JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Coronavirus Pandemic

Detection of SARS-CoV-2 in Nasal Swabs: comparison with Nasopharyngeal Swabs

Hyun Ah Kim[1], Miri Hyun[1], Ji Yeon Lee[1], Sunggyun Park[2], Namhee Ryoo[2], Yong Shik Kwon[3], Jae Seok Park[3], Jin Young Kim[4], Jae Cheon Jeon[5], Kyong Ran Peck[6]

[1] *Department of Infectious disease, Keimyung University Dongsan hospital, Keimyung University School of Medicine, Daegu, Korea*
[2] *Department of Laboratory Medicine, Keimyung University Dongsan hospital, Keimyung University School of Medicine, Daegu, Korea*
[3] *Department of Pulmonology, Keimyung University Dongsan hospital, Keimyung University School of Medicine, Daegu, Korea*
[4] *Department of Radiology, Keimyung University Dongsan hospital, Keimyung University School of Medicine, Daegu, Korea*
[5] *Department of Emergency medicine, Keimyung University Dongsan hospital, Keimyung University School of Medicine, Daegu, Korea*
[6] *Division of Infectious disease, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea*

Key words: COVID-19; diagnosis; SARS-Cov-2; mass screening.

J Infect Dev Ctries 2020; 14(10):1081-1083. doi:10.3855/jidc.12942

(Received 03 May 2020 – Accepted 08 July 2020)

Dear Editor,

The World Health Organization declared the outbreak of coronavirus disease (COVID-19) a pandemic [1]. Following Europe and the Unites States, the outbreaks have started in many developing countries, where healthcare systems are less resilient. The first case in South Korea was reported on 20 January 2020 [2]. Daegu is one of the largest cities in South Korea, with about 2.4 million residents. More than 65 % of South Korea's COVID-19 cases were diagnosed in Daegu [3]. The highest number of new cases in a day in Daegu reached 813 on 29 February 2020. The government established clinics for COVID-19 with the cooperation of private hospitals and the public health center. As a surge of people sought to be tested, screening clinics, soon became overwhelmed. Additionally, there were growing concerns about transmission risk through close contact between patients and healthcare personnel (HCP). Traditionally, nasopharyngeal (NP) swabs have been recommended for the detection of respiratory viruses including severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), owing to their high sensitivity [4]. However, procedures that involve obtaining NP swabs are considered aerosol-generating procedures, and they require special facilities like airborne infection isolation rooms (AIIR) and should be performed by trained HCP. Because of the very limited number of patients who can undergo NP swab testing in AIIRs, it is difficult to conduct testing on a large scale. It would be beneficial if other specimen types obtained by patients themselves were as effective as NP swabs. This study is aimed to analyze whether nasal swabs are comparable to NP swabs in the detection of SAR-CoV-2.

The diagnosis of COVID-19 was performed by taking nasopharyngeal (NP) swabs and sputum samples concurrently. However, owing to an elevated demand for testing following a rapid surge in cases of COVID-19, tests were conducted on at least one sample per person. We then collected nasal and NP swabs simultaneously from 18 patients diagnosed with COVID-19 at different time intervals from symptom onset and diagnosis. Sputum was obtained eight patients. COVID-19 testing was performed with real-time reverse transcriptase polymerase chain reaction assay with focus on the *RdRp*, *E*, and *N* genes [5]. A

Table 1. SARS-Cov-2 detection results of nasal swab, nasopharyngeal swab and sputum by real-time RT-PCR.

