

# Upper gastrointestinal stenting during the SARS-CoV-2 outbreak: impact of mitigation measures and risk of contamination for patients and staff



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submitted 21.7.2020

accepted after revision 19.10.2020

## Bibliography

Endoscopy International Open 2021; 09: E76–E86

DOI 10.1055/a-1319-1201

ISSN 2364-3722

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## ABSTRACT

**Background and study aims** The impact of COVID-19 mitigation measures on stent placement procedures has not yet been reported. The aim of this study was to assess the impact of COVID-19 mitigation measures on upper stenting during SARS-CoV-2 outbreak, as well as the use of personal protection equipment (PPE) and risk of contamination for patients and staff.

**Patients and methods** This was a multicenter, retrospective study of consecutive patients who underwent stent placement for upper gastrointestinal obstruction during the second half of SARS-CoV-2 outbreak period in comparison to same period one year before.

**Results** A total of 29 stents were placed for upper gastrointestinal obstruction during the study period, corresponding to an increase of 241% comparing to the same period in 2019 (n=12). No significant major differences were found between the two time periods regarding patients' baseline characteristics, post-stenting management and number of staff involved in stent placement. Fellows' involvement was significantly lower in 2020 compared to 2019 (21% vs 67%;  $P=0.01$ ). The majority of procedures were performed using FFP2/FFP3 mask (76%), protective eyewear (86%), two pairs of gloves (65%), hairnet (76%) and full disposable gowns (90%). One patient tested positive for SARS-CoV-2 after the procedure. None of the medical staff involved in stenting procedures developed COVID-19 14 days after procedure.

**Conclusion** Upper gastrointestinal stenting increased during the SARS-CoV-2 outbreak period, which could be related to yearly variation on the number of procedures or reflect a change of oncologic treatment practice during COVID times.

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## Introduction

The coronavirus disease 2019 (COVID-19) pandemic has placed the world under unprecedented pressure. Gastroenterology departments required drastic reorganization to deal with mitigation measures. Specifically, they were forced to reduce the routine workload to prevent the risk of infection spreading, with consequent quantitative and qualitative impairment of the health services provided and potential impact on patients' healthcare status [1]. Even though mitigation measures resulted in a reduction in the impact of illness on healthcare system capacity, they led to deferral of elective procedures in accordance with recommendations from several society guidelines [2–6].

All endoscopic procedures, especially upper endoscopy, are considered aerosol-generating and adequate personal protection equipment (PPE) should be used [7]. Therapeutic procedures may theoretically increase healthcare professional (HCP) exposure due to their longer duration [8]. Little is known regarding the risk of contamination of patients and HCPs when endoscopic procedures are performed and PPE is used during endoscopic procedures.

Assessment of the overall impact of a crisis such as COVID-19 on clinical practice is an essential and complex exercise. Upper gastrointestinal stenting in patients with symptoms of dysphagia/obstruction due to malignant esophageal [9] or gastric outlet obstruction [10] should be considered a high-priority endoscopic procedure [5], which should be performed immediately, or at least within 1 to 2 weeks [5].

The impact of COVID-19 mitigation measures in self-expandable metal stent (SEMS) procedures has not yet been reported. Therefore, the aim of our study was to assess the impact of COVID-19 mitigation measures on upper gastrointestinal stenting during the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) outbreak, as well as the use of adequate PPE and risk of contamination for patients and HCP.

## Patients and methods

We conducted a multicenter, retrospective study in six European centers of consecutive patients who underwent stenting for upper gastrointestinal obstruction (excluding biliary obstruction) during the second half of the SARS-CoV-2 outbreak (from the 35th day to the 60th day since the first national SARS-CoV-2 patient was registered) and compared it to the same period 1 year before the SARS-CoV-2 outbreak. The number of stents placed during the first half of the SARS-CoV-2 outbreak (from the 10th day to the 35th day) was also identified. All participating centers were tertiary care centers, with significant experience and expertise in upper gastrointestinal stenting.

