Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

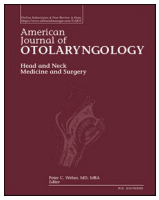
Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

American Journal of Otolaryngology–Head and Neck Medicine and Surgery 42 (2021) 102828

Contents lists available at ScienceDirect

American Journal of Otolaryngology–Head and Neck Medicine and Surgery

journal homepage: www.elsevier.com/locate/amjoto



An alternative way to perform diagnostic nasopharyngeal swab for SARS-CoV-2 infection

Elina Matti [a,1], Roberta Lizzio [a,*,1], Giuseppe Spinozzi [a], Sara Ugolini [a,b], Eugenia Maiorano [a,b], Marco Benazzo [a,b], Fabio Pagella [a,b]

[a] Department of Otorhinolaryngology, Fondazione IRCCS Policlinico San Matteo, Pavia, Italy
[b] Department of Otorhinolaryngology, University of Pavia, Italy

ARTICLE INFO

Keywords:
Nasopharyngeal swab
Oropharyngeal swab
SARS-CoV-2
COVID-19
RT-PCR
COVID-19 diagnosis

ABSTRACT

On March 11, 2020, WHO has defined the novel coronavirus disease SARS-CoV-2 (COVID-19) outbreak as a pandemic and still today continues to affect much of the world. Among the reasons for the rapid spread of SARS–CoV-2 infection, there is not only the high transmissibility of the virus, but also the role of asymptomatic or minimally symptomatic carriers. Therefore diagnostic testing is central to contain the global pandemic. Up to now real-time reverse transcriptase polymerase chain reaction (RT-PCR)–based molecular assays for detecting SARSCoV-2 in respiratory specimens is the current reference standard for COVID-19 diagnosis. Nasopharyngeal swab is the preferred choice for SARS–CoV-2 testing; however is not always a free of complications procedure. In patients with severe coagulopathies or diseases such as HHT, the risk of nosebleeding may be high. As in all those conditions like advanced stage sinonasal neoplasms or unfavorable anatomical characteristics, the nasopharyngeal swab may not be feasible.

This work reports a safe and effective procedure of nasopharyngeal swab collection for COVID-19 testing, through the transoral way, in patients with contraindication to perform it transnasally.

The procedure proved feasible and well tolerated. The discomfort for the patient is comparable with the execution of an oropharyngeal swab without exposing him to additional complications.

In selected cases, the procedure described represents a valid alternative to nasopharyngeal swab performed transnasally. In particular, it allows reaching the area with the highest diagnostic sensitivity. Moreover it can be performed by Otolaryngology and, with adequate training, also by non-specialist staff.

1. Introduction

On Jan. 30, 2020, WHO has declared that the outbreak of 2019-nCoV constituted a Public Health Emergency of International Concern (PHEIC), whereas on March 11, 2020, declared the novel coronavirus disease SARS-CoV-2 (COVID-19) outbreak as a pandemic. The pandemic of coronavirus disease continues to affect much of the world, and as of Nov.03, 2020 globally, there have been 46.403,652 confirmed cases of COVID-19, including 1.198,569 deaths [1].

In response to COVID-19, countries across the globe have implemented a range of public health and social measures, like partial or total closure of public places, quarantine, national and international travel restrictions.

Among the reasons for the rapid spread of SARS–CoV-2 infection, there is not only the high transmissibility of the virus, but also the role of asymptomatic or minimally symptomatic carriers. Particularly, COVID-19 seems to be transmitted mostly during the incubation period, when most of patients have very mild non-specific symptoms. Therefore diagnostic testing, to identify people infected with COVID-19, is central to contain the global pandemic [3]. The development of diagnostic tests has been rapidly progressing and up to now real-time reverse transcriptase polymerase chain reaction (RT-PCR)–based molecular assays for detecting SARS– CoV-2 in respiratory specimens are the current reference standard for COVID-19 diagnosis [2].

