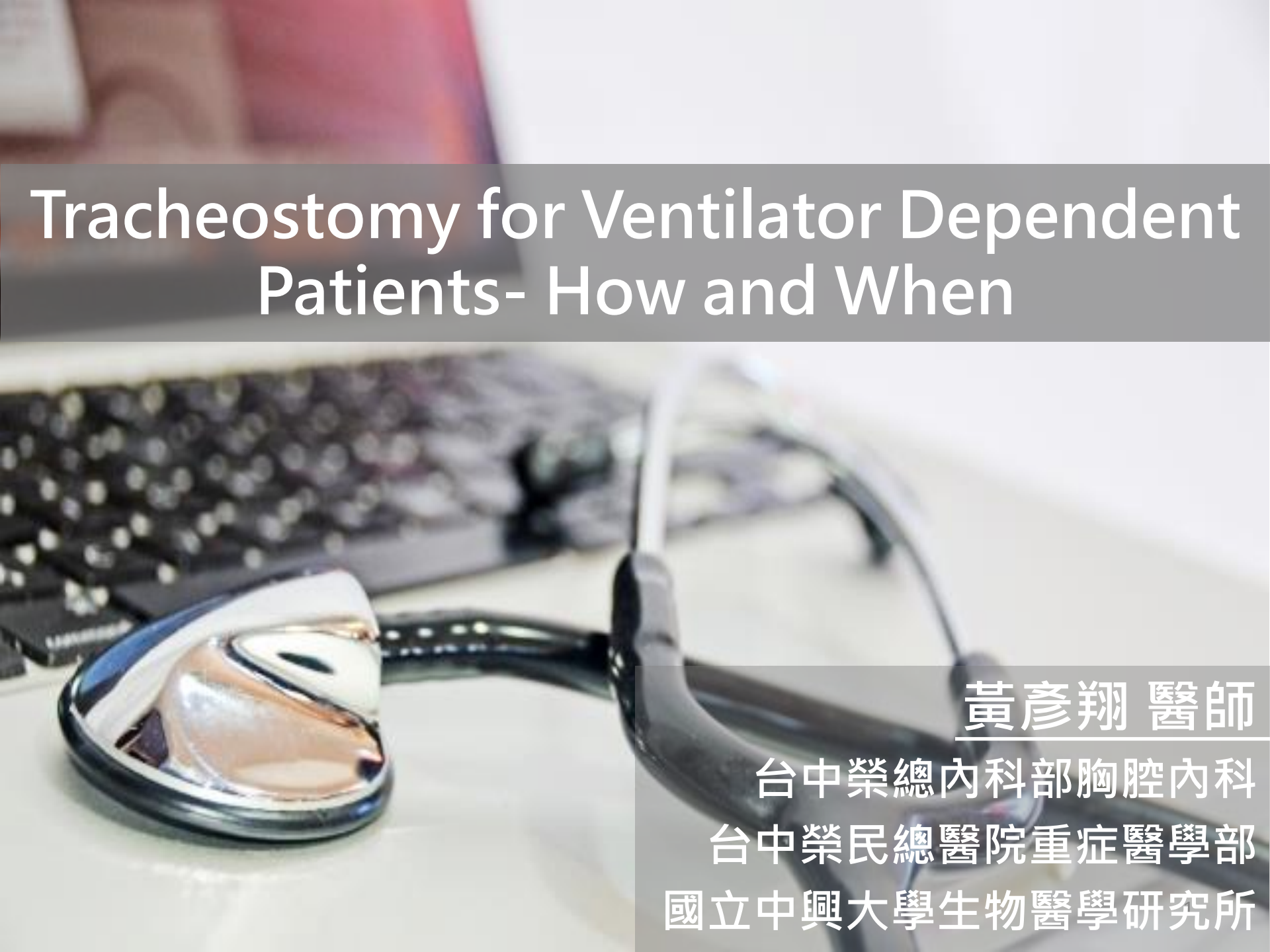
Tracheostomy for Ventilator Dependent Patients- How and When



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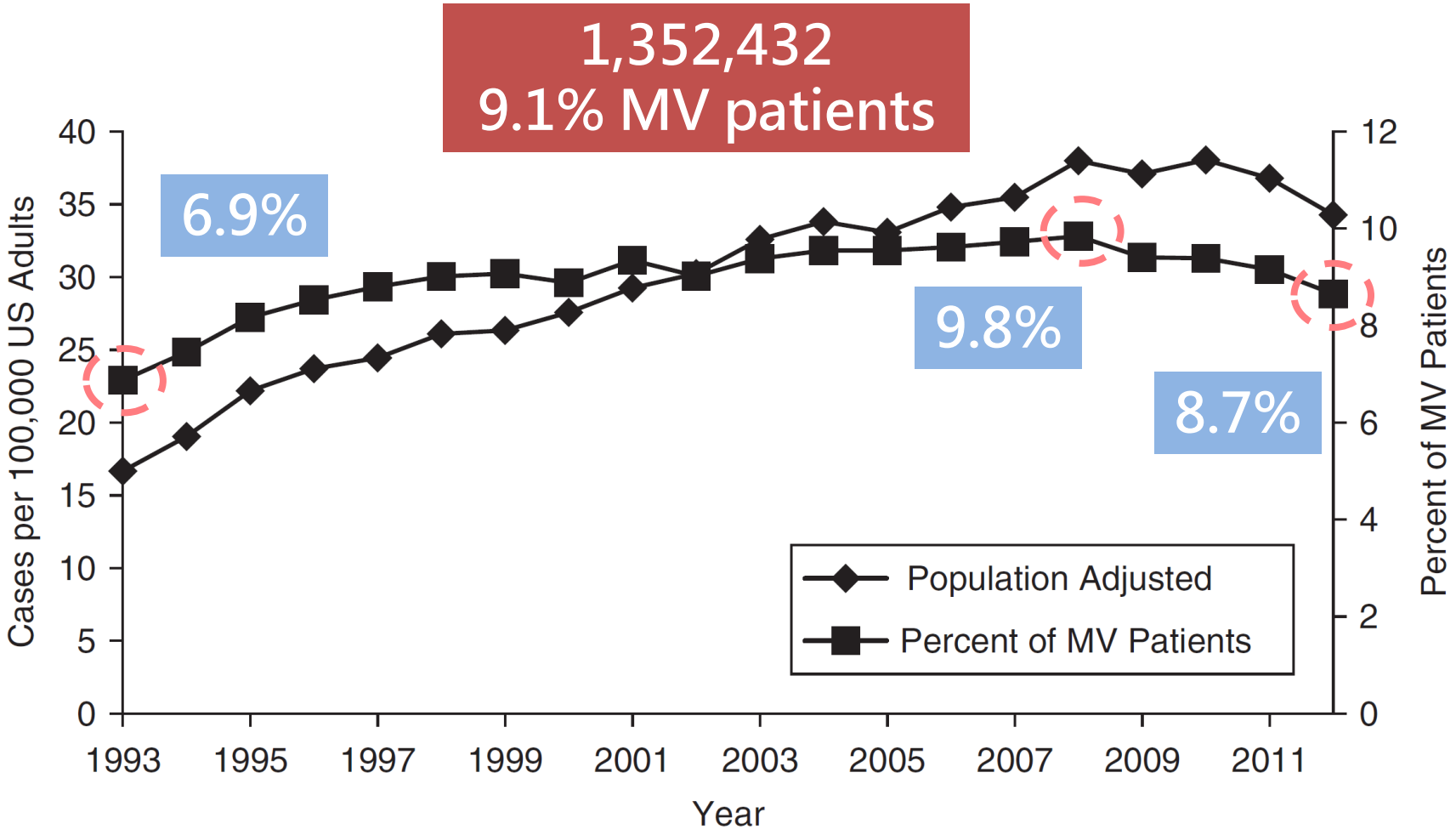
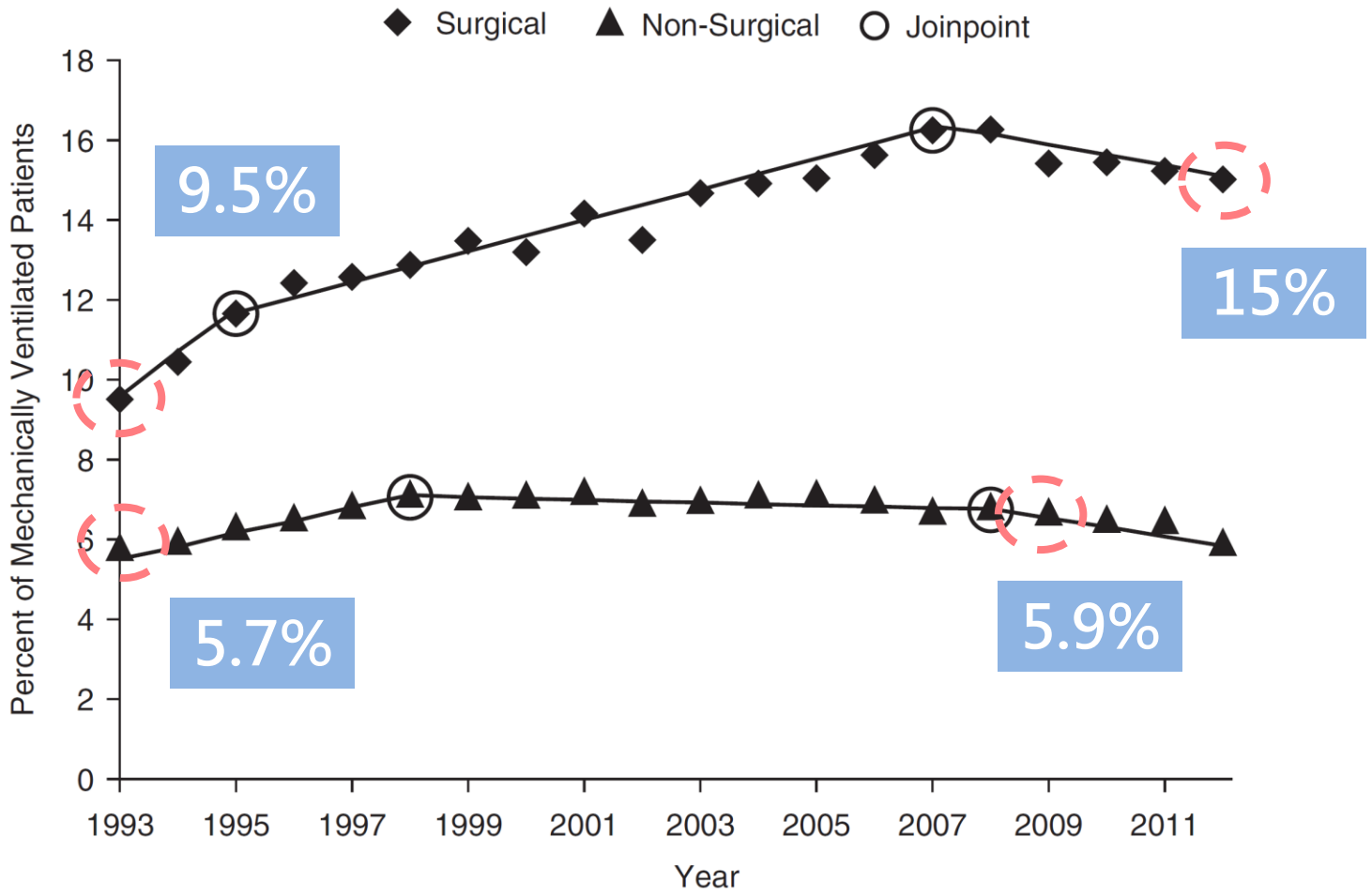
WHO
WHEN
HOW
VGHTC experience

Tracheostomy use rates in the United States, 1993–2012



Am J Respir Crit Care Med. 2015 Aug 15;192(4):446-54.