Information on patient demographic characteristics (age and gender), medical history (disease-causing luminal obstruction, cTNM staging, patient cardiovascular and respiratory comorbidities), renal failure at presentation, ASA classification, hospitalization before SEMS placement, SEMS indication (esophageal dysphagia or gastric outlet obstruction) and dysphagia grade (Takita's dysphagia grading [11]) or gastric outlet

obstruction scoring system (GOOSS) [12] before and 7 days after SEMS placement was collected from medical records. In addition, we collected data on procedural characteristics, such as stricture location and diameter, and specifics of each procedure, such as SEMS characteristics and scope used. We also collected information on the cumulative number of SARS-CoV-2 cases at each hospital and respective country during the study period, COVID impact on each endoscopic unit (number of procedures performed, endoscopists, nurses and infected personal in the unit), number of people in the endoscopic suite during SEMS placement, fellow participation, use of PPE, use of endoscopic suites with negative pressure or air purifiers, as well as COVID status/symptoms of endoscopists, nurses, and anesthesiologists before and 14 days after the SEMS procedure.

Each center used its own clinical decision making regarding which type of stent to use. SEMS placed were nitinol stents, uncovered, partially covered or fully covered, with body diameters ranging from 18 mm to 24 mm. SEMS were deployed under moderate or deep sedation at the discretion of the endoscopist. They were deployed over-the-wire or through-the-scope. Tumor length was estimated endoscopically or radiologically using contrast medium injection. A stent measuring 2 to 4 cm longer than the stricture was used to allow for a 1- to 2-cm extension above and below the proximal and distal tumor borders. Technical success of SEMS placement was defined as successful deployment of the SEMS in the correct position. Adverse events (AEs) were recorded. All dates of disease diagnosis, hospitalization, SEMS placement, beginning of oral diet, hospital discharge and AEs were recorded.

## Statistical analysis

Categorical variables were described using absolute and relative frequencies, while continuous variables were described using means and standard deviations or medians and interquartile ranges (IQR). Comparison of patient characteristics during the COVID outbreak period and the year before was performed using a Mann-Whitney U test for continuous variables and a chi-square test for categorical variables. All reported *P* values were two-sided and  $P < 0.05$  was considered statistically significant. Analyses were performed using SPSS 23.0 (IBM Corp., Armonk, New York, United States).

## Results

### Patient characteristics and SEMS outcomes (2020)

Twenty-nine patients were included. Baseline characteristics of the patients in whom a SEMS was placed and procedure characteristics and related outcomes are summarized in ► **Table 1** and ► **Table 2**. Median age was 68 years (IQR 62–71), with 13 patients (45%) being female. Most obstructions were caused by esophageal cancer ( $n=11$ ; 38%), followed by gastric cancer ( $n=8$ ; 28%) and pancreatic cancer ( $n=6$ ; 21%). Cardiovascular and respiratory comorbidities were present in 13 (45%) and 4 (14%) patients, respectively. Only four (14%) of the SEMS were placed in patients with altered anatomy, while three patients (10%) had a previous SEMS placed for the same indication (► **Table 1**).

► **Table 1** Baseline characteristics of patients with upper gastrointestinal obstruction who underwent luminal stenting.

