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ARTÍCULO ORIGINAL

COMPLICATIONS OF NASOPHARYNGEAL SWAB IN THE DIAGNOSIS OF SUSPECTED COVID-19

Complicaciones del frotis nasofaríngeo en el diagnóstico de sospecha de COVID-19

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SUMMARY: Introduction and objectives: The most sensitive direct diagnostic test for COVID-19 involves collecting nasopharyngeal swab samples for subsequent analysis using RT-PCR. Nevertheless, this technique is invasive, requiring adequate training of the personnel responsible for its execution and is not without potential adverse effects. The aim of this study was to investigate the complications associated with nasopharyngeal swab sampling in patients suspected of SARS-CoV-2 infection. Methods: We prospectively collected complications arising from nasopharyngeal swab procedures treated in the Otorhinolaryngology Service of the Marqués de Valdecilla University Hospital in Santander, since the beginning of the pandemic. Results: Out of 363,070 PCR samples collected during the study period, twenty patients (0.0055 %) between the ages of 29 and 90 years experienced complications related to nasopharyngeal swab sampling for COVID-19 diagnosis. Immediate complications were observed in all cases. The most frequent one was mild to moderate epistaxis (two patients experienced repeated nosebleeds, requiring multiple visits

to the emergency department), as well as swab breakage and impaction in the nasal cavity, with one case of accidental ingestion without consequences. Two patients had swabs impacted without breakage. No severe complications or subsequent sequelae were reported. Conclusions: Nasopharyngeal swab sampling is a generally safe technique when performed by adequately trained personnel with knowledge of nasal anatomy and the proper execution of the procedure. Although complications are exceptionally rare and typically mild, isolated cases of severe side effects have been documented.

KEYWORDS: COVID-19; nasopharynx; nasopharyngeal swab; diagnosis; complications

RESUMEN: Introducción y objetivos: La prueba diagnóstica directa más sensible para COVID-19 implica la recolección de muestras mediante frotis nasofaríngeo para su posterior análisis mediante RT-PCR. No obstante, esta técnica es invasiva, requiere una capacitación adecuada del personal responsable de su ejecución y no está exenta de posibles efectos adversos. El objetivo de este estudio fue investigar las complicaciones asociadas con la toma de muestras con nasofaríngeas en pacientes con sospecha de infección por SARS-CoV-2. Métodos: Recogimos prospectivamente las complicaciones derivadas de los procedimientos toma de muestras nasofaríngeas, tratados en el Servicio de Otorrinolaringología del Hospital Universitario Marqués de Valdecilla en Santander, desde el inicio de la pandemia. Resultados: De las 363,070 muestras de PCR recogidas durante el período de estudio, veinte pacientes (0.0055 %) con edades comprendidas entre 29 y 90 años experimentaron complicaciones relacionadas con la toma de muestras nasofaríngeas para el diagnóstico de COVID-19. Las complicaciones fueron inmediatas en todos los casos. La más frecuente fue la epistaxis leve a moderada (dos pacientes experimentaron hemorragias nasales repetidas, requiriendo múltiples visitas al Servicio de urgencias), así como la rotura e impactación del hisopo en la cavidad nasal. No se objetivaron complicaciones graves ni secuelas posteriores. Conclusiones: La toma de muestras nasofaríngeas mediante hisopo es una técnica generalmente segura cuando es realizada por personal adecuadamente capacitado con conocimientos de la anatomía nasal y la ejecución correcta del procedimiento. Aunque las complicaciones son excepcionalmente raras y típicamente leves, se han documentado casos aislados de efectos secundarios graves.

