.

Immune thrombocytopenic purpura and acute liver injury after COVID-19 vaccine[28].
Hepatitis C virus reactivation following COVID-19 vaccination—A case report[29].

Maternal COVID-19 Vaccination and Its Potential Impact on Fetal and Neonatal Development[30]. Most COVID-19 vaccine reactions include injection site erythema, pain, swelling, fatigue, headache, fever and lymphadenopathy, which may be sufficient to affect fetal/neonatal development.

Genital necrosis with cutaneous thrombosis after COVID-19 mRNA vaccination[31].

Vulvar Aphthous Ulcer in an Adolescent After Pfizer-BioNTech (BNT162b2) COVID-19 Vaccination[32]. Post COVID-19 Vaccination Vulvar Aphthous Ulcers: An Unpopular Case Series[33]. Menstrual disturbances in 12-to 15-year-old girls after one dose of COVID-19 Comirnaty vaccine: population-based cohort study in Norway[34].

Rapid progression of angioimmunoblastic T Cell lymphoma following BNT162b2 mRNA vaccine booster shot: a case report[35].

COVID-19 mRNA vaccination leading to CNS inflammation: a case series[36]. All patients experienced new neurologic symptoms, occurring 1–21 (mean 13.7) days after vaccination, attributable to involvement of the optic nerve, brain, and/or spinal cord, including visual loss, dysmetria, gait instability, paresthesias, sphincter disturbance, and limb weakness. COVID-19 vaccination may carry a short-term risk of CNS demyelination.

Acute bilateral optic/chiasm neuritis with longitudinal extensive transverse myelitis in long-standing stable multiple sclerosis following vector-based vaccination against the SARS-CoV-2[37].

Intracellular Reverse Transcription of Pfizer BioNTech COVID-19 mRNA Vaccine BNT162b2 In Vitro in Human Liver Cell Line[38]. BNT162b2 mRNA is reverse transcribed intracellularly into DNA in as fast as 6 h upon BNT162b2 exposure.

COVID-19 vaccination induced lymphadenopathy in a specialized breast imaging clinic in Israel: Analysis of 163 cases[39].

Acute autoimmune-like hepatitis with atypical anti-mitochondrial antibody after mRNA COVID-19 vaccination: A novel clinical entity[40].

Fatal cerebral venous sinus thrombosis after COVID-19 vaccination[41].

Cerebral venous sinus thrombosis 2 weeks after the first dose of mRNA SARS-CoV-2 vaccine[42].

Erythema Multiforme Major following SARS-CoV-2 vaccine[43].

A neurologist's rhombencephalitis after comirnaty vaccination[44].

A case of acute necrotising pancreatitis following the second dose of Pfizer-BioNTech COVID-19 mRNA vaccine[45].

Fatal cerebral haemorrhage after COVID-19 vaccine[46].

Intracerebral haemorrhage twelve days after vaccination with ChAdOx1 nCoV-19[47].

Innate immune suppression by SARS-CoV-2 mRNA vaccinations: The role of G-quadruplexes, exosomes, and MicroRNAs[48]. These disturbances potentially have a causal link to neurodegenerative disease, myocarditis, immune thrombocytopenia, Bell's palsy, liver disease, impaired adaptive immunity, impaired DNA damage response and tumorigenesis.

Systemic lupus erythematosus and antiphospholipid syndrome after COVID-19 vaccination. A case report[49].

Cutaneous hypersensitivity reaction with acute hepatitis following COVID-19 vaccine[50].

Pancreatic Injury after COVID-19 Vaccine [51]. Acute pancreatitis that occurred shortly after administering the Pfizer BioNTech COVID-19 mRNA vaccine to a young and healthy patient, a healthy woman, breastfeeding mother who did not consume alcohol or drugs.

Cognitive deficits and memory impairments after COVID-19 (Covishield) vaccination[52].

Varicella-zoster virus reactivation after SARS-CoV-2 BNT162b2 mRNA vaccination: Report of 5 cases[53]. Reactivation of varicella zoster virus after vaccination for SARS-CoV-2[54].

Herpes zoster after inactivated SARS-CoV-2 vaccine in two healthy young adults[55]

Kikuchi-Fujimoto disease can present as delayed lymphadenopathy after COVID-19 vaccination[56].