	Global (n = 41)		
	2020 (n = 29)	2019 (n = 12)	P value
Female gender (n, %)	13 (44.8%)	1 (8.3%)	<b>0.033</b>
Age (median, IQR)	68 (62–71)	69 (62–76)	0.877
Gastrointestinal disease (n, %)			0.380
▪ Esophageal cancer	11 (37.9%)	5 (41.7%)	
▪ Esophageal extrinsic compression	2 (6.9%)	2 (16.7%)	
▪ Gastric cancer	8 (27.6%)	3 (25%)	
▪ Pancreatic cancer	6 (20.7%)	–	
▪ Other <sup>1</sup>	2 (6.9%)	2 (16.7%)	
T staging (n, %)			0.650
▪ 1	1 (3.4%)	–	
▪ 2	1 (3.4%)	1 (8.3%)	
▪ 3	9 (31%)	6 (50%)	
▪ 4	16 (55.2%)	4 (33.3%)	
▪ Unknown	2 (6.9%)	1 (8.3%)	
N staging (n, %)			0.649
▪ 0	6 (20.7%)	1 (8.3%)	
▪ ≥ 1	21 (72.4%)	10 (83.3%)	
▪ Unknown	2 (6.9%)	1 (8.3%)	
M staging (n, %)			0.439
▪ 0	10 (34.5%)	6 (50%)	
▪ 1	17 (58.6%)	5 (41.7%)	
▪ Unknown	2 (6.9%)	1 (8.3%)	
ASA classification (median, IQR)	2 (2–3)	3 (2–3)	0.300
Comorbidities (n, %)			
▪ Cardiovascular	13 (44.8%)	9 (75%)	0.098
▪ Respiratory	4 (13.8%)	5 (41.7%)	0.093
Anatomy (n, %)			0.058
▪ Normal	25 (86.2%)	9 (75%)	
▪ Esophagojejunal anastomosis	1 (3.4%)	1 (8.3)	
▪ Gastrojejunal anastomosis	3 (10.3%)	2 (16.7%)	
Previous SEMS placed for same indication	3 (10.3%)	2 (16.7%)	0.620
SEMS indication (n, %)			0.325
▪ Esophageal dysphagia	14 (48.3%)	8 (66.7%)	
▪ Gastric outlet obstruction	15 (51.7%)	4 (33.3%)	
Esophageal dysphagia			
▪ Time from dysphagia onset to SEMS placement in days (days; median, IQR)	32 (15–25)	71 (18–408)	0.658
▪ Patient hospitalization (n, %)	5 (35.7%)	6 (75%)	0.183
▪ Renal failure at presentation (n, %)	0 (0%)	3 (37.5%)	<b>0.036</b>

► **Table 1** (Continuation)

	Global (n = 41)		
	2020 (n = 29)	2019 (n = 12)	P value
▪ Takita grade before SEMS (median, IQR)	4 (3–5)	4 (4–5)	0.920
▪ Stricture estimated diameter, mm (median, IQR)	6 (5–9)	9 (6–11)	0.659
Gastric outlet obstruction			
▪ Time from obstructive symptoms onset to SEMS placement in days (median, IQR)	12 (5–29)	10 (4–14)	0.477
▪ Patient hospitalization (n, %)	14 (93.3 %)	3 (75 %)	0.386
▪ Renal failure at presentation (n, %)	3 (20 %)	0 (0 %)	1.000
▪ GOOSS before SEMS (median, IQR)	0 (0–1)	1 (1–2)	<b>0.037</b>
▪ Stricture estimated diameter, mm (median, IQR)	5 (3–9)	6 (3–9)	0.736

ASA, American Society of Anesthesiologists; GOOSS, gastric outlet obstruction scoring system; IQR, interquartile range; SEMS, self-expandable metal stent.  
<sup>1</sup> Other: ampullary cancer (n = 2); cholangiocarcinoma (n = 1); metastatic cervical cancer (n = 1)

► **Table 2** Procedure characteristics and related outcomes.

	Global (n = 41)		
	2020 (n = 29)	2019 (n = 12)	P value
Stricture location (n, %)			0.116
▪ Upper/mid esophagus	7 (24.1 %)	3 (25 %)	
▪ Distal esophagus/cardia	7 (24.1 %)	5 (41.7 %)	
▪ Gastric body	3 (10.3 %)	–	
▪ Gastric antrum	4 (13.8 %)	–	
▪ Duodenal bulb	1 (3.4 %)	1 (8.3 %)	
▪ Second portion of duodenum	5 (17.2 %)	1 (8.3 %)	
▪ Third portion of duodenum	1 (3.4 %)	–	
▪ Jejunum	–	2 (16.7 %)	
▪ Gastrojejunal anastomosis	1 (3.4 %)	–	
Scope used for SEMS placement (n, %)			0.749
▪ Gastroscope	8 (27.6 %)	4 (33.3 %)	
▪ Therapeutic gastroscopie	15 (51.7 %)	5 (41.7 %)	
▪ Duodenoscope	1 (3.4 %)	–	
▪ Ultrathin scope	5 (17.2 %)	3 (25 %)	
SEMS placement technique (n, %)			0.272
▪ TTS	17 (58.6 %)	7 (58.3 %)	
▪ Over-the-wire	12 (41.4 %)	5 (41.6 %)	
SEMS body diameter (median, mm)	20 (18–22)	22 (19–22.5)	0.475
SEMS flange diameter (median, mm)	26 (24–26)	26.5 (24–27.5)	0.358
SEMS length (median, mm)	110 (89–121.5)	105 (100–120)	0.919
Fluoroscopy use (n, %)	26 (89.7 %)	9 (75 %)	0.334

