Proper Procedures for Performing Nasopharyngeal and Oropharyngeal Swabs for COVID-19

Enrico Fazio[1], Monir Abousiam[1], Arianna Caselli[2], Remo Accorona[3], Aurel Nebiaj[1], Ignazio Ermoli[1], Bettina Erckert[1], Luca Calabrese[1], and Luca Gazzini[1]

[1]Division of Otorhinolaryngology and [2]Service of Speech and Language Therapy, "San Maurizio" Hospital, Bolzano, Italy; and [3]Department of Otorhinolaryngology–Head and Neck Surgery, Fondazione Istituti di Ricovero e Cura a Carattere Scientifico Ca' Granda, Ospedale Maggiore Policlinico, Milano, Italy

ORCID ID: 0000-0002-5077-9847 (L.G.)

The most commonly performed procedure for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) testing is swabbing of the nasopharynx. It is not well known how to correctly perform the procedure. Although these are the mainstay of coronavirus disease (COVID-19) testing, the clinical sensitivity for nasopharyngeal swab diagnostic procedures is 63% and is only 32% for oropharyngeal swabbing (1). One reason these diagnostic procedures lack optimal sensitivity is that they are not simple to perform and may result in inadequate sampling when done improperly. To perform these procedures correctly, basic anatomical knowledge of the nasal cavities, nasopharynx, oral cavity, and oropharynx is needed. The relevant anatomy and procedure are presented in this review and in the accompanying video.

NASAL CAVITIES AND NASOPHARYNX ANATOMY

The anatomy of the nasal cavities is very complex and difficult to master. The superior surface of the hard palate anteriorly and of the soft palate posteriorly forms the floor of the nasal cavity. Medially, it is bounded by the nasal septum that separates it from the contralateral one. The lateral wall consists of three bone structures called turbinates. The turbinates delineate different anatomical recesses where the paranasal sinuses drain their secretions. The significant ones are the lower meatus, between the lower turbinate and the floor of the nasal cavity, and the middle meatus, between the lower and middle turbinate. The roof of the nasal cavity is composed anteriorly by the nasal bones and posteriorly by the lamina cribra of the ethmoid, which separates it from the anterior cranial fossa. This is the anatomical subsite dedicated at the olfactory sensation. Posteriorly, the nasal cavity continues, through the choana, into the nasopharynx.

The nasopharynx is the most cranial portion of the pharynx and is located above a plane passing through the soft palate,

(Received in original form July 16, 2020; accepted in final form August 31, 2020)

Correspondence and requests for reprints should be addressed to Luca Gazzini, M.D., Division of Otorhinolaryngology, "San Maurizio" Hospital, Bolzano, Via Lorenz Böhler 5, Bolzano 39100, Italy. E-mail: drlucagazzini@gmail.com.

ATS Scholar Vol 1, Iss 4, pp 495–497, 2020

DOI: 10.34197/ats-scholar.2020-0109VO

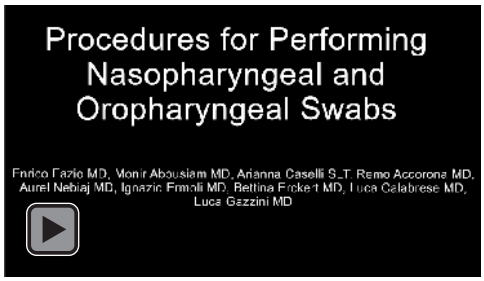
posterior to the nasal cavities. It is a "cuboidal"-shaped space delimited by six walls. Superiorly, it is formed by the basis of the sphenoid; laterally, it is surrounded by the eustachian tube and the retrotubaric recess; posteriorly, it is delimited by the clivus with the firsts cervical vertebras; and anteriorly and inferiorly, it is open and in continuity with the nasal cavity through the choanae and the oropharynx, respectively.

NASOPHARYNGEAL SWAB PROCEDURE

The patient is seated, with the head tilted 30–45° upward and toward the operator who performs the swab. If an electric reclining armchair is available, it is also useful to raise it and recline the backrest. This positioning helps the operator to align with the target areas in the nasopharynx and to have a direct view of the oropharynx. The swab must be inserted in the inferomedial angle of the nostril, next to the nasal septum, proceeding along a plane parallel to the hard palate. The hard palate is the floor of the nasal fossa, is medial to inferior turbinate, and follows an imaginary line connecting the nostril to the ear. Usually, the mucosa of the inferior turbinate is less sensitive to pain than is the septal mucosa. When inserting the swab, its tip should be pointed laterally, away form the nasal septum and toward the inferior turbinate. The nasal fossa corridor measures between 9 and 12 cm from the nostril to the nasopharynx (2). It is important to check the length of swab insertion to be sure that the deepest target area has been reached (Video 1).