Autoimmune mucocutaneous blistering diseases after SARS-Cov-2 vaccination: A Case report of Pemphigus Vulgaris and a literature review[57].

Guillain-Barré syndrome following ChAdOx1 nCoV-19 COVID-19 vaccination: A case series[58]. AstraZeneca COVID-19 vaccine and Guillain-Barré Syndrome in Tasmania[59]. Guillain-Barré syndrome following the first dose of Pfizer-BioNTech COVID-19 vaccine: case report and review of reported cases[60]. A Novel Case of Bifacial Diplegia Variant of Guillain-Barré Syndrome Following Janssen COVID-19 Vaccination[61].

A Case of Ulcerative Colitis Relapse after COVID-19 Vaccination[62].

SIRVA (Shoulder Injury Related to Vaccine Administration) following mRNA COVID-19 Vaccination[63].

Informed consent disclosure to vaccine trial subjects of risk of COVID-19 vaccines worsening clinical disease[64]. COVID-19 vaccines may sensitise vaccine recipients to more severe disease than if they were not vaccinated, via antibody-dependent enhancement (ADE). Medical ethics standards required that, given the extent of evidence in the medical literature, the risk of ADE should be clearly and emphatically distinguished in the informed consent from other risks.

Covid-19 vaccination BNT162b2 temporarily impairs semen concentration and total motile count among semen donors[65].

Paraneoplastic Tumefactive Demyelination Associated With Seminoma[66]. Paraneoplastic tumefactive demyelination (TD) is a rare disorder of the central nervous system that can be challenging to diagnose. 32-year-old man with a TD associated with testicular seminoma. He presented with symptoms of right-sided motor and sensory impairment 2 days after vaccination for coronavirus disease 2019 (COVID-19). Brain magnetic resonance imaging (MRI) showed a high-intensity lesion in the left internal capsule. Whole-body computed tomography (CT) revealed mass lesions in the left testicle. Chemotherapy was administered. After surgery, his neurological symptoms deteriorated. A brain stereotactic biopsy was performed and the sample showed demyelinating lesions.

Multifocal Necrotizing Encephalitis and Myo-Carditis after BNT162b2 Mrna Vaccination against Covid-19[67]. The family of the deceased requested an autopsy due to the ambivalent clinical features noted before death. The brain, in distinctive, revealed multifocal necrotizing encephalitis with massive inflammatory lymphocyte infiltrates. Heart showed signs of serious myocarditis.

Chronic Inflammatory Demyelinating Polyneuropathy Post-mRNA-1273 Vaccination[68].

Intracranial aneurysm rupture within three days after receiving mRNA anti-COVID-19 vaccination: Three case reports[69].

Delayed headache after COVID-19 vaccination: a red flag for vaccine induced cerebral venous thrombosis[70].

Ramsay Hunt syndrome following COVID-19 vaccination[71].

COVID-19 mRNA vaccine may trigger subacute thyroiditis[72].

Autoimmune Bullous Dermatositis Following COVID-19 Vaccination: A Series of Five Cases[73].

Bell's palsy following COVID-19 vaccination[74].

Acute Pancreatitis in an Adolescent Following COVID Vaccination[75], in a 14-year-old female, after the second dose.

Lobar bleeding with ventricular rupture shortly after first dosage of an mRNA-based SARS-CoV-2 vaccine[76].

Acute-onset polyradiculoneuropathy after SARS-CoV2 vaccine in the West and North Midlands, United Kingdom[77].

Atypical hemolytic uremic syndrome triggered by mRNA vaccination against SARS-CoV-2[78]. A rare disease caused by dysregulation in the alternative complement activation pathway. It is a life-threatening condition causing ischemia of a number of organs.

Moyamoya disease with Sjogren disease and autoimmune thyroiditis presenting with left intracranial hemorrhage after messenger RNA-1273 vaccination[79]. 40-year-old female, second dose of Moderna, left intraventricular and intracerebral hemorrhage.

A severe case of papulovesicular exanthema with rhabdomyolysis after corona virus disease 2019 heterologous booster vaccination[80].

Successful treatment of acute spleno-porto-mesenteric vein thrombosis after ChAdOx1 nCoV-19 vaccine[81]. Acute spleno-porto-mesenteric vein thrombosis is a serious condition with potential sequelae, such as small-bowel gangrene and end-stage liver failure. A case of concomitant thrombosis of portal, superior mesenteric and splenic veins in a young female patient with no other risk factors who received AstraZeneca 17 days before.

