

## **Supplemental Material (SM)**

### **Tracheostomy timing and outcome: the WeanTrach multicenter study**

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### **List of participating centers**

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**Table S1. Baseline characteristics of patients at ICU admission stratified for timing and type of tracheostomy.**

Baseline characteristics	Overall	Time to tracheostomy			Type of tracheostomy		
	N = 153	Early N = 76	Late N = 77	P value	Percutaneous N = 100	Surgical N = 53	P value
<b>Patients directly admitted to ICU</b>	28 (18.3)	14 (18.4)	14 (18.2)	0.034	21 (21.0)	7 (13.2)	0.08
<b>Endotracheal intubation</b>							
<i>Before ICU admission</i>	18 (11.8)	4 (5.3)	14 (18.2)		8 (8.0)	10 (18.9)	
<i>On the same day</i>	124 (81.0)	67 (88.2)	57 (74.0)		86 (86.0)	38 (71.7)	
<i>During ICU stay</i>	11 (7.2)	5 (6.6)	6 (7.8)	0.64	6 (6.0)	5 (9.4)	0.59
<b>ICU admission to endotracheal intubation, days</b>	N = 135	N = 72	N = 63		N = 92	N = 43	
	0.6 ± 3.18	0.9 ± 4.19	0.3 ± 1.16		0.7 ± 3.59	0.6 ± 2.05	
	0.0 (0.0 – 31.0)	0.0 (0.0-31.0)	0.0 (0.0-7.0)		0.0 (0.0-31.0)	0.0 (0.0-10.0)	
<b>Type of respiratory support at ICU admission</b>				0.09			0.22
<i>COT (mild)</i>	12 (7.8)	5 (6.6)	7 (9.1)	0.39	6 (6.0)	6 (11.3)	0.10
<i>NIMV (moderate)</i>	67 (43.8)	40 (52.6)	27 (35.1)		41 (41.0)	26 (49.1)	
<i>IMV (severe)</i>	74 (48.4)	31 (40.8)	43 (55.8)		53 (53.0)	21 (39.6)	
<b>Prone position</b>	93/151 (61.6)	43/74 (58.1)	50/77 (64.9)		65/98 (66.3)	28/53 (52.8)	
<b>Ventilation type</b>				-			-
<i>COT (mild)</i>	1 (0.7)	1 (1.3)	0 (0.0)	0.05	0 (0.0)	1 (1.9)	0.93
<i>NIMV (moderate)</i>	1 (0.7)	1 (1.3)	0 (0.0)		0 (0.0)	1 (1.9)	
<i>IMV (PCV)</i>	57 (37.3)	17 (22.4)	40 (51.9)		36 (36.0)	21 (39.6)	
<i>IMV (VCV)</i>	46 (30.1)	19 (25.0)	27 (35.1)		22 (22.0)	24 (45.3)	
<i>IMV (AV)</i>	5 (3.3)	2 (2.6)	3 (3.9)		3 (3.0)	2 (3.8)	
<i>Not reported</i>	43 (28.1)	36 (47.4)	7 (9.1)		39 (39.0)	4 (7.5)	
<b>Blood gas analysis</b>							
<i>PaO<sub>2</sub>/FiO<sub>2</sub></i>	N = 107	N = 38	N = 69	0.05	N = 58	N = 49	0.93
	155.4 ± 74.40	134.1 ± 55.39	167.2 ± 81.02		152.8 ± 70.05	158.5 ± 79.86	
	138.3 (41.7-357.5)	125.4 (53.0-323.3)	148.8 (41.7-357.5)		140.4 (41.7-357.5)	130.0 (51.1-350.0)	