Technical Pitfalls

1) If the swab is directed aimed upward, it may reach the nasal vestibule's roof and, posteriorly, the olfactory fissure.



Video 1. Nasopharyngeal and oropharyngeal swabs for coronavirus disease (COVID-19): proper procedure tips, tricks, and common errors.

2) If the swab is directed too laterally, it will migrate to the inferior nasal meatus between the floor of the nasal fossa and the inferior turbinate or to the middle nasal meatus between middle and inferior turbinate instead of the nasopharynx.
3) Given the extensive innervation of the nasal mucosa especially on the nasal septum, it is very sensitive to pain. If the swab is pressed against this, pain will result usually precluding adequate nasopharyngeal sampling. Sneezing may also result, aerosolizing and spreading a turbulent cloud of respiratory secretions that might contain viral particles (3), increasing the risk of infecting healthcare workers. This is avoided by pointing the swab laterally and not medially during the procedure to avoid pressing on the nasal septum.

Anatomical Variants and Nasal Obstruction

The nasal fossa can be obstructed by septal deviation, nasal polyps, or tumors. Even in these circumstances, a small passage in the inferior portion of the nasal fossa is preserved. However, forcing a swab through this can cause pain and bleeding, especially in patients who are taking anticoagulant medications. When obstruction exists, it is best to use the contralateral nostril.

OROPHARYNGEAL ANATOMY

The oropharynx is the intermediate portion of the pharynx. It communicates

superiorly with the nasopharynx, inferiorly with the hypopharynx and larynx, and anteriorly with the oral cavity, and it includes soft palate, palatine pillars and tonsils, base of the tongue, soft palate, and posterior pharyngeal wall.

OROPHARYNGEAL SWAB PROCEDURE

The correct execution of the oropharyngeal swab requires a selective sampling of the oropharyngeal mucosa of the posterior wall and base of the tongue (4). An oropharyngeal swab is easier to perform than the nasopharyngeal approach because the target area is more accessible. In some cases, the oropharynx is not easily seen with mouth opening (e.g., Mallampati Score III or IV) (5), in which case a lingual retractor should be used (4). The patient is asked to breathe slowly and to focus the attention on breathing to reduce vagal stimulation.

The swab is inserted parallel to the lingual retractor toward the posterior wall. One lateral side of the oropharynx is swabbed, followed by the contralateral side, and finally the base of the tongue is swabbed.

Technical Pitfalls

1) If the swab is angled cranially or too far laterally, its tip will swab the hard or soft palate or the palatine pillars instead of the oropharynx.
2) If the tongue is not adequately retracted, visualization of the oropharynx is limited, resulting in angulation of the swab tip upward to the palate. This increases the risk of triggering vagal reflexes, resulting in gagging and coughing with subsequent emissions of secretions and aerosols.

CONCLUSIONS

Nasopharyngeal and oropharyngeal diagnostic swabbing is not simple, and if not done properly, it can result in false-negative tests. Consequently, it is important for clinicians performing these procedures to be familiar with the anatomy and proper method for performing them.

Author disclosures are available with the text of this article at www.atsjournals.org.

REFERENCES

1. Wang W, Xu Y, Gao R, Lu R, Han K, Wu G, *et al*. Detection of SARS-CoV-2 in different types of clinical specimens. *JAMA* 2020;323:1843–1844.

2. Mukherji SK, Castillo M. Normal cross-sectional anatomy of the nasopharynx, oropharynx, and oral cavity. *Neuroimaging Clin N Am* 1998;8:211–218.

3. Bourouiba L. Turbulent gas clouds and respiratory pathogen emissions: potential implications for reducing transmission of COVID-19. *JAMA* [online ahead of print]. DOI: 10.1001/jama.2020.4756.

4. Loens K, Van Heirstraeten L, Malhotra-Kumar S, Goossens H, Ieven M. Optimal sampling sites and methods for detection of pathogens possibly causing community-acquired lower respiratory tract infections. *J Clin Microbiol* 2009;47:21–31.

5. Detsky ME, Jivraj N, Adhikari NK, Friedrich JO, Pinto R, Simel DL, *et al*. Will this patient be difficult to intubate?: the rational clinical examination systematic review. *JAMA* 2019;321:493–503.