Based on current knowledge regarding the sensitivity of the molecular test, the highest positive detection rate is from lower respiratory tract specimens [2]. However, especially in asymptomatic or paucisymptomatic patients, collection of these specimens is not easily

* Corresponding author at: Department of Otorhinolaryngology, Fondazione IRCCS Policlinico San Matteo, Piazzale Golgi 19, 27100 Pavia, Italy.
E-mail address: robertalizzio@hotmail.com (R. Lizzio).
[1] Elina Matti and Roberta Lizzio contributed equally to this study.

https://doi.org/10.1016/j.amjoto.2020.102828
Received 29 October 2020;
Available online 17 November 2020
0196-0709/© 2020 Elsevier Inc. All rights reserved.

feasible; alternatively it is possible to perform a nasopharyngeal or oropharyngeal swab, among which, the nasopharyngeal one has a higher sensitivity [3].

Nasopharyngeal specimen is the preferred choice for swab-based SARS–CoV-2 testing because, in addition to having greater sensitivity, is considered rapid and safe [4]. However it is not always a procedure simple and free of complications. In patients with severe coagulopathies or diseases such as HHT, the risk of nosebleeding may be high. As in all those conditions like advanced stage sinonasal neoplasms or unfavorable anatomical characteristics, the nasopharyngeal swab may not be feasible.

Supporting Video demonstrates a safe and effective procedure of nasopharyngeal swab collection for COVID-19 testing, through the transoral way, in patients with contraindication to performe it transnasally.

2. Methods

As recommended by WHO guidelines, it is important to wear appropriate personal protective equipment (PPE) included gloves, surgical face masks, protective goggles, face shields and gowns, as well as specific procedures- filtering facepiece respirators (e.g. N95 or FFP2 or FFP3 standard or equivalent) [4].

Before starting, to improve the success of the procedure it is important that the patient is adequately informed, inviting him to relax, breathe slowly from the mouth to reduce pharyngeal reflexes and stiffening.

To perform the test use a plastic swab with the possibility of being folded manually. The stick of the swab is manually modified at a distance of approximately 3.5 cm from the sampling end, with an angle of about 80° (Fig. 1).

It is advisable the use of tongue depressor for better exposure, especially in case of unfavorable oral cavity morphology, like macroglossia, palatine tonsillar hypertrophy or Mallampati type III - IV. In poorly compliant patients it is possible to precede the procedure by administering local anesthesia using Lidocaine spray, having previously investigated any allergies. It is also recommended the use of the front light, in order to have a better control of the procedure.

The operator asks the patient to open the oral cavity as much as possible. While inserting the swab, avoid contact with oral cavity structures in particular with the tongue. Reached the oropharynx at level of the uvula, orient the collecting end of the swab upwards, and then gently swing the swab in latero-lateral and/or cranio-caudal sense for a few seconds. To be sure of reaching the nasopharynx, the angled segment of the swab must be fully beyond the soft palate (Fig. 2).

At the end of the procedure, the swab must be inserted into the test tube taking care not to contaminate adjacent surfaces and medical staff. Although the shape of the swab has been modified, its structure is malleable and can be adapted again to the rigid test tube (Fig. 3).

3. Results

The procedure proved feasible and well tolerated. The use of tongue depressor and Lidocaine spray improve the success of the procedure, especially in those poorly compliant patients in whom pharyngeal reflexes are easily triggered. The discomfort for the patient is comparable with the execution of an oropharyngeal swab without exposing him to additional complications. The plastic swab is readily available and the folding maneuver is easily obtained.

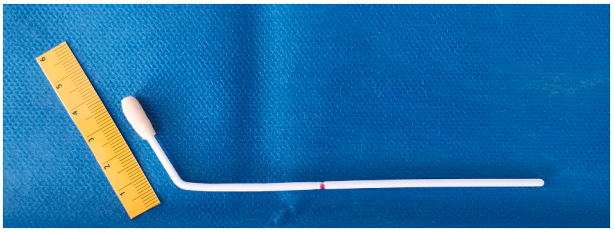


Fig. 1. Modified oropharyngeal swab.
The plastic stick of the swab is manually modified at distance of approximately 3.5 cm from the sampling end, with an angle roughly 80°.