Tracheostomy rates based on underlying surgical status



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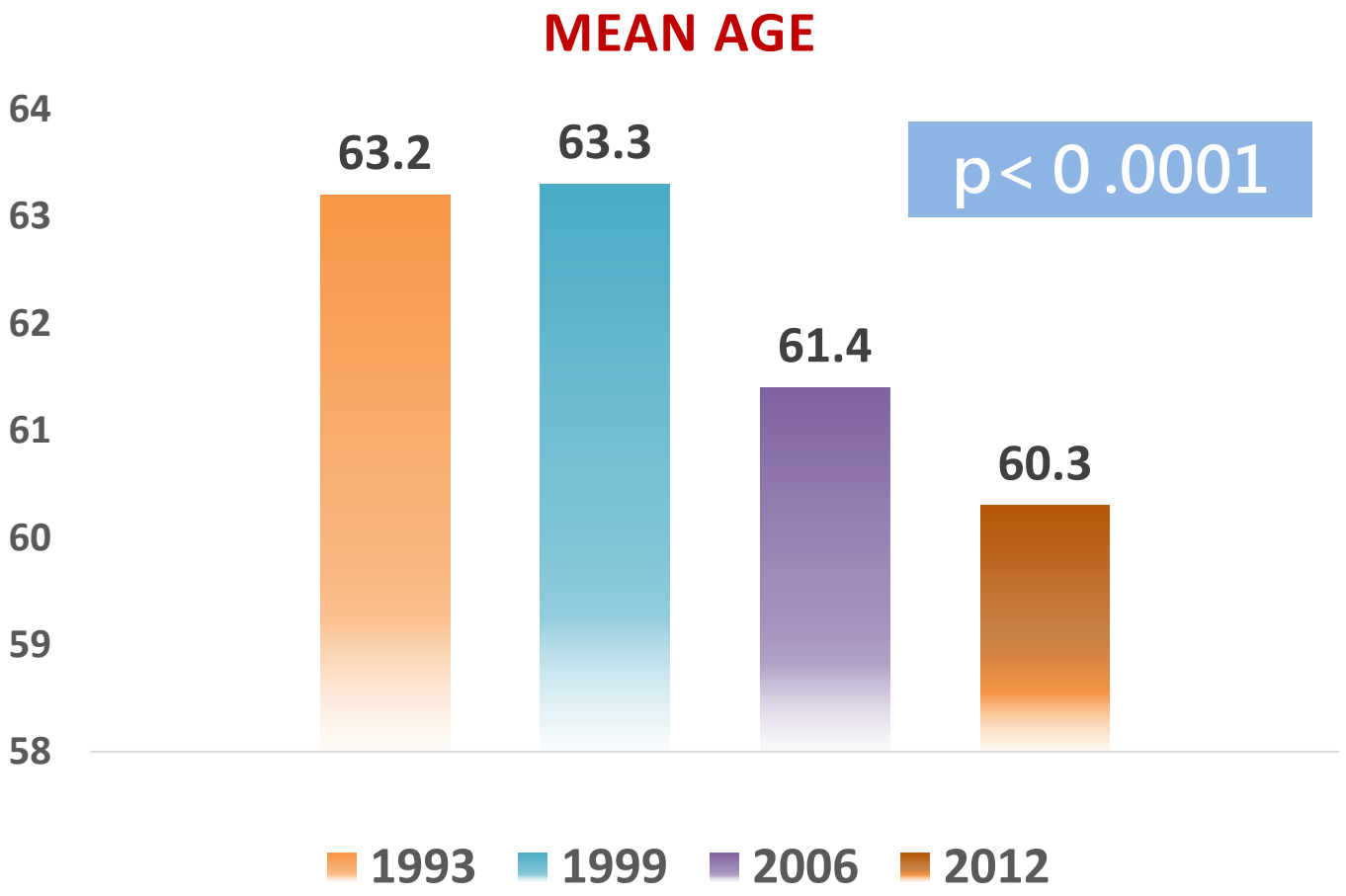
Characteristics of Patients Receiving Tracheostomy in Selected Study Years



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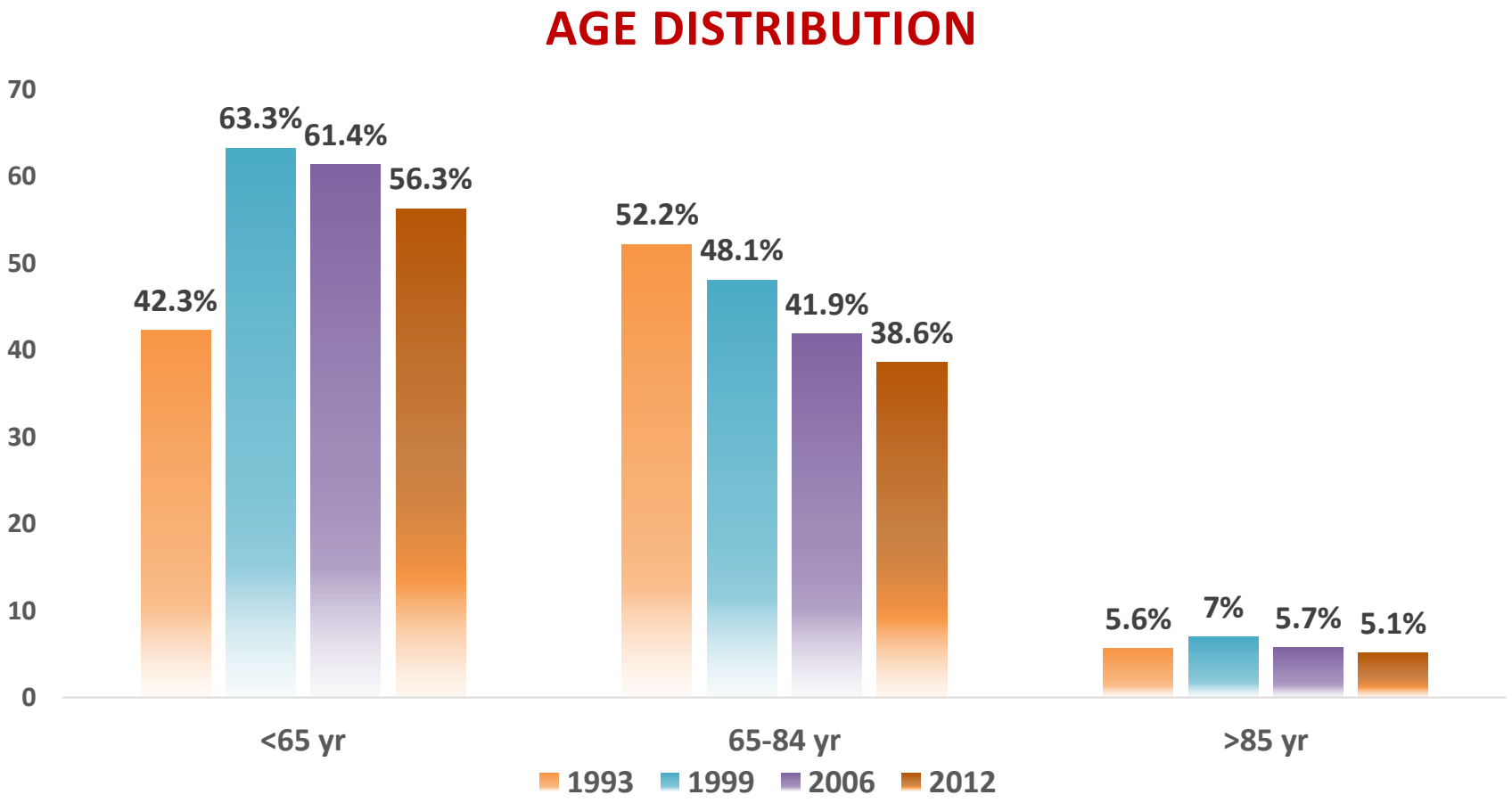

