Aerosol Protection Using Modified N95 Respirator for Upper Gastrointestinal Endoscopy: A Randomized Controlled Trial

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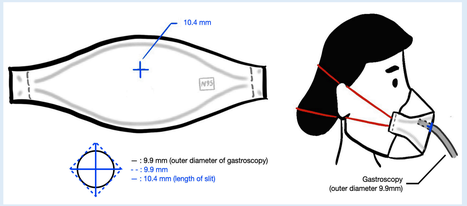
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Introduction

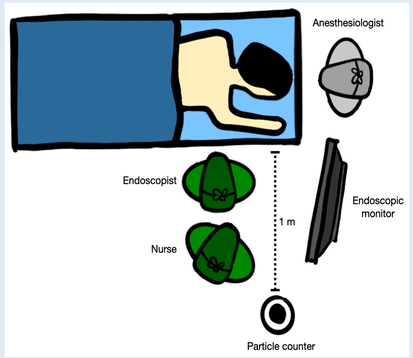
- Since the global pandemic of coronavirus disease in 2019 (COVID-19), upper gastrointestinal endoscopy is now considered as an aerosol-generating procedure.
- The ability of N95 respirator for filtering aerosols and droplets had been proven to prevent viral transmission.
- We modified the N95 respirator for patient use allowing endoscopic insertion and aimed to measure its efficacy in particle release during upper gastrointestinal endoscopy.

Materials and Methods

- **Design of modified N95 respirator:** The standard N95 respirator (3M Aura 1870+) was modified in proportion to the 9.9-mm outer diameter of a gastroscope (Olympus GIF-HQ190). Two crossed 10.4 mm linear stabs were punctured to fit the scope diameter.



- **Participants:** All patients aged 18 and above with undetectable COVID-19 virus in nasopharyngeal swabs by RT-PCR within 48 hours of diagnostic upper gastrointestinal endoscopy were enrolled. Patients who needed intubation, transnasal endoscopy, previous upper gastrointestinal surgeries, or over-the-scope procedure were excluded.
- **Randomization:** 1:1 ratio (modified N95 and control (no mask) group)
- **Procedures:** All patients were monitored by anesthesiologist. TSI AeroTrak (9306-04) handheld particle counter was used to measure the number of particles ranged from 0.3, 0.5, 1, 3, 5, and 10 microns which placed at 1 meter away from patient. Baseline particle counts were measured in the morning before the first case of each day with room closed for at least 15 minutes. During procedure, particle counts were measured and recorded every minute.



Results

Demographic data and endoscopic details

	Modified N95 (n=15)	No mask (n=15)	*P*-value
Age	63.9 ± 12.6	60.4 ± 16.6	0.697
BMI (kg/m²)	23.9 (22.9, 26.3)	24.9 (23.5, 26.6)	0.414
Female	6 (40)	10 (67)	0.272
Anesthesia			0.056
Topical	0 (0)	4 (27)	
TIVA	5 (33)	6 (40)	
Both	10 (67)	5 (33)	
Smoking	0 (0)	3 (20)	0.224
Previous COVID-19 infection	0 (0)	2 (13)	0.483
Endoscopist			0.682
Staff	3 (20)	5 (33)	
Resident/fellow	12 (80)	10 (67)	
Endoscopic diagnosis: benign	15 (100)	12 (80)	0.224
Procedure time (minutes)	14 (10, 20)	15 (11, 22)	0.165
Add-on procedures	14 (93.3)	13 (86.7)	1.000

Comparison of the increased particle counts

	Modified N95 (n=15)	No mask(n=15)	*P*-value
Overall particle (x10³ counts/m³)	231 (54, 385)	579 (213, 1379)	0.056
Particle size (x10³ counts/m³)			
0.3 μm	68 (-25, 185)	242 (72, 588)	0.045
0.5 μm	85 (57, 111)	213 (78, 440)	0.067
1 μm	64 (37, 84)	87 (47, 408)	0.250
3 μm	23 (12, 32)	31 (15, 71)	0.325
5 μm	9 (5, 14)	10 (3, 26)	0.838
10 μm	1 (1, 3)	3 (1, 5)	0.345

Factors affecting increased particle counts:
No correlations between the following factors: BMI, choice of anesthesia, smoking, previous COVID-19 or endoscopic duration and the overall increased particle counts in both groups.

Adverse event:
No complication during and after endoscopic examination. All patients had only one attempt of endoscope insertion through the created channel of the modified N95 respirator.

Conclusions

- Modified N95 respirator could reduce the smallest (0.3-micron) particles and decrease other sizes of particle.
- Applications for patient requiring upper gastrointestinal endoscopy is safe and feasible without increasing difficulty for endoscopist.

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