► **Table 2** (Continuation)

	Global (n = 41)		
	2020 (n = 29)	2019 (n = 12)	P value
Sedation (n, %)			0.166
▪ Conscious sedation	10 (34.5%)	2 (16.7)	
▪ Deep sedation	19 (65.5%)	9 (75%)	
▪ General anesthesia	–	1 (8.3%)	
Technical success (n, %)	29 (100%)	12 (100%)	1.000
Esophageal dysphagia			
▪ Takita grade 1 week after (median, IQR)	2 (2–3)	2 (2–2)	0.212
▪ Time from SEMS placement to beginning of oral diet in days (median, IQR)	1 (1–1)	1 (0–2)	0.602
▪ Time from SEMS placement to hospital discharge in days (median, IQR)	2 (0–3)	3 (0–9)	1.000
Gastric outlet obstruction			
▪ GOOSS 1 week after (median, IQR)	2 (2–3)	3 (3–3)	0.124
▪ Time from SEMS placement to beginning of oral diet in days (median, IQR)	1 (1–1)	1 (1–2)	0.885
▪ Time from SEMS placement to hospital discharge in days (median, IQR)	2 (1–5)	3 (2–6)	0.810
Adverse event (n, %)	5 (17%)	2 (16.7%)	0.983
Pain	1 (3.4%)	1 (8.3%)	
Overgrowth/ingrowth	2 (6.9%)	–	
Bleeding	1 (3.4%)	–	
Nausea/vomiting	1 (3.4%)	–	
Migration	–	1 (8.3%)	
Time from SEMS placement to AE (median, days)	2 (2–22)	13 (0–25)	0.095

IQR, interquartile range; SEMS, self-expandable metal stent; TTS, through-the-scope.

The majority of SEMS were placed using therapeutic gastroscopes (n = 15; 52%), followed by conventional gastroscopes (n = 8; 28%) and ultrathin scopes (n = 5; 17%). SEMS placement technique was through-the-scope in 17 patients (59%) and over-the-wire in the remaining 12 (41%). Technical success was achieved in all patients, with Takita grades and GOOSS at 1 week after SEMS placement improving to a median of 2 (IQR 2–3) in both scores. Early AEs were reported in 5 patients (17%), after a median of 2 days (IQR 2–22) (► **Table 2**).

### Mitigation measures impact

From the 35<sup>th</sup> day to the 60<sup>th</sup> day after the first reported case of SARS-CoV-2 in each country, a total of 1028 endoscopic procedures were performed in the six European centers (median of 161.5 procedures). This corresponds to a reduction of 80% compared to the same time period in 2019, when a total of 5174 endoscopic procedures were performed (median of 799.5 procedures). The number of endoscopists and nurses working in the endoscopy department during the study period also dropped by 70% and 56%, respectively. The burden of SARS-CoV-2 cases varied among hospitals, with admissions

ranging from 0.03% to 3.8% of the total number of national cases (► **Table 3**).

A total of 29 SEMS were placed for upper gastrointestinal obstruction (esophageal dysphagia: 48.3% [n = 14] and gastric outlet obstruction: 51.7% [n = 15]) during the study period, corresponding to an increase of 241% compared to the same time period in 2019, when a total of 12 SEMS were placed.