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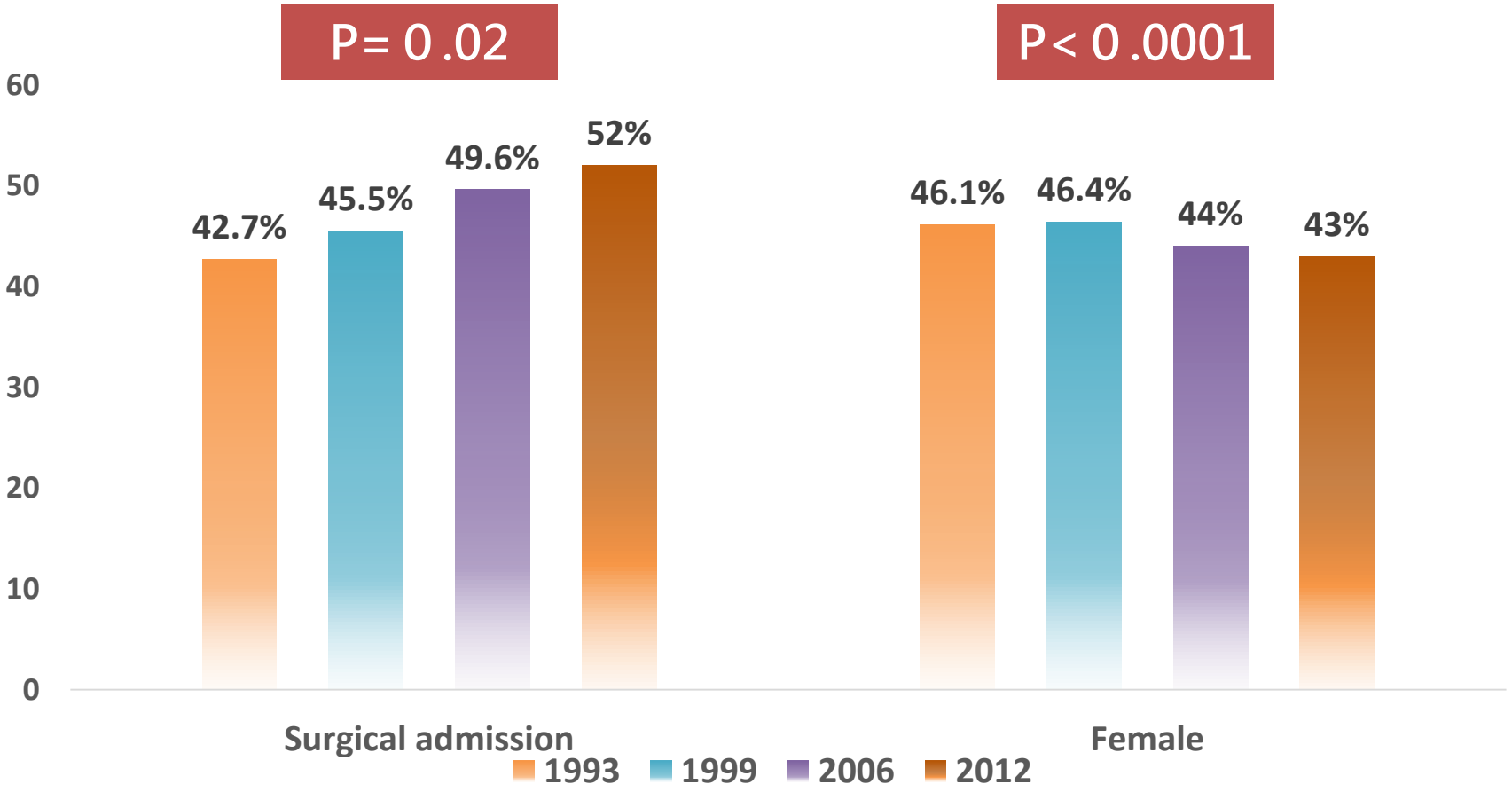
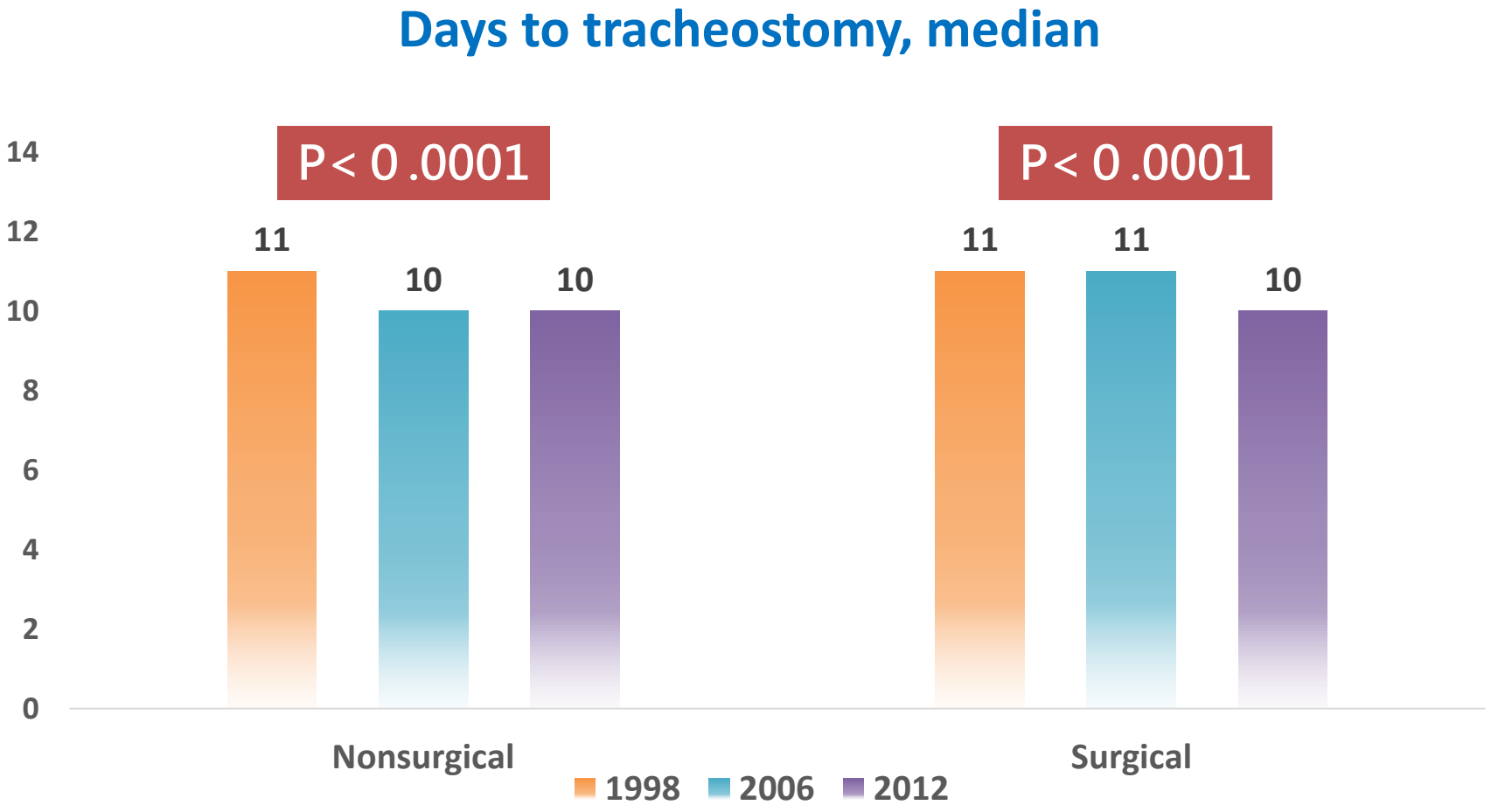


Am J Respir Crit Care Med. 2015 Aug 15;192(4):446-54.

Timing of Tracheostomy among Mechanically Ventilated Patients



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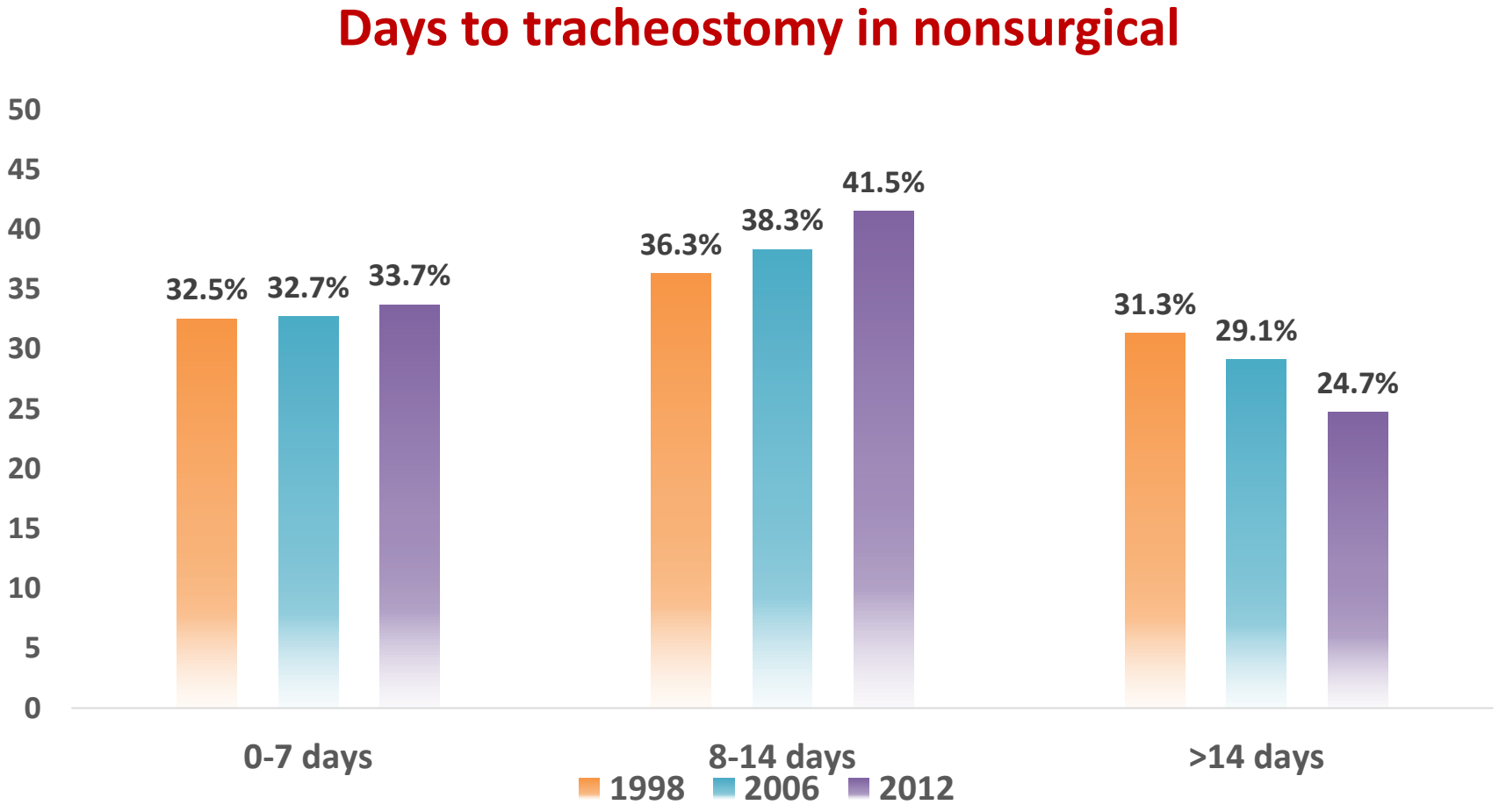
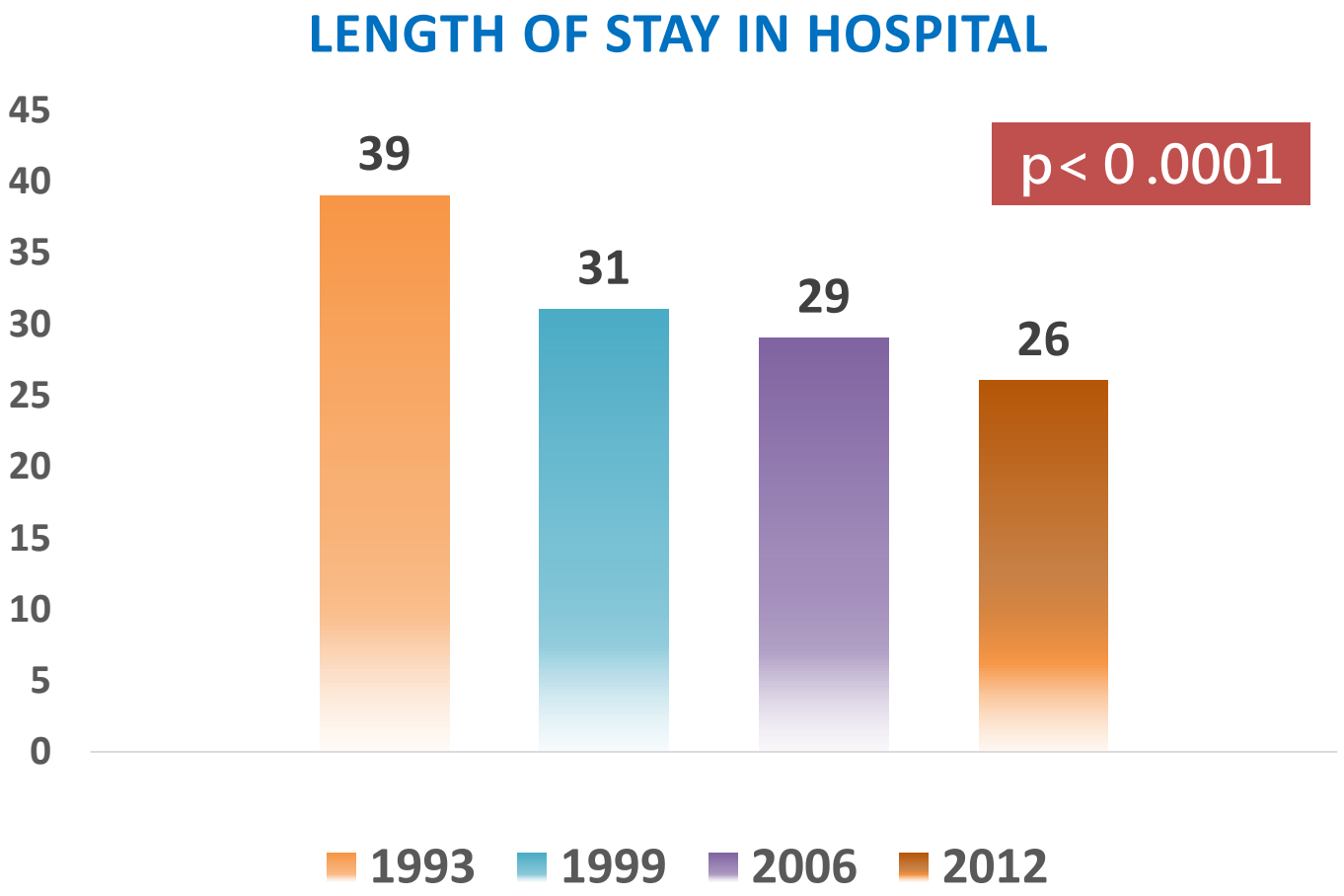


Am J Respir Crit Care Med. 2015 Aug 15;192(4):446-54.

