

Sampling Respiratory Epithelial Cells by Nasal or Nasopharyngeal Flocked Swabs.

Santina Castriciano², Geoffrey So¹, Sonya Buracond¹, Mario Savarese², Daniele Triva² and Marek Smieja¹

¹McMaster University/St. Joseph's Healthcare, Hamilton, ON Canada. ²Copan, Brescia Italy



Abstract

Objective: Nasal swab (NS) collection is less invasive than nasopharyngeal swab (NPS) collection, and may facilitate wider surveillance and diagnosis of respiratory viral infections. We studied NS collection of two new swab designs to determine whether NS could sample respiratory epithelial cells as well as NPS.

Methods: A total of 52 volunteers were studied. 17 had one Copan pernasal Flocked Swab NPS and three different Copan Nasal Flocked Swabs (regular, round, and flat) administered and collected by a physician or trained research staff. The remaining 35 subjects had 3 NS performed without an NPS. For all individuals, the order of the three NS was randomized, while the NPS was done last for the subgroup of 17 volunteers. The swabs were placed in a one mL tube of Copan Universal Transport Medium, vortexed, and centrifuged, with the residual cell pellets resuspended in one mL of PBS. 25 µL of suspension were placed in wells on a glass slide, dried, fixed and counterstained with FITC labelled monoclonal antibody. Respiratory epithelial cells were quantitated using a fluorescent microscope at 400x magnification by an experienced microscopist blinded to swab type while enumerating. An average count from 4 fields was calculated when 10 or more epithelial cells were present per high-powered field (hpf); 10 fields were averaged if there was fewer than 10 cells/hpf.

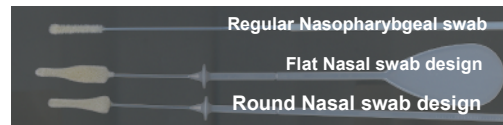
Results: Among the 17 subjects with parallel NS and NPS specimens, mean (SD) cells yields were: 73.3 (31.2), 83.1 (35.5), and 92.5 (35.1) cells/hpf for the regular, round, and flat NS respectively; and 105.9 (44.0) cells/hpf for NPS. The difference between the regular NS and NPS was statistically significant (P=0.02), whereas the two new NS designs (round and flat) were not different from the NPS (P=0.11 and 0.34, respectively). Among all 52 subjects, the mean (SD) cell yields were 65.2 (31.3), 81.8 (42.4), and 81.8(41.7) for regular, round, and flat swabs respectively. The two new NS designs improved cell yield by 16.5 cells/hpf (95% CI: 8.0, 25.0, P<0.001) compared with the regular NS. The 3 NS swabs were equally well tolerated and caused less discomfort than the NPS.

Conclusions: An improved flocked design for NS allows sampling equivalent to NPS with less discomfort. If validated in symptomatic patients, this will have important implications for surveillance swabbing or diagnosis in patients currently not benefiting from respiratory diagnostics.

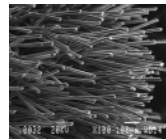
Objective

- Nasal swab collection is less invasive than nasopharyngeal swab collection, and may facilitate wider surveillance and diagnosis of respiratory viral infections.
- We studied Nasal Swabs collection of two new swab designs to determine whether nasal swabs could sample respiratory epithelial cells as well as nasopharyngeal swabs