With the exception of renal failure in patients with esophageal dysphagia, which was significantly higher in 2019 (0 [0%] vs 3 [38%];  $P=0.036$ ), and GOOSS before SEMS placement in patients with gastric outlet obstruction, which was significantly lower in 2020 (0 [0–1] vs 1 [1–2];  $P=0.037$ ), no other significant differences were found between the two time periods regarding median time from dysphagia/obstructive symptoms onset to SEMS placement, hospitalization, stricture estimated diameter, Takita grade before SEMS placement, beginning of oral diet and hospital discharge (► **Table 1** and ► **Table 2**).

► **Table 3** Mitigation measures impact on procedures performance in 2020 compared to the same period in 2019.

	Overall		Hospital São João		Leeds		Essen		Radboud		Clinic		Humanitas	
	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019
SEMS placed from D10 to D34	33	44	1	5	13	9	5	5	8	7	1	1	5	7
SEMS placed from D35 to D60 (study period)	29	12	8	2	6	0	3	2	5	5	2	1	5	2
Number of endoscopists working during study period	35	116	8	18	10	50	3	9	4	12	5	16	5	11
Number of nurses working during study period	65	146	12	22	30	60	5	11	9	24	5	22	4	7
Number of procedures performed during study period	1028	5174	163	732	160	1198	226	573	158	640	130	1164	191	867
Staff endoscopists infected during study period	9	-	0	-	7	-	0	-	0	-	2	-	0	-
Staff nurses infected during study period	4	-	0	-	4	-	0	-	0	-	0	-	0	-
Cumulative number of SARS-CoV-2 cases in hospital during study period	3727	-	490	-	190	-	30	-	292	-	2260	-	465	-
Cumulative number of SARS-CoV-2 cases in country during study period	463133	-	12748	-	33718	-	99891	-	36487	-	87295	-	192994	-
<b>Endoscopic suite</b>														
Air filtration														
Negative pressure	5 (17.2%)	-	-	-	-	-	-	-	-	-	-	-	5 (100%)	-
Air filter	7 (24.1%)	2 (16.7%)	7 (87.5%)	-	-	-	-	-	-	-	-	-	-	2 (100%)
Mask used														
None	2 (6.9%)	12 (100%)	-	2 (100%)	2 (33.3%)	-	-	2 (100%)	-	5 (100%)	-	1 (100%)	-	2 (100%)
Surgical mask	5 (17.2%)	-	-	-	-	-	-	-	5 (100%)	-	-	-	-	-
FFP2/FFP3	22 (75.9%)	-	8 (100%)	-	4 (66.7%)	-	3 (100%)	-	-	-	2 (100%)	-	5 (100%)	-

► Table 3 (Continuation)