Outcomes of Patients Receiving Tracheostomy



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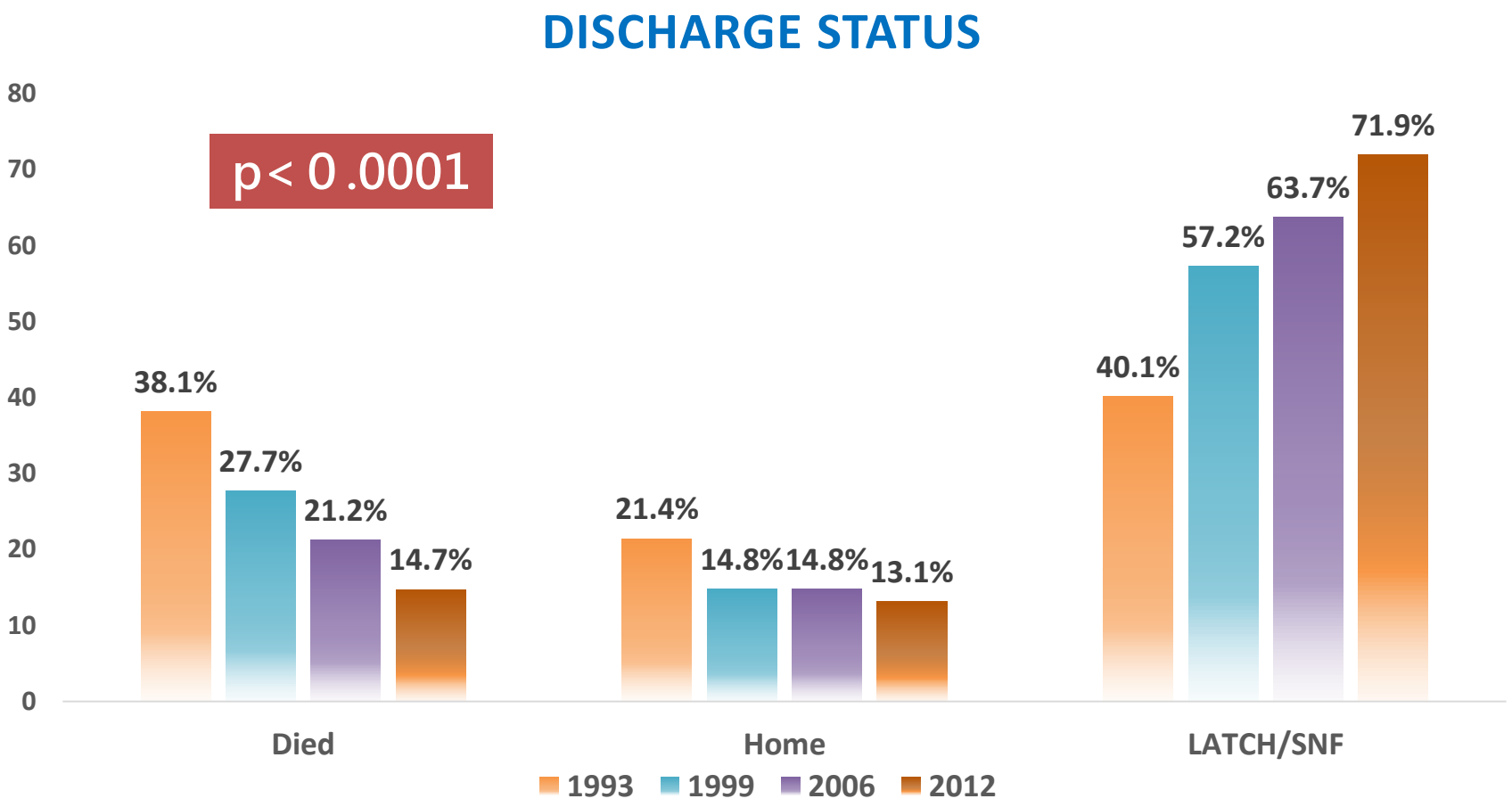
Outcomes of Patients Receiving Tracheostomy



Am J Respir Crit Care Med. 2015 Aug 15;192(4):446-54.

Indications of tracheostomy

Failed trials of extubation/failed weaning attempts

Prolonged mechanical ventilation

Tracheal access to remove thick pulmonary secretions

Airway protection and prevention of pulmonary aspiration

Bypass of upper airway obstruction

Trauma or surgery in the face/neck region

Curr Opin Crit Care. 2007 Feb;13(1):90-7.

Benefits of converting translaryngeal intubation to tracheostomy in ICU patients

Sparing further laryngeal injury

Facilitating airway suctioning and secretion management

Increasing patient mobility

Improving comfort

Promote oral hygiene

Decreasing airway resistance

Facilitating return of speech

Facilitating oral feeding

More aggressive in weaning attempt

Facilitating transfer out of ICU

Semin Respir Crit Care Med 2018;39:720–730.
Crit Care Clin 33 (2017) 311–322.

LET'S PK

Early vs. Late Tracheostomy

Early PDT to prolonged translaryngeal intubation in critically ill medical patients

≦2 days vs. ≧14 days

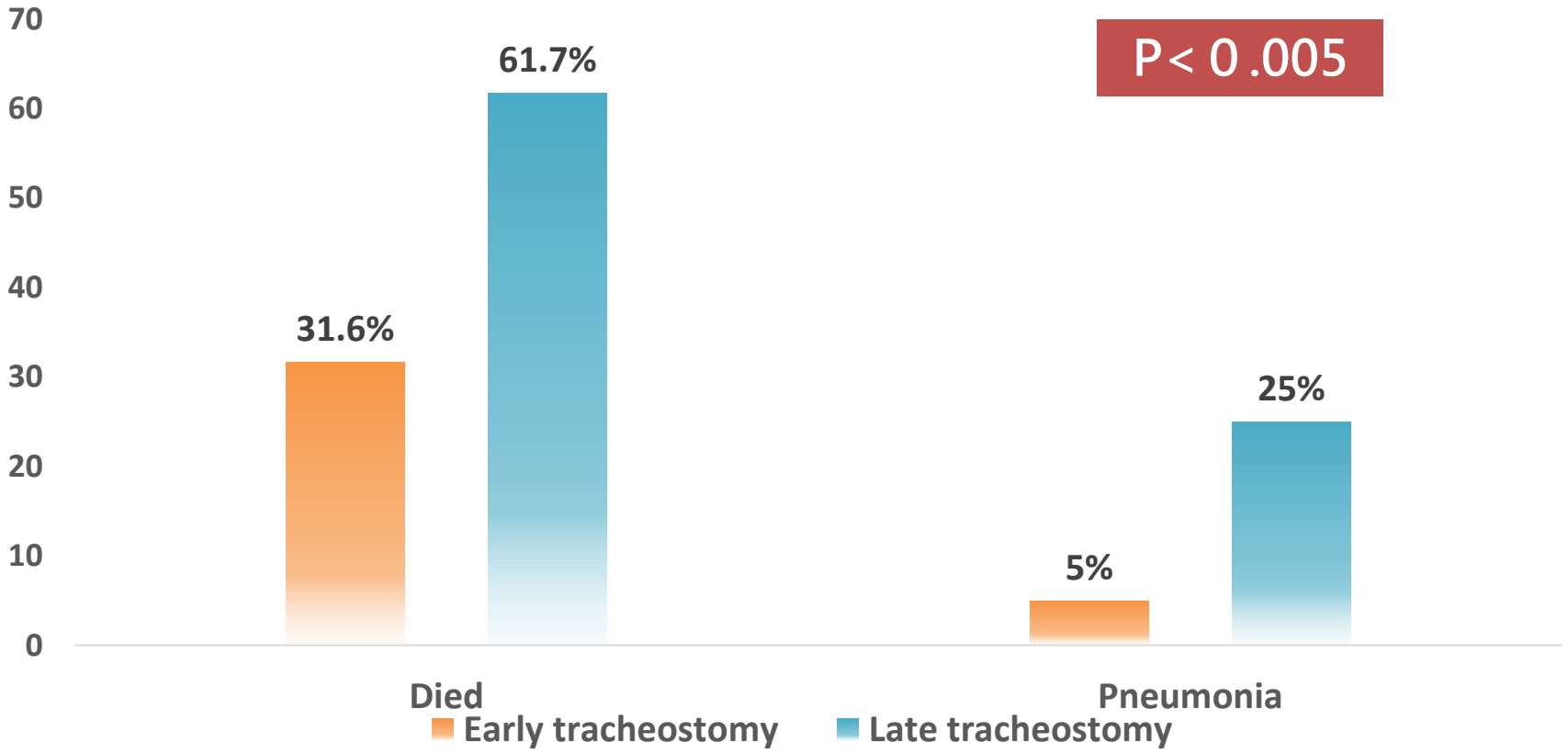
RCT, N=120 randomized, 2 center in US

Baseline Characteristics	Early Tracheotomy (n = 60)	Prolonged Translaryngeal Intubation (n = 60)
Age, yrs ± SD	63 ± 10.4	63 ± 9.3
Male, n (%)	31 (51.7)	34 (56.7)
Body mass index, kg/m^2	20.8 ± 8	21.9 ± 9
APACHE II score ± SD	27.4 ± 4.2	26.3 ± 2.6
African American, n (%)	25 (41.7)	28 (46.7)
White, m (%)	20 (33.3)	21 (35)
Hispanic, n (%)	15 (25)	11 (18.3)
Human immunodeficiency virus[a]	2	3
Diabetes mellitus[a]	5	4
Coronary artery disease[a]	3	3
Malignancy[a]	3	3
Respiratory failure[a]	60	60
Renal failure (new onset)[a]	27	25
Severe sepsis[a]	42	40
Organ failure (≥3)[a]	35	33
High-dose vasopressor use (dopamine ≥5 μ · kg^{-1} · min^{-1} or norepinephrine)[a]	51	50
Overt disseminated intravascular coagulation[a]	51	50
Lactic acidosis[a]	32	33
Initial platelet count <50,000[a]	25	23
Community-acquired pneumonia[a]	15	16
Chronic obstructive lung disease[a]	32	31
Congestive heart failure[a]	10	9
Diabetic ketoacidosis[a]	4	3
Aspiration pneumonia[a]	12	11
Urinary tract infection[a]	11	13

Crit Care Med. 2004 Aug;32(8):1689-94.