Large hemorrhagic stroke after ChAdOx1 nCoV-19 vaccination[82].

Oral erythema multiforme after Pfizer-BioNTech COVID-19 vaccination: a report of four cases[83]. Four cases of oral erythema multiforme flare arising after BNT162b2 vaccination administration. Two of the reported cases presented oral and cutaneous lesions.

Thyrototoxicosis after COVID-19 vaccination: seven case reports and a literature review[84].

Pfizer-biontech COVID-19 RNA vaccination induces phosphatidylserine autoantibodies, cryoglobulinemia, and digital necrosis[85]. 64-year-old female with progressively worsening fingertip necrosis that began three days after receiving a first dose of Pfizer-BioNTech COVID-19 RNA vaccine.

Pfizer COVID-19 vaccine-induced peritonitis[86]. Diagnosed 2 days after first dose of Pfizer BioNTech COVID-19 mRNA vaccine and that recurred after second and third dose of vaccine.

MOG encephalomyelitis after vaccination against severe acute respiratory syndrome coronavirus type 2[87]. 67-year-old man, acute decline in visual acuity and colour desaturation, 10 days after vaccination. Two vaccinations, 210 and 154 days earlier.

Clots in unusual places: lots of stress, limited data, critical decisions [88]. 9 patients developed CVT, and 3 patients developed SVT after vaccination with AstraZeneca. 7 Thrombosis in the cerebral and splanchnic circulation after Johnson and Johnson's.

A severe case of papulovesicular exanthema with rhabdomyolysis after corona virus disease 2019 heterologous booster vaccination[80].

TAFRO syndrome with a fatal clinical course following BNT162b2 mRNA (Pfizer-BioNTech) COVID-19 vaccination[89]. TAFRO syndrome is a rare disorder that manifests as thrombocytopenia. Fatal clinical course, 42-year-old Japanese man.

Anaphylaxis after Moderna COVID-19 vaccine[90]. Anaphylaxis can lead to death if not diagnosed and treated promptly. Not only is anaphylaxis under-recognized but is also under-treated, which has led to preventable fatalities.

First Episode of Psychosis Following the COVID-19 Vaccination[91]. A series of three patients who had no past or family history of mental illness and developed psychotic disorders following COVID-19 vaccination.

A novel adverse effect of the BNT162b2 mRNA vaccine: First episode of acute mania with psychotic features [92]. Two patients displaying first episode of acute mania with psychotic features one day after BNT162b2 mRNA vaccine.

3 Swab complications

Epistaxis Requiring Intervention After Swab[93]. Two female patients who suffered from massive epistaxis requiring intervention after nasopharyngeal swab. The nasopharyngeal swab for diagnosis of SARS-CoV-2 can lead to life-threatening complications.

A man in his seventies underwent testing with nasopharyngeal swab for COVID-19 started bleeding profusely from the nostril insertion site. Nine days in hospital, risk of complications was high[94].

Nasopharyngeal Swab for COVID-19 Test Necessitating Mechanical Ventilation and Tracheostomy[95]. 67-year-old male suffered massive epistaxis following nasopharyngeal (NP) swabbing requiring intubation and tracheostomy. Patient desaturated to low 80s requiring intubation for airway protection and hypoxemic respiratory failure. The patient subsequently underwent tracheostomy and was transferred to sub-acute rehabilitation with a tracheostomy tube on minimal ventilator support.

Acute blood loss anemia after COVID-19 nasopharyngeal sampling[96]. Most long-term care resident testing occurs via nasopharyngeal swab that potentially causes epistaxis with rates of 5% to 8% in healthy populations. It is estimated that 48% of long-term care residents receive oral anticoagulation that increases risk of bleeding. A long-term care resident receiving oral anticoagulation experienced an episode of acute blood loss anemia after nasopharyngeal sampling. Current medications were not reviewed before testing, and oral anticoagulation was not held resulting in acute blood loss anemia.

Cerebrospinal Fluid Leak From COVID-19 Swab [97]. Primarily performed by staff that may not completely understand the anatomy of the nasal cavity, resulting in adverse events such as epistaxis. Cerebrospinal fluid (CSF) leak secondary to skull base trauma from swab testing.