4. Discussion

Diagnostic tests to identify people infected with COVID-19 are critical to adopt the adequate medical and epidemiological measures necessary to control the global pandemic [3]. In particular a quick identification of cases among hospitalized patients remains a high priority to prevent nosocomial spread with subsequent occurrence of outbreaks [2].

The primary, and preferred, method for diagnosis is the collection of upper respiratory samples via nasopharyngeal swabs, which, compared to the oropharyngeal swab, has a greater sensitivity [3].

In fact nasopharyngeal swabs showed higher positive rate than oropharyngeal swabs for SARS-CoV-2 detection, and oropharyngeal swabs may result in a worryingly high false negative rate [3]. The high number of false negatives depends also on inappropriate timing of collection and inadequate sampling technique or specimen handling [5].

To minimize the rate of false negatives, the execution of the nasopharyngeal swab must be preceded by adequate training of health professionals. However, even experienced operators in performing the procedure in patients with a higher risk of epistaxis, with anatomical anomalies or nasal pathologies that contraindicate the execution may present difficulties.

The procedure described, in selected cases, represents a valid alternative to nasopharyngeal swab performed transnasally. In particular, it allows reaching the area with the highest diagnostic sensitivity, when the nasopharyngeal specimen is not possible to obtain or is contraindicated. Furthermore, it is not necessary to have special equipment, except a moldable swab.

With adequate training the transoral nasopharyngeal swab can be performed by non-specialist staff. However the otolaryngologist who is more familiar with head-neck surgical maneuvers and has greater knowledge of the pharyngeal anatomy, guarantees best comfort for the patient, shorter execution time and greater chance of success.

Voice over transcription

00:00–00:12: This is a demonstration of a nasopharyngeal swab for diagnosis of SARS-CoV-2 infection performed transorally, using an 80 degree angled swab.

00:13–00:51: On March 11, 2020, World Health Organization has defined the novel coronavirus disease SARS-CoV-2 (COVID-19) outbreak as a pandemic and still today continues to affect much of the world.

Among the reasons for the rapid spread of SARS–CoV-2 infection, there is not only the high transmissibility of the virus, but also the role of asymptomatic carriers.

Therefore diagnostic testing, to identify people infected with COVID-19, is central to contain the global pandemic [3].

00:52–01:47: Up to now real-time reverse transcriptase polymerase chain reaction (RT-PCR) - based molecular assays for detecting SARS–CoV-2 in respiratory specimens are the current reference standard for COVID-19 diagnosis [2].

Based on current knowledge, the highest positive detection rate is from lower respiratory tract specimens [2].

Alternatively, especially in asymptomatic or paucisymptomatic patients, it is possible to perform a nasopharyngeal or oropharyngeal swab, among which, the nasopharyngeal one has a higher sensitivity [3].

Nasopharyngeal specimen is the preferred choice for swab-based SARS–CoV-2 testing because, in addition to having greater sensitivity, is considered rapid and safe [4].

