Use of 3D printer for face mask production to protect endoscopy unit personnel in contact with high-risk patients during COVID-19 pandemic

Endoscopy unit personnel are exposed to COVID-19 infection from inhalation of airborne droplets [1, 2]. Peri-endoscopic aerosolized infections have indeed been reported, making upper gastrointestinal endoscopy a high-risk procedure [3, 4]. In the current situation, infection prevention represents the only way to ensure the safety of both endoscopy unit personnel and patients. Whenever possible, patients who are considered at high risk or who have confirmed COVID-19 infection should undergo endoscopy in a negative-pressure room [5]. However, such a dedicated facility is not universally available to all endoscopy units, thus limiting the degree of preventive measures in most centers to protective clothing for endoscopists, specialist nurses, and technicians.

We had an idea to create a negative pressure micro-environment inside a ventilation mask, which was modified to allow easy passage of the endoscope into the mouth while allowing simultaneous administration of oxygen and use of suction. Two separate holes of appropriate size were therefore drilled into the original disposable ventilation mask for oxygen inflow and/or suction respectively. Sealed passage of the endoscope was achieved by use of a soft-valve adapter that fits to the existing built-in plastic cylinder of the original mask (▶ **Fig. 1**, ▶ **Fig. 2**). In order to provide sufficient gas flow for effortless respiration and low intra-mask negative pressure, disposable gas flow adapters were also manufactured using the 3 D printing technology, which was available at our clinical laboratory for 3 D printing, 3D4Med.

The STL files of the described adaptors are downloadable for free at www.3d4med.eu.

An oxygen inflow rate of 8 L/min and vacuum suction at a negative pressure of 200 millibar (with safety filter interposition) (▶ **Fig. 3**) provided the best tolerability and function of the device, as tested on healthy volunteers.

▶ **Fig. 1** The 3D-printed adapters.

▶ **Fig. 2** The modified ventilation mask.

A modified ventilation mask provides a low-cost alternative when negative-pressure room facilities are not available. It proved effective in creating a micro negative-pressure environment around the patient's mouth and nose. This device can be easily manufactured by hospitals at a relatively low cost using available 3 D printing technology.

Although long-term data are needed to confirm the efficacy of this mask in providing protection against COVID-19 transmission, we believe that it could represent a suitable alternative when negative-pressure endoscopy rooms are not available.

▶ **Fig. 3** Device in use.

Competing interests

The authors declare that they have no conflicts of interest.

The authors

Federico De Grazia[1], Stefania Marconi[2], Marco Bardone[1], Aurelio Mauro[1], Gianluca Alaimo[2], Ferdinando Auricchio[2], Andrea Pietrabissa[3], Antonio Di Sabatino[1]

1 Unit of Digestive Endoscopy, Department of Internal Medicine, San Matteo Hospital Foundation, Pavia, Italy
2 ProtoLab, Department of Civil Engineering and Architecture, University of Pavia, Pavia, Italy
3 University of Pavia and San Matteo Hospital Foundation, Pavia Italy

Corresponding author

Federico De Grazia, MD
Unit of Digestive Endoscopy, Department of Internal Medicine, San Matteo Hospital Foundation, Viale Camillo Golgi 19, Pavia 27100, Italy
Fax: +39-038-2501602
f.degrazia@smatteo.pv.it

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