Early PDT to prolonged translaryngeal intubation in critically ill medical patients

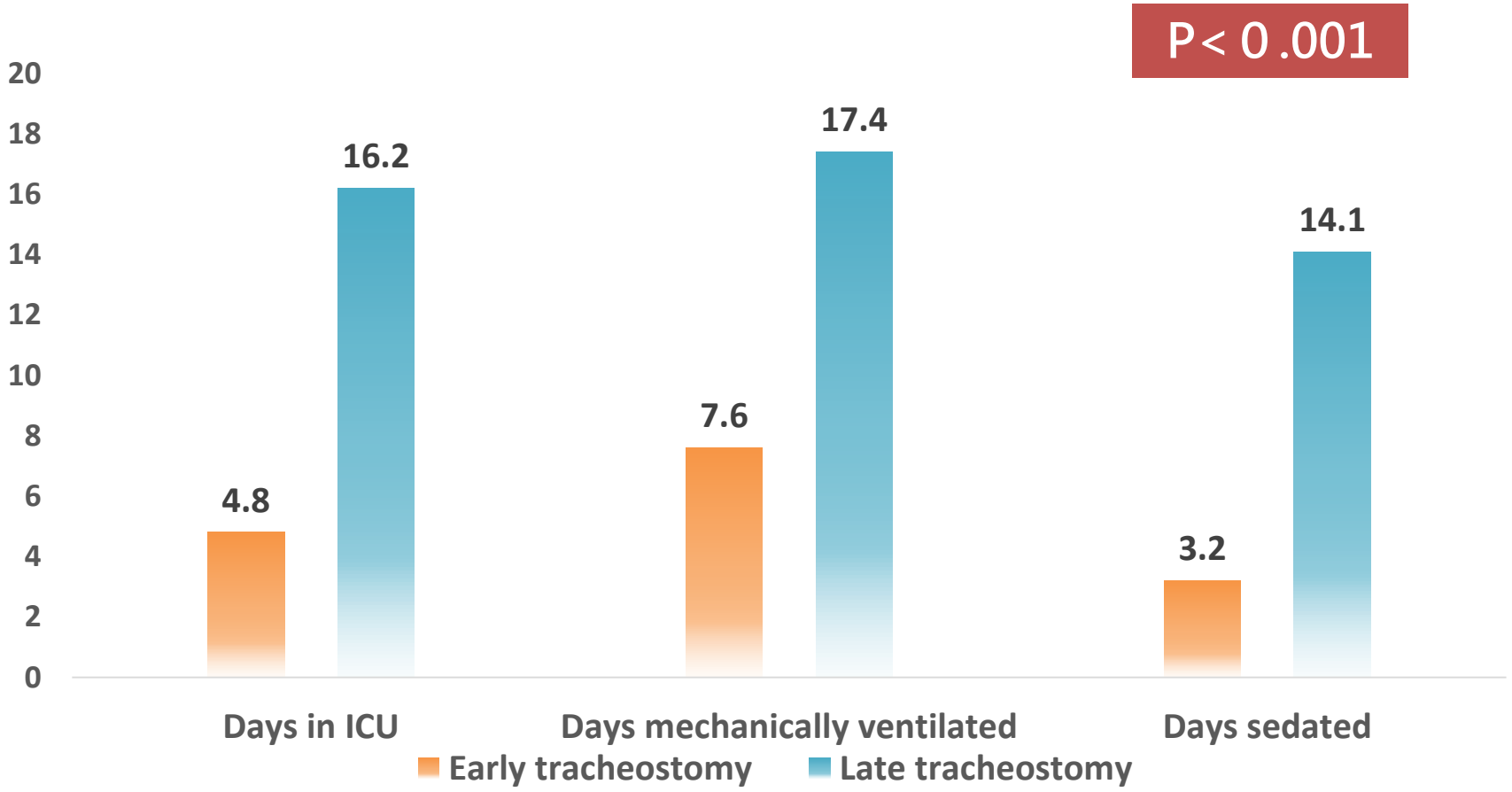
Outcomes



Crit Care Med. 2004 Aug;32(8):1689-94.

Early PDT to prolonged translaryngeal intubation in critically ill medical patients

Outcomes

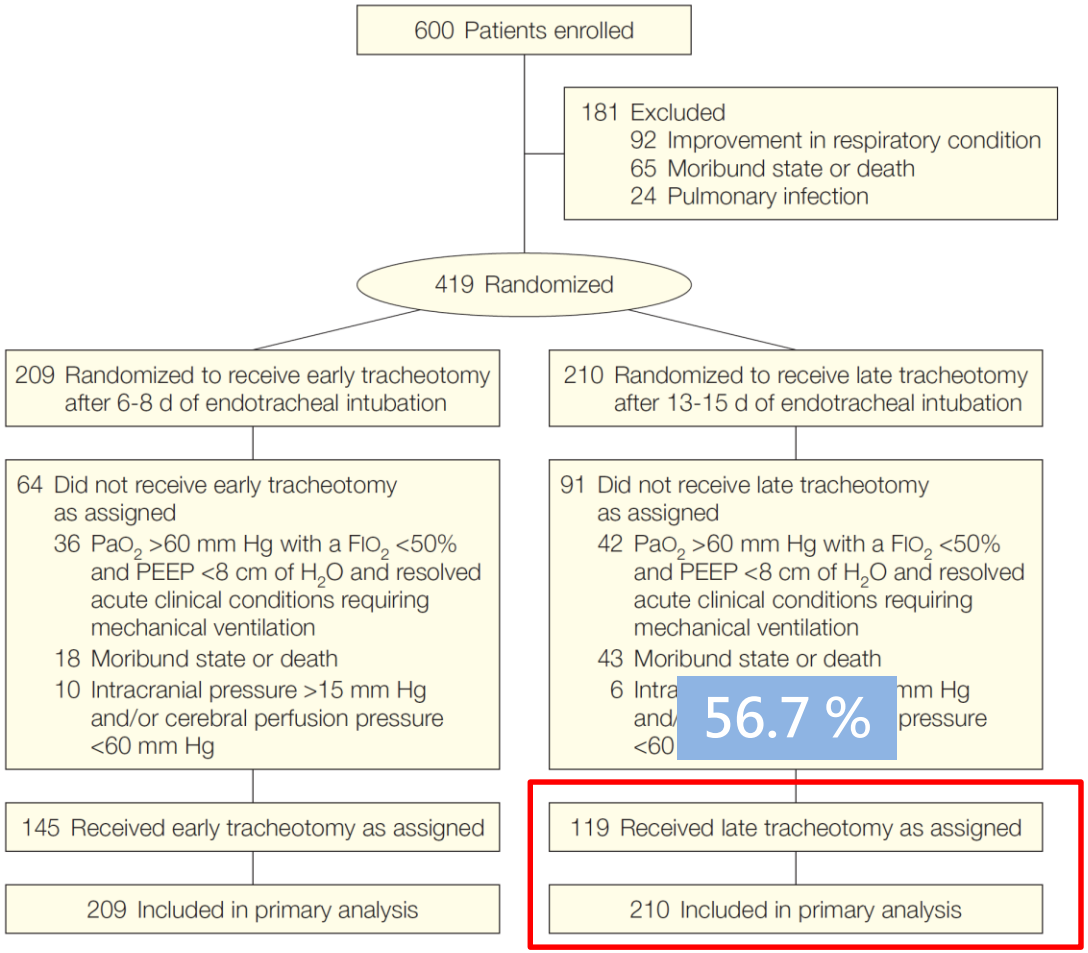


Crit Care Med. 2004 Aug;32(8):1689-94.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

VAP

RCT, N=619 randomized, 12 Italian ICUs, June 2004 to June 2008



6-8 days vs. 13-15 days

Exclusion

Pulmonary infection

COPD

Esophageal, tracheal, or pulmonary cancer

Hematological malignancy

JAMA. 2010;303(15):1483-1489.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

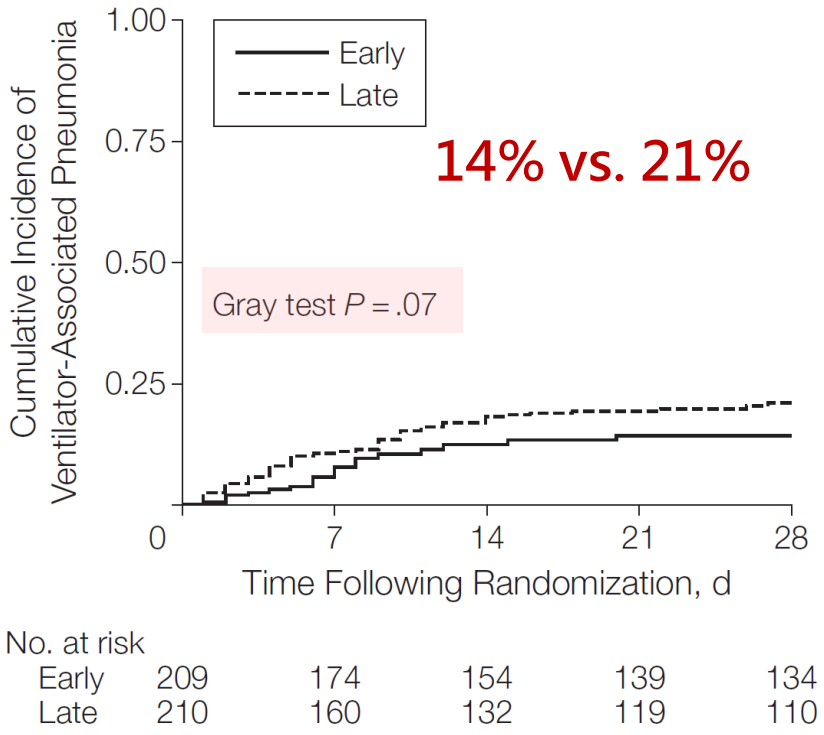
Characteristics of the Study Population

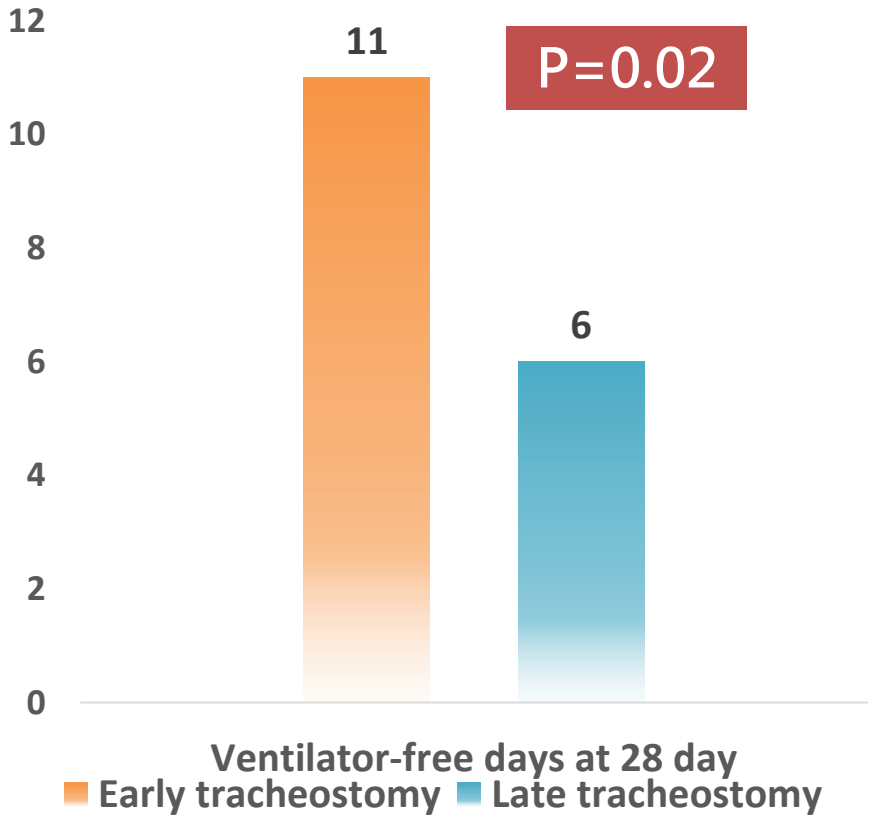
	Early Tracheotomy (n = 209)	Late Tracheotomy (n = 210)
At enrollment		
Age, mean (SD), y	61.8 (17.4)	61.3 (16.8)
Male sex, No. (%)	138 (66.0)	142 (67.6)
SAPS II score, mean (SD)[b]	51.1 (8.7)	49.7 (8.6)
SOFA score, mean (SD)[c]	7.9 (2.6)	7.6 (2.9)
PaO_2, mean (SD), mm Hg	123 (50)	123 (54)
FIO_2, mean (SD)	0.52 (0.17)	0.53 (0.19)
PEEP, mean (SD), cm H_2O	6.1 (3.6)	6.6 (3.4)
Primary organ failure, No. (%)		
Respiratory	96 (45.9)	99 (47.1)
Central nervous system	48 (22.9)	54 (25.7)
Cardiovascular	51 (24.4)	42 (20.0)
Renal	11 (5.3)	10 (4.8)
Coagulation	3 (1.4)	5 (2.4)
At randomization, mean (SD)		
SOFA score	10.1 (1.3)[d]	9.8 (1.5)[e]
PaO_2, mm Hg	76 (14)[d]	73 (13)[f]
FIO_2	0.64 (0.10)[d]	0.68 (0.11)[f]
PEEP, cm H_2O	9.4 (1.2)[f]	9.3 (1.1)[d]