<i>PaCO<sub>2</sub>, mmHg</i>	N = 107 46.5 ± 11.98 45.0 (22.0-100.0)	N = 38 46.7 ± 12.24 46.5 (22.0-100.0)	N = 69 46.3 ± 11.92 44.0 (28.0-83.8)	0.56	N = 58 48.1 ± 13.43 45.6 (28.0-100.0)	N = 49 44.6 ± 9.80 44.0 (22.0-83.0)	0.27
<b>IMV setting</b>							
<i>Minute volume, L/min</i>	N = 106 9.0 ± 1.99 8.5 (2.8-15.0)	N = 37 8.7 ± 2.04 8.4 (2.8-14.3)	N = 69 9.1 ± 1.97 8.5 (6.0-15.0)	0.62	N = 59 8.7 ± 1.96 8.4 (2.8-14.4)	N = 47 9.4 ± 1.99 9.0 (5.6-15.0)	0.07
<i>PEEP, cmH<sub>2</sub>O</i>	N = 108 12.0 ± 3.00 12.0 (5.0-20.0)	N = 38 11.5 ± 2.90 12.0 (5.0-17.0)	N = 70 12.3 ± 3.03 12.0 (6.0-20.0)	0.26	N = 61 11.4 ± 2.81 12.0 (5.0-18.0)	N = 47 12.7 ± 3.09 13.0 (7.0-20.0)	0.017
<i>Tidal volume, ml/kg</i>	N = 107 5.8 ± 1.06 5.9 (3.3-9.2)	N = 38 5.7 ± .87 5.8 (4.1-7.9)	N = 69 5.9 ± 1.16 6.0 (3.3-9.2)	0.40	N = 60 5.7 ± 1.06 5.7 (3.3-9.2)	N = 47 6.0 ± 1.07 6.0 (4.1-8.3)	0.13

Table Legend: ICU, intensive Care Unit; IMV, invasive mechanical ventilation; COT, conventional oxygen therapy; NIMV, non-invasive mechanical ventilation; PCV, pressure-controlled ventilation; VCV, volume-controlled ventilation; AV, assisted ventilation; PaO<sub>2</sub>, arterial partial pressure of oxygen; FiO<sub>2</sub>, fraction of inspired oxygen; PaCO<sub>2</sub>, partial pressure of carbon dioxide; PEEP, positive end-expiratory pressure. Data expressed as absolute number (percentage), mean ± standard deviation, or median (IQR) as appropriate. IQR: interquartile range.

**Table S2. Treatment characteristics of critically ill COVID-19 patients.**

Treatment characteristics of COVID-19 patients (N = 153)		
<b>Corticosteroids</b>		
	No	32 (20.9)
	Yes	121 (79.1)
<b>Tocilizumab</b>		
	No	104 (69.3)
	Yes	46 (30.7)
<b>Immunoglobulins</b>		
	No	141 (93.4)
	Yes	10 (6.6)
<b>Antivirals</b>		
	No	33 (22.1)
	Yes	116 (77.9)
<i>Antivirals used per patient, number</i>		1.6 ±1.2
		2.0 (0.0 - 5.0)
<i>Type of antiviral</i>		
<i>Remdesivir</i>	No	132 (88.6)
	Yes	17 (11.4)
<i>Ritonavir</i>	No	99 (66.4)
	Yes	50 (33.6)
<i>Cobicistat</i>	No	114 (76.5)
	Yes	35 (23.5)
<i>Darunavir</i>	No	85 (57.0)
	Yes	64 (43.0)
<i>Hydroxychloroquine</i>	No	129 (86.6)
	Yes	20 (13.4)
<i>Lopinavir</i>	No	111 (74.5)
	Yes	38 (25.5)
<i>Oseltamivir</i>	No	137 (91.9)
	Yes	12 (8.1)