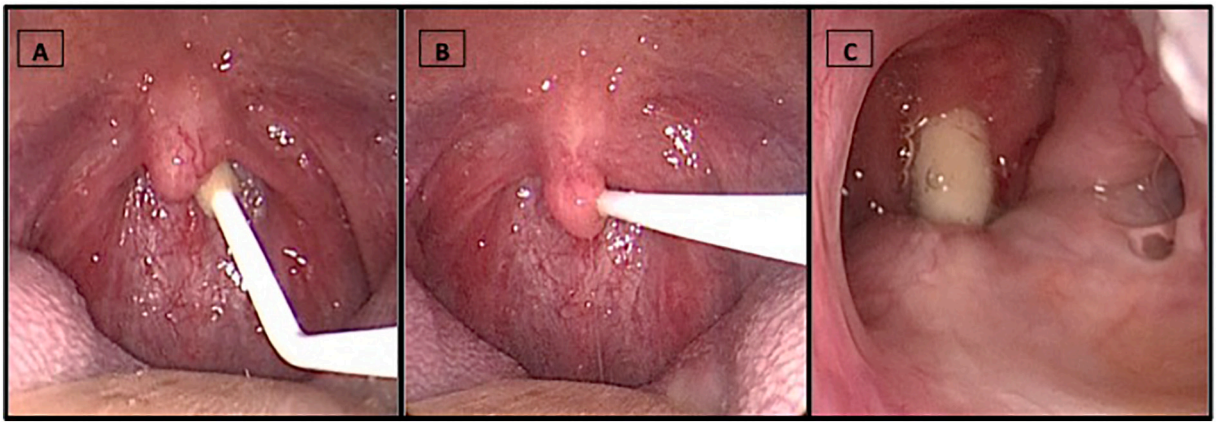


Fig. 2. Procedure of nasopharyngeal swab for COVID-19 diagnosis through the transoral way.
(A) Transoral view: the swab reaches the oropharynx at level of the uvula with the collecting end oriented upwards. (B) Transoral view: to be sure of reaching the nasopharynx, the angled segment of the swab must be fully beyond the soft palate.
(C) Transnasal view: the swab is in nasopharynx it is rotated in a latero-lateral and/or cranio-caudal sense for a few seconds.

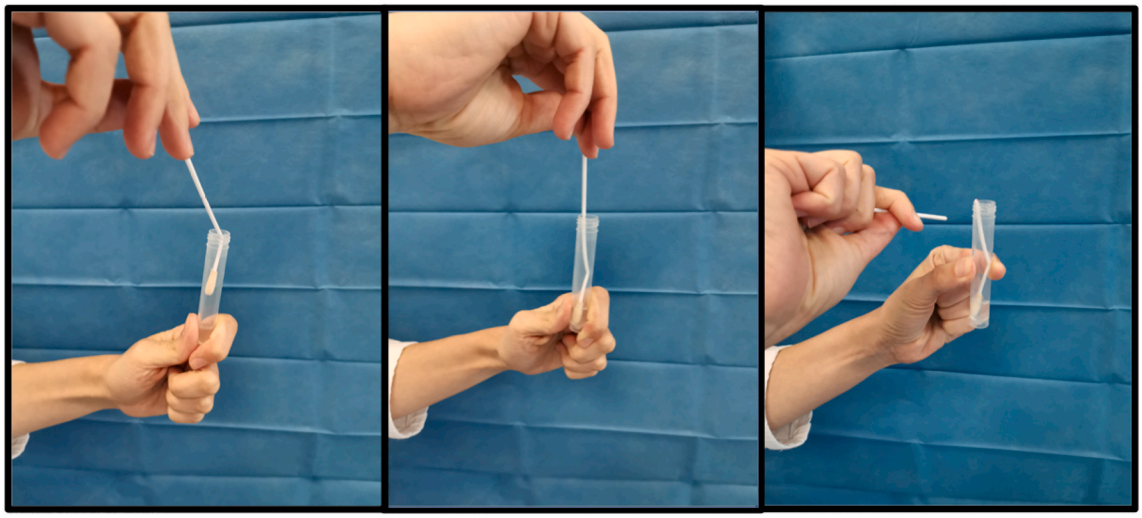


Fig. 3. Specimen handling.
At the end of the procedure the swab must be inserted into the test tube. Although the shape of the swab has been modified, its structure is malleable and can be adapted again to the rigid test tube.

01:48–02:17: However it is not always a procedure simple and free of complications.

In patients with severe coagulopathies or diseases such as Hereditary Hemorrhagic Teleangiectasia, the risk of nosebleeding may be high. As in all those conditions like advanced stage sinonasal neoplasms or unfavorable anatomical characteristics, the nasopharyngeal swab may not be feasible.