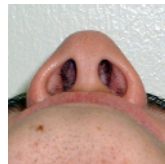
Materials



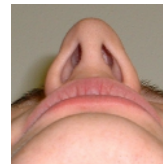
Copan flocked swabs



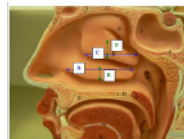
Flocked swabs
Nylon fibers



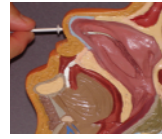
Round Nares



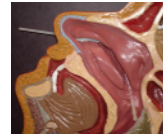
Flat Nares



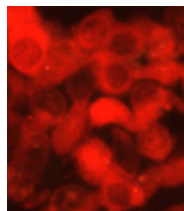
Path of Nasal swab



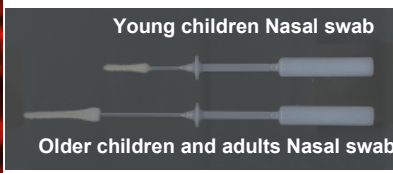
Nasal swab collection



Nasopharyngeal swab collection



Nasal epithelial cells



Young children Nasal swab

Older children and adults Nasal swab

Final design round nasal swabs

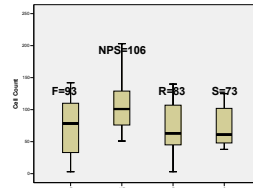
Methods

- The nasal cavity anatomy was studied in order to design the new swabs.
- The distance between nares to the start of the inferior turbinate (IT) is usually around 1-1.5 cm with variations between of 1 – 2 cm.
- The nasal swab is believed to sample the mid/superior portion of the lateral surface of the IT, the septum, and inferior portion of the middle turbinate (MT). Upon entrance, the swab will need to be able to bend approximately 30-45° (with reference to the palate floor) to sample the area described above.

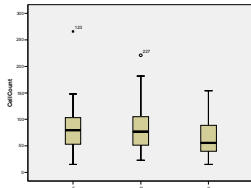
Methods cont.

- The inferior turbinate measures a length of 3.5 – 4.5 cm (A) and height of 1-1.3 cm (B).
- The inferior meatus (IM) (measured from the palate floor to inferior portion of the respective turbinate) is approximately 3 mm.
- The middle turbinate (MT) is superior to the IT and begins approximately 1 cm from the start of the IT (or 2 – 2.5 cm from the nares). The MT length is approximately 2.5-3.5 cm with a variation of 2.5-4 cm (C).
- The posterior portion of the MT will eventually curve down around the posterior portion of the IT – resulting in a downward curved middle meatus (MM).
- The height of the MT is also about 1-1.3 cm (D) The posterior portion of the MT will eventually curve down around the posterior portion of the IT – resulting in a downward curved middle meatus (MM). The height of the MT is also about 1-1.3 cm (D).
- A total of 52 volunteers were studied.
- 17 volunteers had one nasopharyngeal swab collected with a Copan pernasal Flocked Swab and three nasal swabs using a standard, a round and a flat design Copan Nasal Flocked Swabs.
- All swabs were administered and collected by a physician or trained research staff.
- The remaining 35 volunteers had 3 nasal swabs performed as the previous group without an Nasopharyngeal swab.
- For all individuals, the order of the three nasal swabs was randomized, while the Nasopharyngeal was done last for the subgroup of 17 volunteers.
- The swabs were placed in a one mL tube of Copan Universal Transport Medium, vortexed, and centrifuged, the residual cell pellets were resuspended in one mL of phosphate buffer saline.
- 25 µL of suspension were placed in wells on a glass slide, dried, fixed and counterstained with FITC labelled monoclonal antibody.
- Respiratory epithelial cells were quantitated using a fluorescent microscope at 400x magnification by an experienced microscopist blinded to swab type while enumerating.
- An average count from 4 fields was calculated when 10 or more epithelial cells were present per high-powered field (hpf); 10 fields were averaged if there was fewer than 10 cells/hpf.

Results



First 17 NS and NPS



52 Nasal swabs

- Among the 17 subjects with parallel NS and NPS specimens, mean (SD) cells yields were: 73.3 (31.2), 83.1 (35.5), and 92.5 (35.1) cells/hpf for the standard, round, and flat NS respectively; and 105.9 (44.0) cells/hpf for NPS. The difference between the regular NS and NPS was statistically significant (P=0.02), whereas the two new NS designs (round and flat) were not different from the NPS (P=0.11 and 0.34, respectively).
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- Among all 52 subjects, the mean (SD) cell yields were standard 65.2 (31.3), round 81.8 (42.4), and flat 81.8 (41.7) swabs.
- The two new NS designs improved cell yield by 16.5 cells/hpf (95% CI: 8.0, 25.0, P<0.001) compared with the standard nasal swabs.
- The 3 nasal swabs were equally well tolerated and caused less discomfort than the nasopharyngeal swabs.

Conclusion

- The Copan improved flocked design for nasal swabs allows sampling equivalent to nasopharyngeal swabs with less discomfort.
- If validated in symptomatic patients, this will have important implications for surveillance swabbing or diagnosis in patients currently not benefiting from respiratory diagnostics.