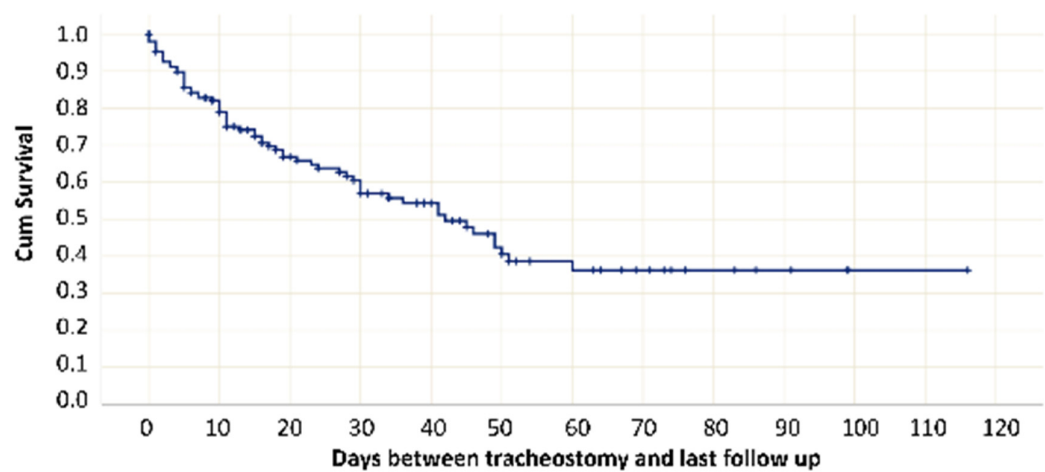
Table Legend: Data expressed as absolute number (percentage), mean ± standard deviation, or median (IQR) as appropriate. IQR: interquartile range.

**Table S3. Characteristics of ventilatory management on days 1, 7, 15 from ICU admission until the day of tracheostomy.**

Ventilatory parameter	Day 1	Day 7	Day 15	Day of tracheostomy*
<b>Ventilation type</b>				
<i>COT (mild)</i>	1 (0.7)	9 (5.9)	2 (1.3)	0 (0.0)
<i>NIMV (moderate)</i>	1 (0.7)	4 (2.6)	2 (1.3)	0 (0.0)
<i>IMV (severe)</i>				
<i>PCV</i>	57 (37.3)	32 (20.9)	47 (30.7)	34 (22.2)
<i>VCV</i>	46 (30.1)	19 (12.4)	22 (14.4)	21 (13.7)
<i>AV</i>	5 (3.3)	43 (28.1)	37 (24.2)	52 (34.0)
<i>Not reported</i>	43 (28.1)	46 (30.1)	43 (28.1)	42 (27.5)
<b>Blood gas analysis</b>				
<i>PaO<sub>2</sub>/FiO<sub>2</sub></i>	N = 107	N = 109	N = 106	N = 107
	138.3 (41.7 - 357.5)	162.0 (58.0 - 460.0)	164.5 (56.0 - 500.0)	168.0 (57.5 - 496.0)
<i>PaCO<sub>2</sub>, mmHg</i>	N = 107	N = 109	N = 106	N = 106
	45.0 (22.0 - 100.0)	47.0 (27.0 - 137.0)	44.0 (29.0 - 79.0)	46.5 (30.0 - 72.0)
<b>IMV setting</b>				
<i>MV, L/min</i>	N = 106	N = 89	N = 68	N = 71
	8.5 (2.8 - 15.0)	9.0 (2.0 - 18.0)	9.5 (2.3 - 18.0)	9.4 (1.5 - 15.9)
<i>PEEP, cmH<sub>2</sub>O</i>	N = 108	N = 106	N = 97	N = 107
	12.0 (5.0 - 20.0)	10.0 (4.0 - 18.0)	10.0 (4.0 - 15.0)	10.0 (2.0 - 31.0)
<i>Tidal volume, ml/kg</i>	N = 107	N = 88	N = 68	N = 71
	5.9 (3.3 - 9.2)	5.9 (1.5 - 9.2)	5.9 (1.8 - 12.5)	5.8 (2.6 - 12.5)

Table Legend: ICU, intensive care unit; FiO<sub>2</sub>, fraction of inspired oxygen; PaO<sub>2</sub>, partial pressure of arterial oxygen; PaCO<sub>2</sub>, partial pressure of arterial carbon dioxide; COT, conventional oxygen therapy; NIMV, non-invasive mechanical ventilation; IMV, invasive mechanical ventilation; VCV, volume-controlled ventilation; PCV, pressure-controlled ventilation; AV, assisted ventilation; PEEP, positive end-expiratory pressure; MV, minute ventilation. Data are reported as median (IQR); number of patients (percentage) as appropriate. \* Day when tracheostomy performed.