02:18–02:33: The aim of this study is to demonstrate a safe and effective procedure of nasopharyngeal swab collection for COVID-19 testing, through the transoral way, in patients with contraindication to perform it transnasally.

02:34–04:27: As recommended by WHO guidelines, it is mandatory to wear appropriate personal protective equipment (PPE) [4].

To perform the test use a plastic swab with the possibility of being folded manually. The stick of the swab is manually modified at a distance of approximately 3.5 cm from the sampling end, with an angle of about 80°.

Before starting, to improve the success of the procedure it is important that the patient is adequately informed, inviting him to breathe slowly from the mouth to reduce pharyngeal reflexes and stiffening. In poorly compliant patients it is possible to precede the procedure by administering local anesthesia using Lidocaine spray. It is advisable the use of tongue depressor for better exposure, especially in case of unfavorable oral cavity morphology, like macroglossia or Mallampati type III and IV. It is also recommended the use of the front light, in order to have a better control of the procedure.

The operator asks the patient to open the oral cavity as much as possible.

While inserting the swab, avoid contact with oral cavity structures in particular with the tongue. Reached the oropharynx at level of the uvula, orient the collecting end of the swab upwards, and then gently swing the swab in latero-lateral and/or cranio-caudal sense for a few seconds.

At the end of the procedure, although the shape of the swab has been modified, its structure is malleable and can be adapted again to the rigid test tube.

04:28–04:58: The procedure described, in selected cases, represents a valid alternative to nasopharyngeal swab performed transnasally. In particular, it allows reaching the area with the highest diagnostic sensitivity, when the nasopharyngeal specimen is not possible to obtain or is contraindicated. Furthermore, it is not necessary to have special equipment, except a moldable swab.

04:59–05:16: The procedure proved feasible and well tolerated. The

discomfort for the patient is comparable with the execution of an oropharyngeal swab without exposing him to additional complications.

05:17–05:45: With adequate training the transoral nasopharyngeal swab can be performed by non-specialist staff. However the otolaryngologist who is more familiar with head-neck surgical maneuvers and has greater knowledge of the pharyngeal anatomy, guarantees best comfort for the patient, shorter execution time and greater chance of success.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amjoto.2020.102828.

Financial material & support

None.

Declaration of competing interest

The authors disclose no conflicts of interest.

Acknowledgments

The authors thank Alessandro Gnolfo for the voice-over in support of Video.

References

[1] World Health Organization. Coronavirus disease 2019 (COVID 2019) situation report—90. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200419-sitrep-90-covid-19.pdf?sfvrsn=551d47fd_4. [Accessed 3 November 2020].

[2] Cheng MP, Papenburg J, Desjardins M, Kanjilal S, Quach C, Libman M, et al. Diagnostic testing for severe acute respiratory syndrome-related coronavirus-2: a narrative review. Ann Intern Med 2020;172(11):726–34. https://doi.org/10.7326/M20-1301. Jun 2. [Epub 2020 Apr 13].

[3] Wang X, Tan L, Wang X, et al. Comparison of nasopharyngeal and oropharyngeal swabs for SARS-CoV-2 detection in 353 patients received tests with both specimens simultaneously. Int J Infect Dis 2020;94:107–9. https://doi.org/10.1016/j.ijid.2020.04.023.

[4] World Health Organization. Rational use of personal protective equipment for coronavirus disease (COVID-19) and considerations during severe shortages. WHO/2019-nCov/IPC PPE_use/2020.1. https://www.who.int/publications/i/item/rational-use-of-personal-protective-equipment-for-coronavirus-disease-(covid-19)-and-considerations-during-severe-shortages.

[5] Coden E, Russo F, Arosio AD, Castelnuovo P, Karligkiotis A, Volpi L. Optimum naso-oropharyngeal swab procedure for COVID-19: step-by-step preparation and technical hints [published online ahead of print, 2020 Jul 27]. Laryngoscope. 2020; https://doi.org/10.1002/lary.29010. doi:https://doi.org/10.1002/lary.29010.