	Overall		Hospital São João		Leeds		Essen		Radboud		Clinic		Humanitas	
	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019
Protective eyewear														
None	4 (13.8%)	10 (83.3%)	-	2 (100%)	2 (33.3%)	-	-	2 (100%)	2 (40%)	5 (100%)	-	1 (100%)	-	-
Goggles	13 (44.8%)	2 (16.7%)	-	-	-	-	3 (100%)	-	3 (60%)	-	2 (100%)	-	5 (100%)	2 (100%)
Face shield	12 (41.4%)	-	8 (100%)	-	4 (66.7%)	-	-	-	-	-	-	-	-	-
Number of gloves pairs														
One	10 (34.5%)	12 (100%)	-	2 (100%)	2 (33.3%)	-	3 (100%)	2 (100%)	5 (100%)	5 (100%)	-	1 (100%)	-	2 (100%)
Two	19 (65.5%)	-	8 (10%)	-	4 (66.7%)	-	-	-	-	-	2 (100%)	-	5 (100%)	-
Hairnet	22 (75.9%)	-	8 (100%)	-	4 (100%)	-	3 (100%)	-	-	-	2 (100%)	-	5 (100%)	-
Shoe covers	10 (34.5%)	-	8 (100%)	-	-	-	-	-	-	-	2 (100%)	-	-	-
Gown														
No	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apron	3 (10.3%)	8 (66.7%)	-	2 (100%)	2 (33.3%)	-	-	-	1 (20%)	5 (100%)	-	1 (100%)	-	-
Full disposable gown	26 (89.7%)	4 (33.3%)	8 (100%)	-	4 (66.7%)	-	3 (100%)	2 (100%)	4 (80%)	-	2 (100%)	-	5 (100%)	2 (100%)
Endoscopic staff														
Number of endoscopists (n, %)														
1	20 (69%)	8 (66.7%)	7 (87.5%)	2 (100%)	4 (66.7%)	-	1 (33.3%)	2 (100%)	5 (100%)	3 (60%)	2 (100%)	1 (100%)	1 (80%)	-
2	9 (31%)	4 (33.3%)	1 (12.5%)	-	2 (33.3%)	-	2 (66.7%)	-	-	2 (40%)	-	-	4 (20%)	2 (100%)
3														
Number of nurses (n, %)	5 (17%)	4 (33.3%)	-	-	-	-	-	1 (50%)	-	1 (20%)	-	-	5 (100%)	2 (100%)
1	17 (59%)	6 (50%)	7 (87.3%)	2 (100%)	-	-	3 (100%)	1 (50%)	5 (100%)	2 (40%)	2 (100%)	1 (100%)	-	-
2	7 (24%)	2 (16.7%)	1 (12.7%)	-	6 (100%)	-	-	-	-	2 (40%)	-	-	-	-
Anesthesiologist (n, %)	16 (55%)	8 (66.7%)	7 (87.5%)	0 (0%)	0 (0%)	-	0 (0%)	0 (0%)	2 (40%)	5 (100%)	0 (0%)	0 (0%)	5 (100%)	2 (100%)
Fellow present (n, %)	6 (21%)	8 (66.7%)	0 (0%)	2 (100%)	1 (16.7%)	-	1 (33.3%)	0 (0%)	0 (0%)	5 (100%)	0 (0%)	1 (100%)	4 (80%)	0 (0%)

SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; SEMS, self-expandable metal stent.

## Endoscopic staff and personal protection equipment

The endoscopic procedures were performed in rooms with negative pressure in 17% of the cases, with an additional 17% being performed in rooms with air purifiers (► **Table 3**).

No significant differences were found between the two time periods regarding the number of endoscopists in the endoscopic suite (2020: one endoscopist 69% vs 2019: one endoscopist 67%), nurses and anesthesiologists (2020: 55% vs 2019: 67%). However, fellows' involvement was significantly lower in 2020 (21% vs 67%;  $P=0.01$ ) (► **Table 3**).

Regarding PPE, in 2020, the majority of procedures were performed using facial masks (FFP2/FFP3 in 76% and surgical masks in 17%), protective eyewear (goggles in 45% and face shield in 41%), two pairs of gloves (65%), hairnet (76%) and full disposable gowns (90%); shoe covers were used in 34% of the procedures. In 2019, all procedures were performed without facial mask, hairnet or shoe covers, and only one pair of gloves; most procedures were performed without protective eyewear (83%) and with aprons only (67%) (► **Table 3**).

## COVID-19 status

In 2020, no SEMS procedures were performed in COVID-19-confirmed patients, but 55% of the patients were not tested for SARS-CoV-2 before the procedure (► **Table 4**); even though two patients (7%) presented with respiratory symptoms and one (3%) had fever before SEMS placement, and all of them were real-time polymerase chain reaction (RT-PCR) test-negative. One patient (3%) tested positive for SARS-CoV-2 after the procedure and two patients (7%) reported respiratory symptoms up to 14 days after SEMS placement (► **Table 4**).

The majority of endoscopists (86%), nurses (76%), and anesthesiologists (87%) were not tested for SARS-CoV-2 before the procedure. No medical staff involved in the SEMS procedures developed COVID-19 14 days after the procedure (► **Table 4**). However, nine of 35 endoscopists and four of 65 nurses involved in other procedures got infected during the overall study period (► **Table 3**).