Meningitis due to cerebrospinal fluid leak after nasal swab testing for COVID-19[98]. 41-year-old woman with holocraneal headache worsened by position changes and fever. One week after PCR testing, she developed unilateral continuous rhinorrhoea with metallic taste. Four months later, head magnetic resonance imaging (MRI) was performed identifying the presence of a left-side frontonasal CSF fistula leaking into superior ethmoidal cells. We should be aware of CSF leaks as a possible meningitis cause in patients.

A fractured nasopharyngeal swab in the duodenum of a toddler: an unusual complication of preoperative COVID-19 testing[99]. 22-month-old female. Swab test performed due to hospital policy. NPS fractured because the patient moved suddenly. 5cm of the swab stick in the nasopharynx. Fragment found in the duodenum.

Complications in Testing for COVID-19 with Nasopharyngeal Swabs: The Severance of a Nasopharyngeal Swab in a 13-Month-Old Toddler and Review of Literature[100]. Treatment of a toddler with a broken swab after testing and the currently unknown location of the swab in the body.

Ethmoidal silent sinus syndrome after nasal swab test[101]. Swab insertion into the nasal cavity was particularly painful. Deformity of the left middle nasal turbinate with occlusion of the osteomeatal complex, resulting in ethmoid silent sinus syndrome.

Broken swabs were removed via nasal endoscopy under local anesthesia. Surgical and endovascular procedures and led to fetal risk, sepsis, and blood transfusions. Half of the bleeds were potentially life threatening[102].

Preseptal cellulitis and infraorbital abscess as a complication of a routine COVID-19 swab[103].

Cerebrospinal fluid rhinorrhea after repetitive nasal swab testing for coronavirus disease 2019 (COVID-19)[104]. 47-year-old male was admitted with a right-sided rhinorrhea and headache. The patient had been tested for COVID-19 four times within the span of a month. Three days after the last nasal swab test, the dripping developed into massive fluid leak following a sneeze. The physical examination showed leakage of a clear fluid from the right nasal cavity. The patient was admitted to the hospital for an endoscopic transnasal surgery.

CSF rhinorrhoea post COVID-19 swab [105]. A 59 year old male who presented with 2 months of persistent rhinorrhoea from left nostril post a nasal swab. Left middle cranial fossa encephalocele herniating into the sphenoid sinus as the site of the leak post swab.

Misdirection of a nasopharyngeal SARS-CoV-2 swab: An unexpected complication[106]. 79-year-old man, right orbital cellulitis after a nasopharyngeal swab test for SARS-CoV-2, violation of the lamina papyracea due to misdirection of the nasopharyngeal swab.

Cribriform plate injury after nasal swab testing for COVID-19[107]. Man in his 40s, clear water rhinorrhea after nasal swab testing. Mistakenly considered to be allergic rhinitis, after test by a mobile unit, resulting in cerebrospinal fluid (CSF) leak/fistula.

Anesthesia for extraction of a fractured COVID-19 nasopharyngeal swab[108]. A 12-year old female with a foreign body retained within her left nasal cavity. Accidently sustained a fracture of a COVID-19 NP swab. Scheduled for foreign body removal under anesthesia.

Fractured aluminum nasopharyngeal swab during drive-through testing for COVID-19: radiographic detection of a retained foreign body[109]. Aluminum shaft of the nasopharyngeal swab fractured during specimen collection at a drive-through testing facility and was suspected to have remained in the asymptomatic patient. Initial evaluation with a series of radiographs covering the skull base, neck, chest, and abdomen did not reveal the swab. On further clinical evaluation, the swab was found endoscopically, lodged between the left inferior turbinate and nasal floor, and was removed by an otorhinolaryngologist.

An unusual retained choanal foreign body: a possible complication of COVID-19 testing with nasopharyngeal swab[110]. A complication occurred during a nasopharyngeal swab collection performed in a noncooperative patient where the plastic shaft of the swab fractured during the procedure, resulting in swab tip retention deep into the nasal cavity. The foreign body was found endoscopically, stuck between the nasal septum and the superior turbinate tail at the upper level of the left choana and removed under general anesthesia.

SARS-CoV-2 nasopharyngeal swab as a foreign body: a case report[111]. A nasopharyngeal swab became a retained foreign body during swabbing. Bedside flexible fiberoptic endoscopy was performed and did not reveal a foreign body in the nasopharynx or larynx. Subsequent

computed tomography (CT) scan demonstrated the radiopaque retained foreign body at the distal gastroesophageal junction.