PALABRAS CLAVE: COVID-19; nasofaringe; hisopo nasofaríngeo; diagnóstico; complicaciones

INTRODUCTION

Early and accurate diagnosis was a crucial aspect of effectively managing the COVID-19 pandemic. The gold standard for diagnosis in the early stages of the disease is the collection of nasopharyngeal swab samples for analysis using reverse transcription polymerase chain reaction (RT-PCR) to detect viral RNA, primarily from the SARS-CoV-2 virus [1]. The sensitivity of this diagnostic method varies depending on the timing of sample collection (closely linked to the viral load), the severity of the clinical presentation, the technique employed, post-sampling handling, and the RT-PCR methodology [1, 2]. Notably, this method exhibits a low rate of false-positive results [1]. However, it necessitates proper training to ensure its accurate application and prevent complications. While alternative methods that avoid nasal entry have been proposed for nasopharyngeal sampling [3], the traditional approach through the nasal passage remains the most common.

With the urgent need to conduct widespread diagnostic testing to control COVID-19 and future viral pandemics, various healthcare professionals are responsible for administering these tests. Ideally, these professionals should undergo adequate training to ensure safe sample collection [4]. In cases where accessing the nasopharynx is challenging, bilateral or combined anterior nasal sampling,

along with oropharyngeal sampling, may be sufficient [5]. Another alternative is saliva samples, although they exhibit lower sensitivity compared to nasopharyngeal samples [5-6]. Failure to adhere to these fundamental practices can result in incorrect sample collection, leading to false-negative results, significant discomfort, or complications [7].

The objective of our study was to investigate complications related to nasopharyngeal sampling during the early phases of the COVID-19 pandemic in the Cantabria region.

MATERIAL AND METHODS

We prospectively collected data on complications associated with nasopharyngeal sample collection in the Otorhinolaryngology Service at Marqués de Valdecilla Hospital, located in Santander, Cantabria (Spain), from March 1, 2020, to January 31, 2021. Data collected for each case included the patient's age, gender, type of complication, administered treatment, and any lasting sequelae.

Data were entered into a Microsoft Excel program and subjected to descriptive statistical analysis.

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by Ethics Committee for Research with Medicines and Health Products of Cantabria (CEIM) (identification code 2023.397, Acta: 20/2023 de 24/11/2023).

RESULTS

Throughout the study period, a total of 363,070 nasopharyngeal PCR swab samples were collected in our Autonomous Community for COVID-19 diagnosis using RT-PCR. These samples were primarily collected by nursing staff specially trained for this purpose. Out of these, 20 patients (0.0055 % or 1 in 18,153) experienced complications that necessitated otorhinolaryngological intervention. These patients ranged in age from 29 to 90 years.

The complications that were observed are summarized in Table 1, with mild to moderate epistaxis being the most common, requiring anterior tamponade with materials such as gauze, RapidRhino®, or Merocel®. Two patients experienced several episodes of epistaxis, requiring multiple visits to the emergency room and several tamponade procedures with local anesthesia. The second most prevalent complication was swab breakage with subsequent impaction in the nasal cavity, which was successfully removed under local anesthesia and endoscopic guidance in all cases, without any further complications. Two additional patients had swabs impacted in the nasal cavity, without breakage, and these were also safely removed with local anesthesia and endoscopic guidance. No patients required hospital admission or surgical procedures, and they did not experience any lasting sequelae.

Table 1. Complications of nasopharyngeal swab sampling

Age/sex	Complication	Treatment
45/female	Moderate epistaxis (anticoagulant treatment)	Anterior nasal packing with gauce
46/male	Breakage and impaction of the swab.	Extraction on an outpatient basis with local anesthesia with endoscopy.
49/male	Breakage and impaction of the swab.	No treatment (The patient swallows it)
79/male	Moderate epistaxis	Anterior nasal packing with gauce
70/female	Moderate epistaxis	Nasal packing with Rhapid Rhino®
80/female	Moderate epistaxis (fibrinolytics treatment)	Nasal packing with Rhapid Rhino®
44/female	Breakage and impaction of the swab.	Extraction on an outpatient basis with local anesthesia with endoscopy.