Figure S1. Cumulative survival after tracheostomy in critically ill COVID-19 patients.



Days of Follow Up	Events	Cum. prop. surv. [S.E.]
10	30	0.790 (0.034)
20	44	0.668 (0.042)
30	53	0.570 (0.047)
40	55	0.544 (0.048)
50	63	0.405 (0.056)
60	65	0.362 (0.058)

**Table S4. Timing and cause of death in COVID-19 patients.**

COVID-19 (N = 153)	
Death	65 (42.5)
Days elapsed from tracheostomy to death	25.4 ± 24.47
	16.0 (0.0 – 116.0)
Cause of death	
<i>Cardiocirculatory arrest</i>	10 (15.4)
<i>Respiratory failure</i>	6 (9.2)
<i>Multiorgan dysfunction</i>	45 (69.2)
<i>Pulmonary embolism</i>	2 (3.1)
<i>Pancreatitis</i>	1 (1.5)
<i>Not available</i>	1 (1.5)

Table Legend: ICU, intensive care unit. Data expressed as mean ± standard deviation, median (range), or number (percentage) as appropriate.



Figure S2. Cumulative survival after receiving percutaneous tracheostomy (early vs late)

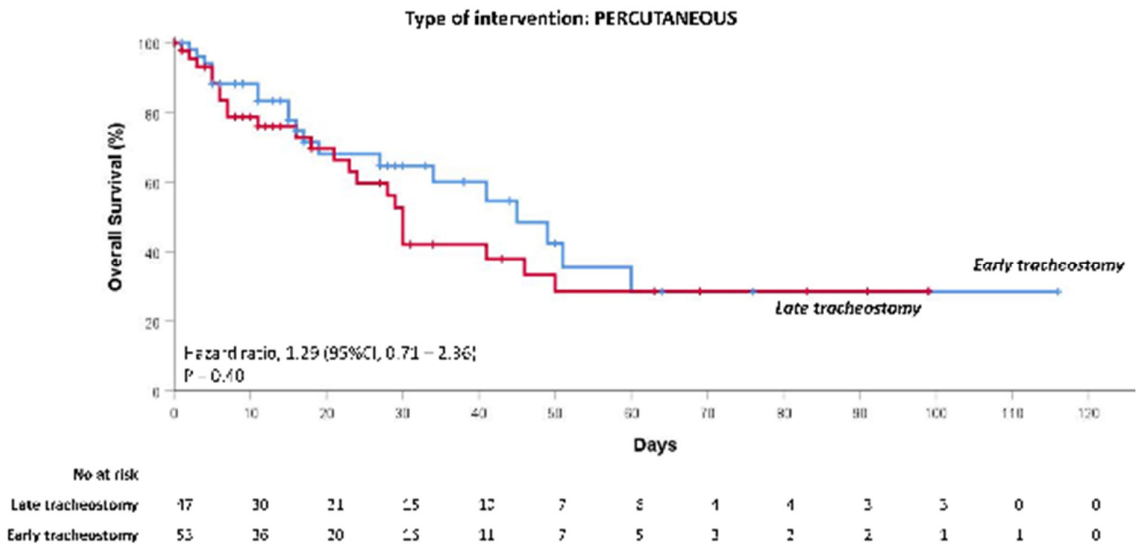
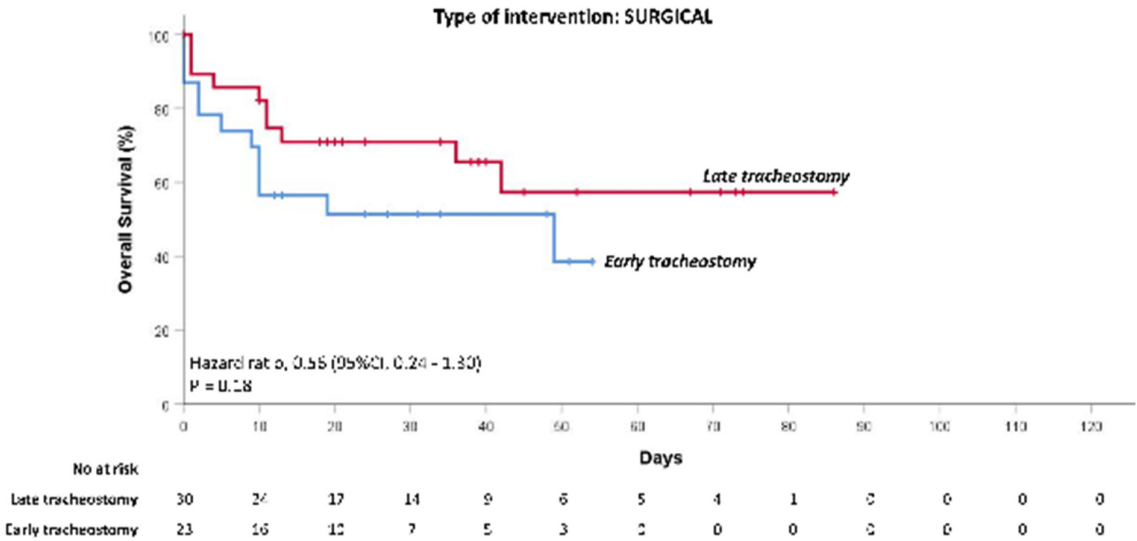