Patient	Days after symptom onset	Days of Admission	Nasal swab				Nasopharyngeal swab				Sputum			
			E gene	RdRp gene	N gene	Result	E gene	RdRp gene	N gene	Result	E gene	RdRp gene	N gene	Result
1	5	1	19.02	20.2	21.52	+	22.38	24.33	25.57	+				
2	6	0	30.49	31.58	33.47	+	·	·	·	-				
3	6	3	·	·	·	-	·	·	36.01	Id				
4	7	2	30.84	32.66	32.04	+	16.8	18.8	21.12	+				
5	7	4	32.23	35.36	33.73	+	28.56	30.93	30.94	+	20.92	24.89	23.26	+
6	8	1	26.11	27.69	28.69	+	·	·	·	-				
7	8	1	24.86	26.59	28.07	+	31.35	34.67	33.99	+	20.01	22.29	21.81	+
8	8	5	·	·	·	-	·	·	36.67	Id	26.27	30.03	28.99	+
9	10	1	·	·	·	-	·	·	39.21	Id				
10	10	4	·	·	·	-	31.82	34.92	34.04	+	22.09	26.08	24.78	+
11	11	0	19.64	21.76	23.88	+	16.2	18.79	20.55	+				
12	12	4	·	·	·	-	·	·	·	-				
13	12	8	·	·	34.69	Id	·	·	37.24	Id	27.7	30.05	29.63	+
14	12	9	·	·	32.5	Id	·	·	36.29	Id				
15	15	2	·	·	·	-	33.58	·	33.09	Id	30.04	30.33	31.25	+
16	15	8	·	·	·	-	·	·	34.16	Id	25.53	28.39	28.5	+
17	15	8	·	·	·	-	·	·	·	-				
18	16	6	·	·	38.85	Id	25.4	29.59	28.94	+	25.92	·	30.06	Id

Id: indeterminate.

diagnosis was confirmed if all three genes showed cycle threshold (Ct) values below the reference value. If just one or two of the three were below the reference value, the case was defined as indeterminate. The study was approved and the requirement for informed consent was waived by the Institutional Review Board (2020-03-027).

Among the 18 patients enrolled, nine patients tested positive from nasal or NP swabs, results were concordantly positive for both tests in five patients (Table 1). From the seven patients with positive nasal swabs, specimens were obtained from four patients within a week of symptom onset. Sputum showed positive results in seven out of eight patients. Results were positive in 12 patients for either nasal swab or sputum test and 11 patients out of 18 patients for either NP swab or sputum test. The positivity was evaluated after the classification of patients by symptoms duration. Among 5 patients from whom specimens were taken within a week of symptom onset, nasal swabs were positive in four patients (80 %, 4/5) and NP swabs in 3 (60 %, 3/5) (Table 2). Among 13 specimens taken later than a week after symptom onset, nasal swabs were positive in three patients and NP swabs in four.

In this study, SARS-CoV-2 was detected in nasal swabs, even from patients without a coryza. The detection of SARS-CoV-2 in nasal swabs (63 %, 5/8) has also been reported in another study [6]. However, the positivity rates of nasal and NP swabs were not compared in that study. Having compared them in this study, we found that the positivity rates of nasal swabs were comparable to those of NP swabs. When specimens were obtained within 7 days of symptom onset, the positivity rates of nasal swabs were high (80 %, 4/5) as those of NP swabs. Overall, sputum showed higher positivity rates than NP or nasal swabs in this study. Although sputum is difficult to obtain in the early phase of diseases, it remains PCR positive for a longer time from symptom onset in patients with COVID-19 [7]. Therefore, sputum is a superior specimen if it is obtainable, especially in the later stages of the disease.

One study reported the generation of false-negative NP swab test results by unskilled HCP in a case of nasal obstruction [8]. As such, had the screening tests been performed by skilled HCP, the sensitivity of the samples would have definitely improved. However, owing to the overwhelming spread of the current

Table 2. Difference in positivity rate by sample type according to symptom onset.

Sample type	Days after onset of symptom	
	≤ 7 days	> 7days
Nasal swab	4/5 (80%)	3/13 (23%)
Nasopharyngeal swab	3/5 (60%)	4/13 (30%)

pandemic, it is impractical for experienced HCP to perform all screening tests.

Prior studies reported that nasal swabs were as sensitive as NP swabs in detecting respiratory viruses [9,10], and the lower sensitivity of a specimen type could be overcome by the use of molecular methods, which are standard methods of detecting SARS-CoV-2 at this point [11]. One study revealed that some level of reduced sensitivity of nasal swabs in the detection of respiratory syncytial virus could be acceptable if it were outweighed by facility, lower cost, and better acceptability among patients in developing countries [12]. Nasal swabs can be obtained by patients themselves, and this is an important advantage. This can be applied to the development of self-test kits usable at home.