(*continued*)

Table 1. Complications of nasopharyngeal swab sampling (*continued*)

Age/sex	Complication	Treatment
48/male	Breakage and impaction of the swab.	Extraction on an outpatient basis with local anesthesia with endoscopy.
62/female	Impaction of the swab (without breakage)	Extraction on an outpatient basis with local anesthesia with endoscopy.
48/male	Impaction of the swab (without breakage)	Extraction on an outpatient basis with local anesthesia with endoscopy.
67/female	Recurrent epistaxis	Several anterior nasal packing
64/female	Mild epistaxis	Nasal packing with Merocel®
43/female	Breakage and impaction of the swab.	Extraction on an outpatient basis with local anesthesia with endoscopy.
29/male	Breakage and impaction of the swab.	Extraction on an outpatient basis with local anesthesia with endoscopy.
90/male	Breakage and impaction of the swab.	Extraction on an outpatient basis with local anesthesia with endoscopy.
55/male	Breakage and impaction of the swab.	Extraction on an outpatient basis with local anesthesia with endoscopy.
30/female	Mild epistaxis	Anterior nasal packing with gauce
75/male	Recurrent moderate epistaxis	Nasal packing with Merocel®
65/male	Mild epistaxis	Anterior nasal packing with gauce
62/male	Mild epistaxis	Nasal packing with Merocel®

DISCUSSION

Nasopharyngeal swab sampling is the preferred diagnostic method for detecting SARS-CoV-2 infection, especially when collected within 2-3 days prior to symptom onset or within the first week of symptom presentation, as it offers high sensitivity [5]. However, this diagnostic technique is not without its complexities and potential complications. The main reasons for complications are typically related to inadequate training of the personnel responsible for the procedure, including a lack of knowledge about intranasal anatomy. This can result in swabs being directed incorrectly, towards the eye, rather than towards the middle or lower part of the pinna. Swabs may also deviate laterally or inward, or excessive force may be applied if met with resistance. It is important to note that a significant proportion of the population has asymptomatic septal deviations. Other risk factors for complications include coagulopathies or thrombocytopenia [8].

In our study, we observed a complication rate of 0.0055 % (1 in 18,153), which is higher than the rate reported by Koskinen et al. at 1.24 per 100,000 (1 in 80,645). It's worth noting that their study was retrospective [9]. However, our rate was lower than that reported by Foh in a small sample of individuals, which was 0.024, likely influenced by the criteria used [10].

A common complication in our series was swab breakage, leading to impaction in the nasal cavity. In all cases, removal was performed in outpatient settings under endoscopic guidance without subsequent complications. However, in cases involving children, removal under general anesthesia may be necessary [11]. It is important to mention that while swab breakage typically occurs at the predetermined breaking point before the swab is placed in the transport medium, there are cases, as observed in one of our patients, where breakage occurs at a different level.

Some authors recommend the use of swabs that are not designed to break [12]. However, this can complicate their subsequent handling, as they either need to be cut with other means or sent to the laboratory in longer containers.

Less frequently encountered is swab impaction without breakage, which prevents the healthcare worker from removing it. This occurred in two patients and is likely related to slight forceful insertion and subsequent nasal mucosa edema formation, hindering extraction. In both cases, it was relatively straightforward to remove the swab on an outpatient basis. In certain cases, the residual swab may

be ingested, and although some recommend early upper gastrointestinal endoscopy to prevent complications [13], one patient in our series swallowed a swab fragment without subsequent complications. Nonetheless, it has been previously documented that intestinal perforation can occur [7].

Another frequently observed complication in our series was epistaxis. In nearly all cases, these were patients without a history of coagulopathies or systemic vascular conditions, experiencing mild to moderate nasal bleeding that required anterior nasal packing with non-absorbable materials. While some guidelines suggest using absorbable tampons during times of high SARS-CoV-2 virus infection risk [14], practical considerations often lead to the use of tampons that require later removal for rapid patient treatment and reduced exposure to aerosols [15].