## Discussion

The COVID-19 pandemic has been and still is affecting daily practice of gastrointestinal endoscopy worldwide. Several recommendations and statements have already been published in order to ensure safety of patients and endoscopy unit personnel [2–6]. With the significant increase in hospital admissions of COVID-19 patients, European hospitals have markedly reduced elective endoscopies, and the majority of resources have been directed to the COVID-19 pandemic. A recent survey reported a reduction in endoscopic volume of 91% compared to the volume before the COVID-19 outbreak [13]. In our study, a drop of 80% in the number of endoscopic procedures was noticed. The number of endoscopists and nurses working in the endoscopy department also dropped by 70% and 56%, respectively. However, the number of staff involved in SEMS placement was not impacted, with similar numbers of endoscopic

staff present in the endoscopic suite compared to 2019. Nonetheless, fellows' participation in SEMS placement reduced from 67% to 21%. This can be explained by the demand for stringent standards of infection control, rationing the use of necessary PPE [14] and redeployment of fellows to support critical services of each hospital as a result of the COVID-19 pandemic.

It is unknown for how long the COVID-19 pandemic will last. Despite a universal desire to return to usual endoscopic and clinical care, patients may still avoid undergoing scheduled endoscopic procedures because of fear of being infected by SARS-CoV-2, but likely also because they consider it safe to further postpone an endoscopic procedure. It has been reported in Italy that up to 30% of patients do not show up to the endoscopic unit despite being scheduled [15]. Nonetheless, in our study, patients with symptomatic obstruction did not seem to have avoided or delayed going to the hospital. An increase of 241% (from 12 to 29) in the number of SEMS placements was observed when compared to the same time period in 2019. The reason for this unexpected increase remains uncertain. Potentially, it could be related to a lower number of interventional cases in 2019; however, it could also reflect a change of practice in oncology during COVID times, with more patients being referred for definitive palliation rather than being considered for chemo- and/or radiotherapy due to fear of increased risks or lack of capacity to administer it. There were relatively more T4 patients in 2020, which could suggest that some patients have waited longer themselves or had to wait for treatment with chemotherapy and/or radiotherapy. In addition, 40% of the patients had no metastases at presentation, which could suggest that chemotherapy and/or radiotherapy had indeed been delayed or not performed due to a preferred choice for COVID-19 care in the hospital. As the number of procedures was small, we do not have sufficient evidence to support any solid conclusion. Of interest, major patient baseline characteristics and post-stenting management policies did not differ between the two time periods.

The risk of COVID-19 after endoscopic procedures and the risk factors associated with it have not yet been established. Endoscopy presents a source of aerosolization, potentially increasing the risk of infection with SARS-CoV-2 for endoscopy staff; however, preliminary reports suggest a low risk for professional and patient infection [16]. Repici et al [17] reported only one confirmed case of COVID-19 in 802 patients who underwent an endoscopic procedure. Although we did not place SEMS in COVID-19-confirmed patients, 55% of the patients were not tested for SARS-CoV-2 before the procedure. Only one patient tested positive for SARS-CoV-2 after the procedure; however, he had not been tested before. None of the medical staff involved in the SEMS procedures developed COVID-19 symptoms, even though 26% of endoscopists and 6% of nurses involved in other procedures got infected during the study period; however, the source of their infection has not been elucidated. These findings are in line with a recent Italian report describing the rate of COVID-19 infected physicians in gastroenterology units [18]. The entire gastroenterology department of Hospital São João in Portugal underwent serological testing at the end of the study, with the results being nega-



► **Table 4** Coronavirus disease 19 status in healthcare professionals and patients before and 14 days after endoscopic procedure.