Our study finding suggest that nasal swabs could be considered as an alternative methods of specimen collection to NP swabs in the detection of SARS-CoV-2, In particular, they are advantageous where there is a shortage of healthcare personnel and facilities, especially if they are obtained an early stage of infection. Nasal swabs could be useful in screening larger populations as specimens can be collected more rapidly and efficiently. Considering the relatively low sensitivity of nasal swabs at later stages of infection and the difficulty of collecting sputum, combining tests for both specimens would be more effective in the detection of SARS-CoV-2. Notwithstanding, the effectiveness of nasal swabs should be evaluated further in future studies.

References

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, Niu P, Zhan F, Ma X, Wang D, Xu W, Wu G, Gao G, Tan W, China Novel Coronavirus Investigating and Research Team (2020) A novel coronavirus from patients with pneumonia in China. N Engl J Med 382: 727–733.
2. Kim JY, Choe PG, Oh Y, Oh KJ, Kim J, Park SJ, Park JH, Na HK, Oh MD (2020) The first case of 2019 novel coronavirus pneumonia imported into Korea from Wuhan, China: Implication for infection prevention and control measures. J Korean Med Sci 35: e61.
3. Korean Society of Infectious Diseases, Korean Society of Pediatric Infectious Diseases, Korean Society of Epidemiology, Korean Society for Antimicrobial Therapy, Korean Society for Healthcare-associated Infection Control and Prevention, Korea Centers for Disease Control and Prevention (2020) Report on the Epidemiological Features of Coronavirus Disease 2019 (COVID-19) Outbreak in the Republic of Korea from January 19 to March 2, 2020. J Korean Med Sci 35: e112.
4. Spencer S, Thompson MG, Flannery B, Fry A (2019) Comparison of Respiratory Specimen Collection Methods for Detection of Influenza Virus Infection by Reverse Transcription-PCR: A Literature Review. J Clin Microbiol 57: e00027-19.
5. Corman VM, Landt O, Kaiser M, Molenkamp R, Meijer A, Chu DK, Bleicker T, Brünink S, Schneider J, Schmidt ML, Mulders DG, Haagmans BL, van der Veer B, van den Brink S, Wijsman L, Goderski G, Romette JL, Ellis J, Zambon M, Peiris M, Goossens H, Reusken C, Koopmans MP, Drosten C (2020) Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. Euro Surveill 25: 2000045.
6. Wang W, Xu Y, Gao R, Lu R, Han K, Wu G, Tan W (2020) Detection of SARS-CoV-2 in different types of clinical specimens. JAMA 323: 1843–1844.
7. Chen C, Gao G, Xu Y, Pu L, Wang Q, Wang L, Wang W, Song Y, Chen M, Wang L, Yu F, Yang S, Tang Y, Zhao L, Wang H, Wang Y, Zeng H, Zhang F (2020) SARS-CoV-2-Positive sputum and feces after conversion of pharyngeal samples in patients with COVID-19. Ann Intern Med 172: 832-834.
8. Piras A, Rizzo D, Uzzau S, De Riu G, Rubino S, Bussu F (2020) Inappropriate nasopharyngeal sampling for SARS-CoV-2 detection is a relevant cause of false-negative reports. Otolaryngol Head Neck Surg 163: 459-461.
9. Heikkinen T, Marttila J, Salmi AA, Ruuskanen O (2002) Nasal swab versus nasopharyngeal aspirate for isolation of respiratory viruses. J Clin Microbiol 40: 4337–4339.
10. Irving SA, Vandermause MF, Shay DK, Belongia EA (2012) Comparison of nasal and nasopharyngeal swabs for influenza detection in adults. Clin Med Res 10: 215–218.
11. Lambert SB, Whiley DM, O'Neill NT, Andrews EC, Canavan FM, Bletchly C, Siebert DJ, Sloots TP, Nissen MD (2008) Comparing nose-throat swabs and nasopharyngeal aspirates collected from children with symptoms for respiratory virus identification using real-time polymerase chain reaction. Pediatrics 122: e615–e620.
12. Stensballe LG, Trautner S, Kofoed PE, Nante E, Hedegaard K, Jensen IP, Aaby P (2002) Comparison of nasopharyngeal aspirate and nasal swab specimens for detection of respiratory syncytial virus in different settings in a developing country. Trop Med Int Health 7: 317–321.

Corresponding author

Kyong Ran Peck, MD, PhD
Division of Infectious Diseases, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea
Tel: 82-2-3410-0329
Fax: 82-3-3410-0064
Email: krpeck@skku.edu

Conflict of interests: No conflict of interests is declared.