JAMA. 2010;303(15):1483-1489.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

Cumulative incidence of VAP

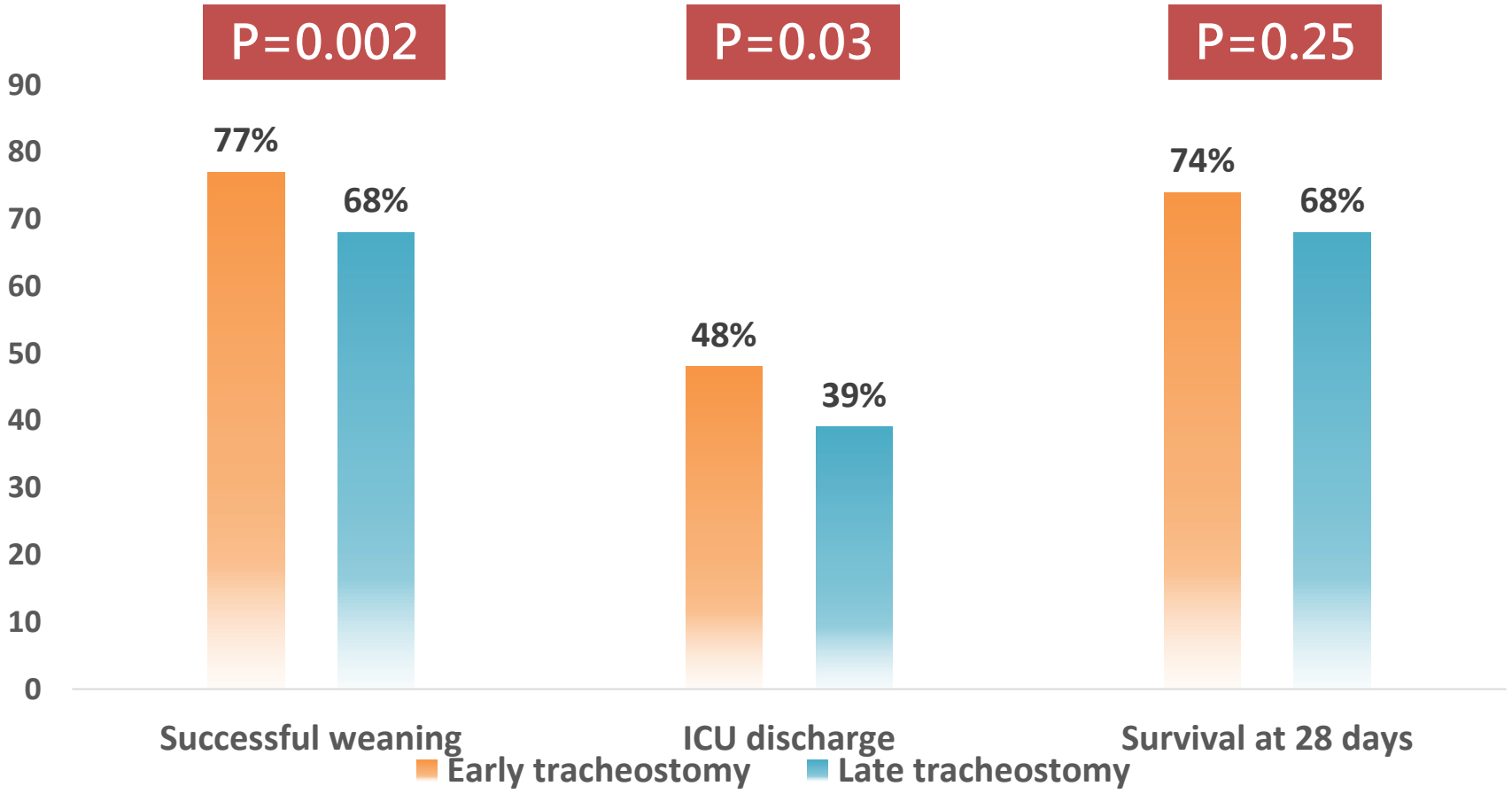




JAMA. 2010;303(15):1483-1489.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

Secondary Endpoints



JAMA. 2010;303(15):1483-1489.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

Adverse Events Associated With Tracheotomy

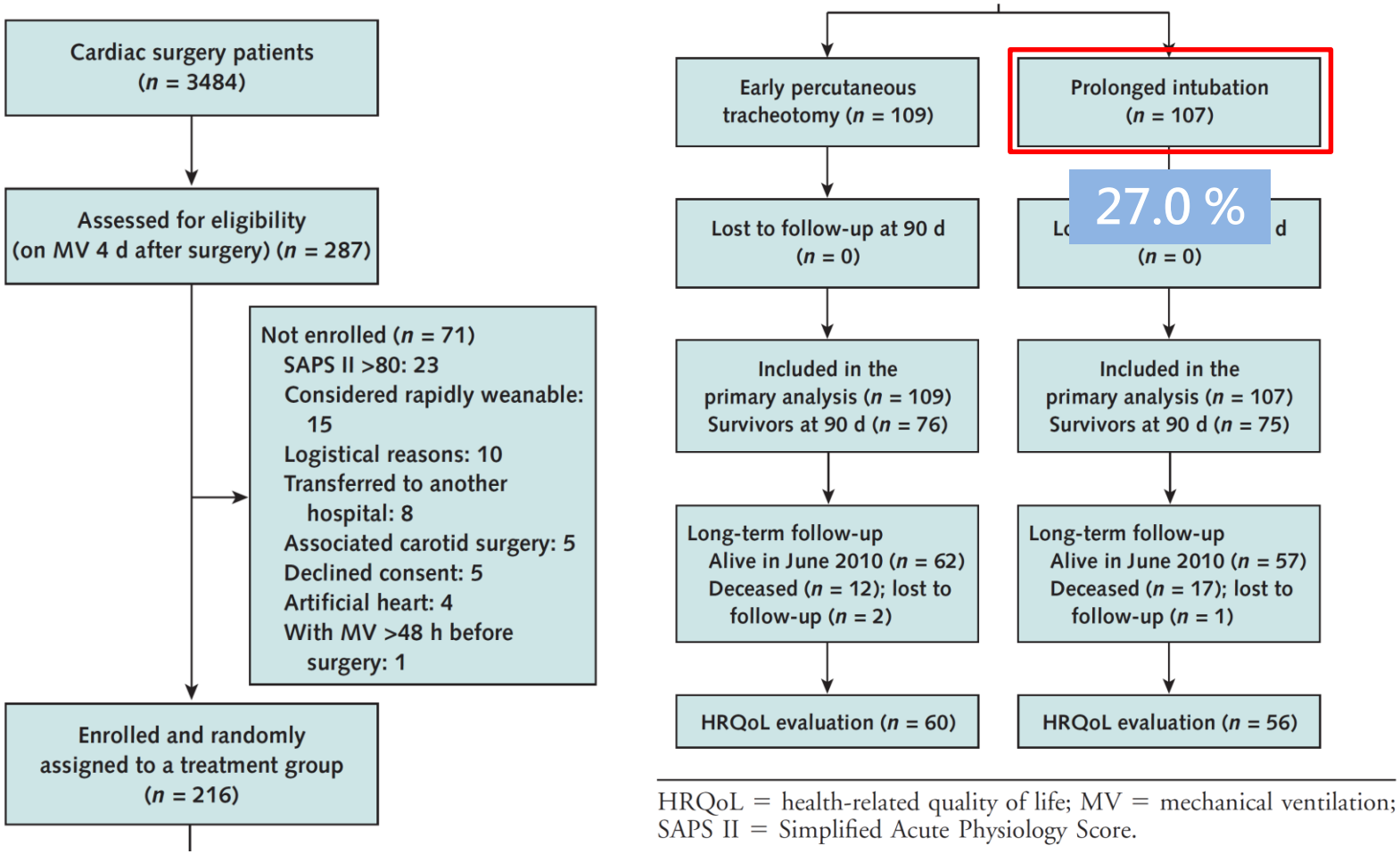
	No. (%) of Patients	
	Early Tracheotomy (n = 145)	Late Tracheotomy (n = 119)
Intraoperative		
Minor bleeding	2 (1)	3 (3)
Significant bleeding	0	0
Tube dislocation	2 (1)	3 (3)
Hypoxemia	7 (5)	5 (4)
Arrhythmia	0	0
Cardiac arrest	0	0
Postoperative		
Stoma inflammation	22 (15)	18 (15)
Stoma infection	9 (6)	7 (6)
Minor bleeding	8 (5)	6 (5)
Major bleeding	3 (2)	3 (3)
Pneumothorax	1 (<1)	0
Subcutaneous emphysema	1 (<1)	0
Tracheoesophageal fistula	0	1 (<1)
Cannula displacement or need for replacement	2 (1)	0
Total	**57** (39)	**46** (39)

[a] Comparisons between early and late tracheotomy were not statistically significant (χ^2 test or Fisher exact test).

JAMA. 2010;303(15):1483-1489.