Accidental swab swallowing[112]. 47-year-old male with no known comorbidity, who accidentally swallowed a portion of a naso-pharyngeal swab half-broken during the second diagnostic test for SARS-CoV-2. The intact swab had a total length of 15 cm and was made of wood.

Accidental ingestion broken COVID-19 swab[113] 7-month-old previously healthy male presented to the emergency department. Tip of the swab broke off in his nose. The child had not experienced any choking, gagging, or coughing, so its location remained unknown. Otolaryngology was consulted and performed a bedside flexible nasolaryngoscopy, which did not reveal the swab. Neck, chest, and abdominal x-rays as well as computerized tomography (CT) foreign body protocol were obtained, but the swab was not visualized. Within a few hours, the patient became fussy and inconsolable. Given concern for size (6 cm in length) as well as sharpness (pointed end of broken swab), esophagogastroduodenoscopy was performed and revealed the 6 cm tip of the swab in the stomach, traversing the pylorus into the duodenal bulb.. The swab was removed using rat tooth forceps to grab the sharp end.

64-year-old man was admitted to the gastroenterology department after a nasopharyngeal swab broke inside his left nasal fossa during testing for SARS-CoV-2[114]. In the gastric cavity, the broken swab was visualized and seen to be approximately 6 cm long. The foreign body was retrieved with grasping forceps by the broken swab's extremity.

Gastrointestinal complication of COVID-19 deep nasal swab testing[115]. 35-year-old woman at 40 weeks gestation who presented to the hospital for a scheduled elective induction and delivery for full-term pregnancy. On admission, she underwent routine testing for COVID-19 with deep nasal swab. The swab was inserted into her left naris, and while being rotated, broke off in the patient's posterior nasopharynx. Almost immediately, the patient felt pain in her throat that quickly subsided. The broken swab was located in the fourth portion of the duodenum.

Nasal foreign body, an unanticipated complication of COVID-19 care[116]. A 52-year-old previously healthy woman presented with 4 days of nasal pain and discharge after using a home collection kit in an attempt to obtain a nasopharyngeal viral sample for COVID-19 testing. Emergency physicians must be cognizant of and monitor for poor outcomes and potential downstream complications, especially in underserved patient populations.

Self-performed tests: a case of a swallowed swab[117]. A 45-year-old man who accidentally ingested a swab during self-performed SARS-CoV-2 rapid antigen testing. Urgent gastroscopy confirmed the presence of the swabbing applicator in the gastric lumen. Serious events can occur that may require immediate medical interventions.

Infected oropharyngeal haematoma after SARS-CoV-2 oropharyngeal swab[118]. An 81-year-old male with a history of atrial flutter receiving anticoagulant therapy, who developed an oropharyngeal haematoma and subsequent infection following a test for SARS-CoV-2 by oropharyngeal swab. Anticoagulant therapy is widely used and should lead to caution when performing oropharyngeal swabs.

An Intracranial Complication of COVID-19 Nasopharyngeal Swab [119]. A 54-year-old female experienced two months of persistent headache and rhinorrhea since her coronavirus disease 2019 (COVID-19) nasopharyngeal swab. She was diagnosed with a CSF leak from ruptured congenital meningocele. On ED presentation, she was afebrile, but with mild tachy-

cardia, leukocytosis, and meningismus. Lumbar puncture revealed acute streptococcal meningitis. This patient's meningitis developed due to prolonged occult CSF leak after her COVID-19 nasopharyngeal swab ruptured a pre-existing congenital meningocele.

Iatrogenic cerebrospinal fluid leak after repeated nasal swab tests[120]. A 41-year-old man presented with clear continuous rhinorrhea through his left nostril for 5 days after repeated nasal swabbing for COVID-19. Magnetic resonance imaging confirmed the presence of a CSF fistula between his left cribriform plate and superior nasal concha. The patient underwent endoscopic endonasal repair. CSF rhinorrhea ceased after the surgery, and no recurrence was noted during the 12-week postoperative follow-up period. Iatrogenic CSF leakage can be a serious complication following COVID-19 nasal swab tests, especially when infection may cause significant neurological sequelae.

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