n (%)	Global (n = 29)		Hospital São João (n = 8)		Leeds (n = 6)		Essen (n = 3)		Radboud (n = 5)		Clinic (n = 2)		Humanitas (n = 5)	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Endoscopist COVID-19 status														
▪ Negative	4 (13.8%)	3 (10.3%)	-	-	-	-	-	-	2 (40%)	1 (20%)	2 (100%)	2 (100%)	-	-
▪ Positive	-	-	-	-	-	-	-	-	-	-	-	-	-	-
▪ Not-tested	25 (86.2%)	26 (89.7%)	8 (100%)	8 (100%)	6 (100%)	6 (100%)	3 (100%)	3 (100%)	3 (60%)	4 (80%)	-	-	5 (100%)	5 (100%)
Nurse COVID-19 status														
▪ Negative	7 (24.1%)	3 (10.3%)	4 (50%)	-	-	-	-	-	1 (20%)	1 (20%)	2 (100%)	2 (100%)	-	-
▪ Positive	-	-	-	-	-	-	-	-	-	-	-	-	-	-
▪ Not-tested	22 (75.9%)	26 (89.7%)	4 (50%)	8 (100%)	6 (100%)	6 (100%)	3 (100%)	3 (100%)	4 (80%)	4 (80%)	-	-	5 (100%)	5 (100%)
Anesthesiologist COVID-19 status														
▪ Negative	2 (6.9%)	1 (3.4%)	-	-	-	-	-	-	2 (40%)	1 (20%)	-	-	-	-
▪ Positive	-	-	-	-	-	-	-	-	-	-	-	-	-	-
▪ Not-tested	13 (44.8%)	14 (48.2%)	8 (100%)	8 (100%)	-	-	-	-	-	1 (20%)	-	-	5 (100%)	5 (100%)
▪ Not present in the room	14 (48.3%)	14 (48.2%)	-	-	6 (100%)	6 (100%)	3 (100%)	3 (100%)	3 (60%)	3 (60%)	2 (100%)	2 (100%)	-	-
Patient COVID-19 status														
▪ Negative	13 (44.8%)	3 (10.3%)	8 (100%)	2 (25%)	-	-	1 (33.3%)	-	1 (20%)	-	1 (50%)	-	2 (40%)	1 (20%)
▪ Positive	-	1 (3.4%)	-	-	-	-	-	-	-	1 (20%)	-	-	-	-
▪ Not-tested	16 (55.2%)	23 (79.3%)	-	6 (75%)	6 (100%)	6 (100%)	2 (66.7%)	3 (100%)	4 (80%)	4 (80%)	1 (50%)	2 (100%)	3 (60%)	2 (40%)
▪ Unknown	-	2 (6.9%)	-	-	-	-	-	-	-	-	-	-	-	2 (40%)
COVID-19, Coronavirus disease 2019.														

tive for all of them. Infection prevention and control has been shown to be highly effective in assuring the safety of both HCP and patients [19–22]. In our study, negative pressure or rooms with air purifiers were only available in 34% of the procedures; 76% and 17% of our procedures were performed with FFP2/FFP3 and surgical masks, respectively. In one of the hospitals, due to a shortage of PPE, FFP2 masks were only allowed for RT-PCR-positive cases or for highly suspicious but test-negative cases. While a recent guideline has suggested that surgical masks can be used in this setting [23], there remains a significant false-negative rate for RT-PCR testing and concern for infection between the time of testing and the procedure. Protective eyewear, offering additional protection against aerosol droplets from patients [24], was also used in 86% of the procedures.

Limitations of our study include its retrospective design, being conducted in six tertiary referral centers. None of the patients included were, as far as we know, COVID-19-positive, so it is not possible to assess whether the risk of HCP infection after therapeutic endoscopy is higher when performed in confirmed COVID-19 patients. Nonetheless, we present data from centers for which the SARS-CoV-2 outbreak had a major impact on their endoscopic activity during the outbreak period and were located in geographical areas with high rates of community transmission.

## Conclusion

This is the first multicenter international study to quantify the impact of COVID-19 on endoscopic placement of SEMS in patients with upper gastrointestinal obstruction. Upper gastrointestinal stenting increased during the SARS-CoV-2 outbreak period. This could be related to yearly variation in the number of procedures (unrelated to the pandemic) or reflect a change of oncologic treatment practice during COVID times.

## Competing interests

Dr. Repici is a consultant for Boston Scientific, ERBE, Fujifilm, Medtronic, EndoKey, EndoStart and Q3Medical. Dr. Ginès is an advisor for Boston Scientific and Olympus Europe. Dr. Siersema receives research support from MicroTech (China) and Pentax (Japan). He previously received research support from Boston Scientific (US), Cook Medical (Ireland), and EllaCS (Czech Republic).

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