Early Tracheotomy Versus Prolonged Intubation of Mechanically Ventilated Patients After Cardiac Surgery

RCT, N=216 randomized, 1 center, June 2006 to March 2009



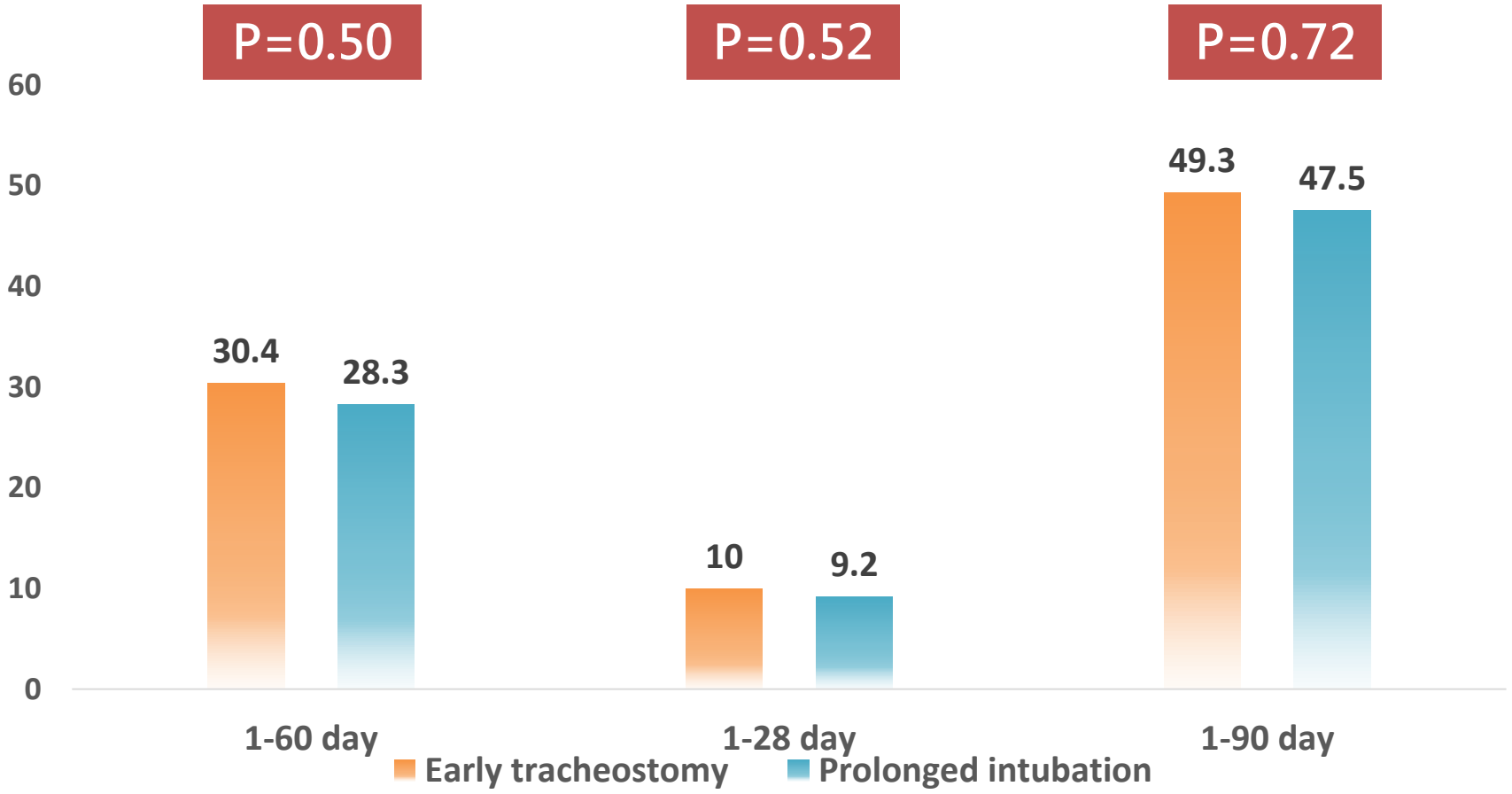
HRQoL = health-related quality of life; MV = mechanical ventilation; SAPS II = Simplified Acute Physiology Score.

≦ 5days vs. >15 days

Ann Intern Med. 2011;154:373-383.

Early Tracheotomy Versus Prolonged Intubation of Mechanically Ventilated Patients After Cardiac Surgery

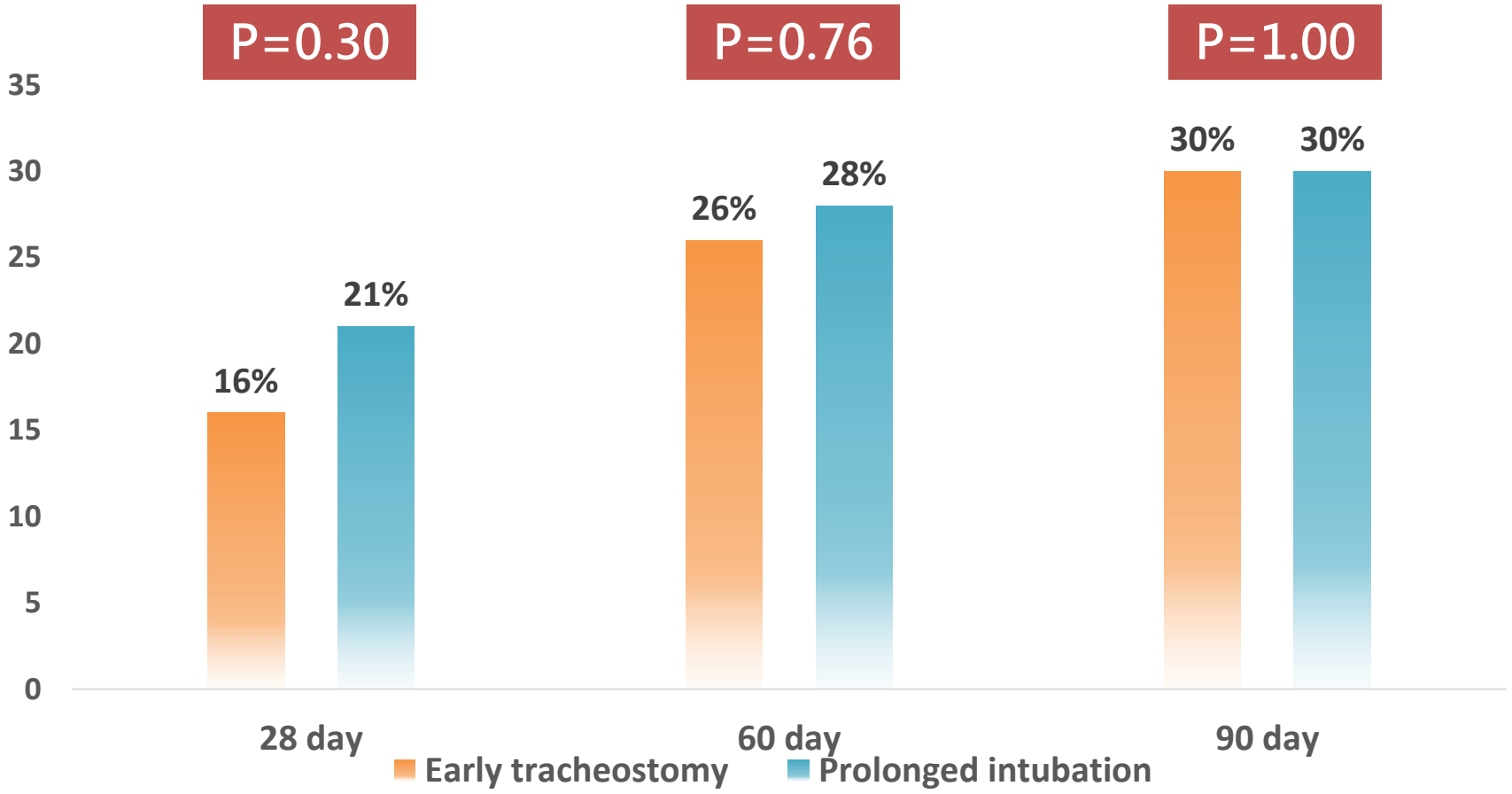
Ventilator-free days



Ann Intern Med. 2011;154:373-383.

Early Tracheotomy Versus Prolonged Intubation of Mechanically Ventilated Patients After Cardiac Surgery

Mortality



Ann Intern Med. 2011;154:373-383.

Early Tracheotomy Versus Prolonged Intubation of Mechanically Ventilated Patients After Cardiac Surgery

Short-Term Outcomes

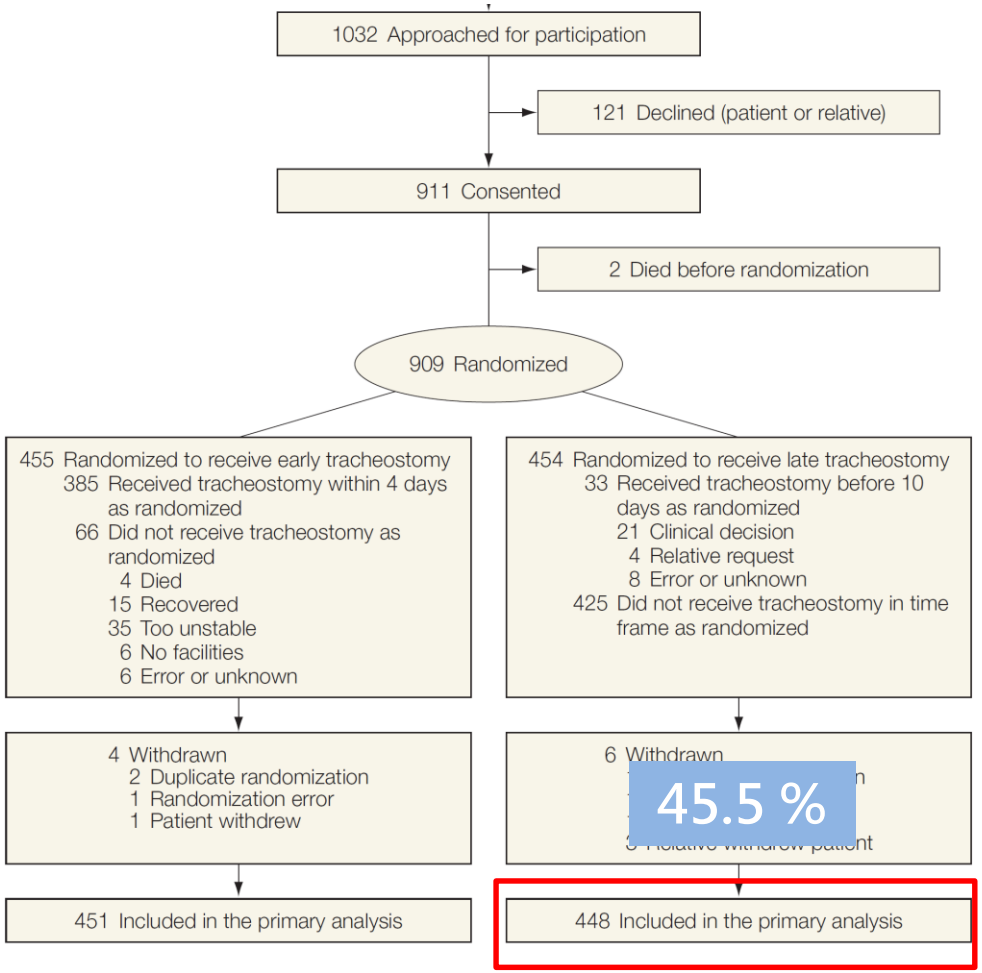
Variable	Early Percutaneous Tracheotomy (n = 109)	Prolonged Intubation (n = 107)	Mean Difference or Absolute Risk Difference (95% CI)	P Value
Sedation				
Mean duration of intravenous sedation (SD), *d*‡	6.4 (5.9)	9.6 (7.3)	−3.2 (−5.0 to −1.3)	0.007
Mean sedation-free days during 1–28 d (SD)	19.0 (9.1)	15.5 (9.3)	4.5 (1.2 to 6.9)	0.005
Mean cumulative sufentanil dose during 1–15 d (SD), *μg/kg*	4.0 (6.5)	10.2 (18.2)	−6.2 (−9.9 to −2.5)	0.001
Mean cumulative propofol dose during 1–15 d (SD), *mg/kg*	32.9 (60.2)	67.8 (116.7)	−34.9 (−60.1 to −9.8)	0.004
Mean cumulative midazolam dose during 1–15 d (SD), *mg/kg*	2.7 (4.7)	6.4 (14.3)	−3.7 (−6.6 to −0.8)	0.01
Mean days (during 1−15 d) of haloperidol therapy (SD)	1.9 (3.0)	3.2 (4.2)	−1.3 (−2.3 to −0.3)	0.01
Mean cumulative haloperidol dose during 1–15 d (SD), *mg/kg*	0.26 (0.51)	0.57 (0.92)	−0.3 (−0.5 to −0.1)	0.002
VAP after randomization, *n (%)*	50 (46)	47 (44)	2.0 (−11.3 to 15.2)	0.77
Sternal wound infection, *n (%)*	14 (13)	14 (13)	−0.2 (−9.2 to 8.7)	0.96
Bloodstream infection, *n (%)*	18 (17)	16 (15)	1.5 (−8.1 to 11.3)	0.85
Mean days (during 1−15 d) nurse-assessed as comfortable (SD)	11.8 (3.8)	10.4 (4.4)	1.4 (0.3 to 2.5)	0.01
Mean days (during 1−15 d) with nurse-assessed easy management (SD)	12.0 (3.8)	10.8 (4.4)	1.2 (0.05 to 2.3)	0.04
Received oral nutrition at 15 d, *n (%)*	91 (83)	57 (53)	30.2 (18.5 to 42.2)	<0.001
Bed-to-chair transfer at 15 d, *n (%)*	72 (66)	47 (44)	22.1 (9.2 to 35.1)	0.002
Muscle strength assessment (SD)§				
14 d (n = 76, 68)	156.9 (87.0)	134.9 (92.8)	22.0 (−7.7 to 51.6)	0.15
28 d (n = 36, 36)	164.0 (86.1)	176.9 (85.6)	−12.9 (−53.3 to 27.5)	0.52
42 d (n = 21, 21)	170.1 (86.4)	195.4 (67.5)	−25.3 (−73.6 to 23.1)	0.30
56 d (n = 8, 11)	149.7 (70.4)	185.4 (76.0)	−35.7 (−108.0 to 36.6)	0.31