Figure S3. Cumulative survival after receiving surgical tracheostomy (early vs late)



**Table S5. Pathogens identified in bronchoalveolar lavage fluid before and after tracheostomy.**

Pathogens in BALF	Pre-tracheostomy	Post-tracheostomy
<i>Patients with <math>\geq 2</math> pathogens in BALF</i>	18 (11.8)	30 (19.6)
<i>Patients without available BALF</i>	84 (54.9)	66 (43.1)
<i>Patients with negative BALF</i>	19 (12.4)	17 (11.1)
<i>Patients with positive BALF</i>	50 (32.7)	70 (45.8)
<i>Overall identified pathogens in BALF</i>	75 (100)	107 (100)
<i>Type of pathogens identified in positive BALF</i>	Pre-tracheostomy	Post- tracheostomy
<i>Pseudomonas aeruginosa</i>	23 (30.7)	29 (27.1)
<i>Klebsiella pneumoniae</i>	10 (13.3)	13 (12.1)
<i>Staphylococcus aureus</i>	7 (9.3)	9 (8.4)
<i>Candida albicans</i>	6 (8.0)	7 (6.5)
<i>Acinetobacter baumannii</i>	5 (6.7)	9 (8.4)
<i>Stenotrophomonas maltophilia</i>	4 (5.3)	4 (3.7)
<i>Candida parapsilosis</i>	3 (4.0)	3 (2.8)
<i>Aspergillus fumigatus</i>	1 (1.3)	7 (6.5)
<i>Others</i>	<i>C. glabrata, C. tropicalis, P. C. glabrata, C. tropicalis, C. mirabilis, A. pittii, A. fumigatus, auris, A. niger, A. pittii, E. E. aerogenes, E. cloacae, E. coli, aerogenes, E. faecalis, E. faecium, H. influenzae, O. anthropi, P. E. cloacae, E. coli, H. influenzae, fluorescens, R. ornithinolytica, O. anthropi, K. oxytoca, M. S. anginosus, S. hominis, S. morganii, S. epidermidis, P. putida</i>	

Table Legend: BALF, bronchoalveolar lavage fluid. Data expressed as number (percentage).