In other series, mild epistaxis, along with foreign body impaction, was also the most common complication [7, 9, 11]. However, life-threatening epistaxis cases have been reported, necessitating endoscopic sinus surgery or endovascular treatment under general anesthesia, sometimes involving repeated transfusions, and occasionally complicated by septic conditions or leading to septal perforation as a sequel due to repeated nasal packing [9, 16].

Although there are few contraindications for nasopharyngeal swab sample collection, it should be avoided in patients with a history of recurrent epistaxis due to hereditary hemorrhagic telangiectasia (Rendu-Osler-Weber disease) [17, 18], those with coagulopathies or thrombocytopenias, and individuals with a history of significant prior nasal bleeding. Nasopharyngeal swab testing can induce severe bleeding in such cases, necessitating hospitalization for management. This is especially critical for children undergoing hematological oncological treatments, as they are prone to nasal hemorrhagic complications, prompting the need for guidelines for sampling in this patient group [8].

For these patients, oropharyngeal swabs or saliva samples are recommended, albeit with the awareness that their sensitivity is lower (5, 8). Additionally, in nursing homes where COVID-19 outbreaks are frequent and require nasopharyngeal swabs, almost 40 % of the population is on anticoagulant treatment [19, 20]. Therefore, it is crucial to insert the swab gently, seeking the natural passage area, without excessive force. If this is not possible, an anterior nasal, oropharyngeal, combined, or saliva sample should be obtained [5].

Caution should be exercised when dealing with individuals who have a history of nasal trauma or recent sinonasal surgery [20]. In cases of severe nasal obstruction due to septal deviation, completing the procedure properly may be challenging, and it is advisable to perform an anterior nasal swab [5]. When dealing with children, difficulties may arise due to their limited cooperation and the challenge of reaching the nasopharynx. In such cases, it is important to avoid forcibly inserting the swab.

While our series did not include patients with serious complications, the literature reports several cases, including severe epistaxis [8], cribriform plate fracture with subsequent cerebrospinal fluid leakage [21], leading to meningitis [22] or brain abscess [23]. Some of these cases had a history of previous skull base surgery and the development of secondary encephalocele [17], which likely increased the risk of complications. In other cases, complications arose due to suboptimal diagnostic techniques without preexisting nasal abnormalities [20]. Table 2 provides a summary of complications described in the literature.

In a comparative study conducted by Gupta et al. to assess complications associated with the use of commercial swabs versus 3D printed swabs, both groups experienced epistaxis as the most common complication. However, epistaxis occurred more frequently with conventional swabs, and only one patient required emergency assistance due to uncontrolled epistaxis at the sampling site [30].

It is essential to consider the use of proper protective measures when caring for these patients to prevent potential transmission to healthcare

Table 2. Complications described in the literature related to the use of swabs for nasopharyngeal sampling

Anterior or posterior epistaxis: mild to very severe [8-10,15]
Partial or total impaction of the swab [7, 9, 10, 24]
Cribriform plate fracture with secondary liquorrhea [25]
Meningitis [22]
Fracture of the orbital lamina papyracea [26]
Subperiosteal orbital abscess [27]
Orbital cellulitis [26, 27]
Brain abscess [23]
Septal abscess [7]
Intestinal perforation [28]
Foreign body impaction in bronchi [29]
Sinus infection [26]

professionals. Many of these patients have a high suspicion of SARS-CoV-2 infection or are close contacts [15].

One of the main limitations of our study is that milder cases may not have presented to our Otorhinolaryngology Service. However, considering that the Community of Cantabria has a National Health System offering free urgent care coverage across the entire region, it is unlikely that cases went to other facilities. During the study period, emergencies of this nature were primarily managed at the largest hospital center, which was the only facility with an on-call otorhinolaryngologist.

CONCLUSIONS

Despite the high number of nasopharyngeal swabs performed for COVID-19 diagnosis, the complications in our series remained mild, with no need for hospital admission or surgical interventions, and no permanent sequelae were observed. This outcome is attributed to the extensive training courses provided to nursing staff involved in swab collection since the beginning of the pandemic. The most common complications observed were epistaxis and partial swab impaction.

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