Ann Intern Med. 2011;154:373-383.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

The TracMan Randomized Trial

RCT, N=909 randomized, 72 UK ICUs, November 2004 to Jaunary 2011



≦ 4days vs. ≧ 10 days

Exclusion

Life-saving tracheostomy

Tracheostomy was contraindicated for anatomical or other reasons

Respiratory failure due to chronic neurological disease

JAMA. 2013;309(20):2121-2129.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

Baseline Characteristics of Patients

Treatment Group	No. (%) of Patients		
	Early (n = 451)	Late (n = 448)	Total (n = 899)
Men	263 (58.3)	264 (58.9)	527 (58.6)
Age, mean (SD), y[a]	63.6 (13.7)	64.2 (13.3)	63.9 (13.5)
Major clinical syndrome[a]			
Intracranial pathology	18 (4.0)	17 (3.8)	35 (3.9)
Altered consciousness level due to drug or metabolic causes	17 (3.8)	19 (4.2)	36 (4.0)
Peripheral nervous system or muscular disorder or weakness	7 (1.6)	6 (1.3)	13 (1.4)
Pulmonary pathology[d]	311 (69.0)	312 (69.6)	623 (69.3)
Burns	0 (0.0)	1 (0.2)	1 (0.1)
Decompensated (congestive) heart failure	8 (1.8)	6 (1.3)	14 (1.6)
Other	90 (20.0)	87 (19.4)	177 (19.7)
APACHE II score, mean (SD)[b]	19.6 (6.5)	20.1 (6.0)	19.8 (6.3)
Admission type			
Medical	359 (79.6)	353 (78.8)	712 (79.2)
Surgical	92 (20.4)	95 (21.2)	187 (20.8)
Emergency	36 (39.1)	40 (42.1)	76 (40.6)
Urgent	32 (34.8)	32 (33.7)	64 (34.2)
Scheduled	8 (8.7)	8 (8.4)	16 (8.6)
Elective	16 (17.4)	15 (15.8)	31 (16.6)

JAMA. 2013;309(20):2121-2129.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

Details of the Tracheostomies Performed

Treatment Group	No. (%) of Patients		
	Early (n = 418)[a]	Late (n = 204)[a]	Total (n = 622)[a]
Grade of clinician performing tracheostomy[b]			
Attending/specialist physician	222 (53.1)	116 (56.9)	338 (54.3)
Resident	133 (31.8)	47 (23.0)	180 (28.9)
House officer/junior resident	46 (11.0)	27 (13.2)	73 (11.7)
Staff grade/associate specialist/fellow	16 (3.8)	11 (5.4)	27 (4.3)
Grade of most senior clinician actively involved in, or directly supervising the tracheostomy procedure[b]			
Attending/specialist physician	387 (92.6)	179 (89.1)	566 (91.4)
Resident	27 (6.5)	19 (9.5)	46 (7.4)
House officer/junior resident	2 (0.5)	1 (0.5)	3 (0.5)
Staff grade/associate specialist/fellow	2 (0.5)	2 (1.0)	4 (0.6)
Type of procedure[b]			
Surgical			
Operating theater	37 (8.9)	25 (12.3)	62 (10.0)
Bedside	3 (0.7)	2 (1.0)	5 (0.8)
Percutaneous			
Operating theater	1 (0.2)	2 (1.0)	3 (0.5)
Bedside	377 (90.2)	174 (85.7)	551 (88.7)
Percutaneous technique			
Single-tapered dilator	295 (78.2)	131 (75.3)	426 (77.3)
Multiple dilator technique	37 (9.8)	21 (12.1)	58 (10.5)
Dialating forceps technique	8 (2.1)	4 (2.3)	12 (2.2)
Threaded dilator	1 (0.3)	3 (1.7)	4 (0.7)
Other[c]	36 (9.5)	15 (8.6)	51 (9.3)
Duration of procedure, median (IQR), min[b]			
All procedures	30 (20-45)	30 (20-45)	30 (20-45)
Surgical	49 (30-74)	45 (37-73)	45 (31-73)
Percutaneous	30 (20-40)	30 (20-40)	30 (20-40)

JAMA. 2013;309(20):2121-2129.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

Primary Outcome and Secondary Mortality Outcome

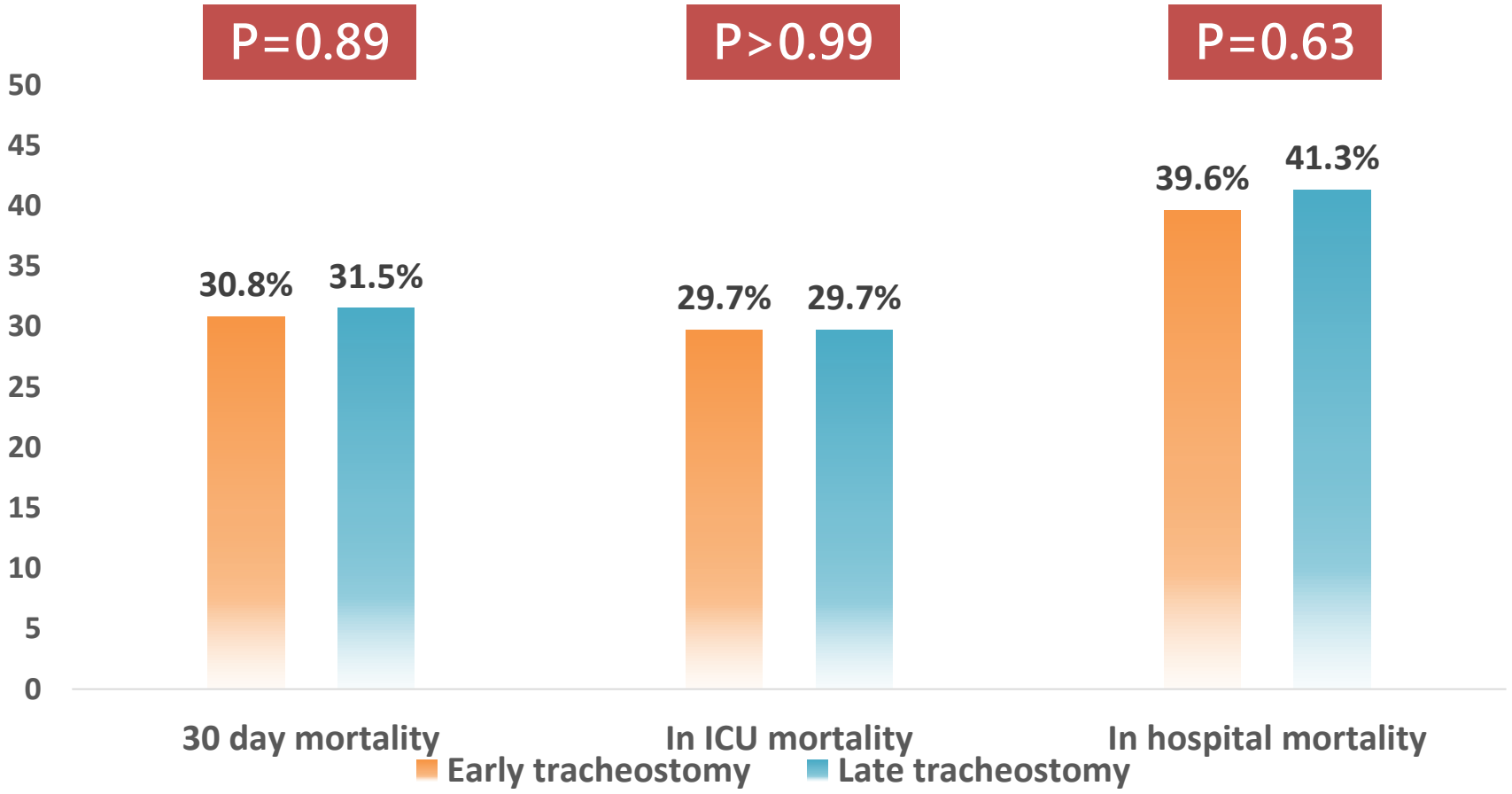
	No. (%) of Patients [95% CI]			Absolute Risk Reduction for Early vs Late (95% CI), %	Relative Risk for Early vs Late (95% CI)	*P* Value for Fisher Exact Test
	Early (n = 451)	Late (n = 448)	Total (n = 899)			
Status at 30 d (primary outcome)						
Died	139 (30.8) [26.7 to 35.2]	141 (31.5) [27.3 to 35.9]	280 (31.2) [28.2 to 34.3]	0.7 (−5.4 to 6.7)	0.98 (0.81 to 1.19)	.89
Status at ICU discharge[a]						
No. of patients	448	445	893			
Died	133 (29.7) [25.6 to 34.1]	132 (29.7) [25.6 to 34.1]	265 (29.7) [26.8 to 32.8]	0.0 (−6.0 to 6.0)	1.00 (0.82 to 1.22)	>.99
Status at hospital discharge[b]						
No. of patients	424	436	860			
Died	168 (39.6) [35.1 to 44.4]	180 (41.3) [36.8 to 46.0]	348 (40.5) [37.2 to 43.8]	1.7 (−4.9 to 8.2)	0.96 (0.82 to 1.13)	.63
Status at 1 y[c]						
No. of patients	451	443	894			
Died	207 (45.9) [41.4 to 50.5]	217 (49.0) [44.4 to 53.6]	424 (47.4) [44.2 to 50.7]	3.1 (−3.5 to 9.6)	0.94 (0.82 to 1.08)	.38
Status at 2 y[d]						
No. of patients	451	443	894			
Died	230 (51.0) [46.4 to 55.6]	238 (53.7) [49.1 to 58.3]	468 (52.3) [49.1 to 55.6]	0.7 (−3.8 to 9.3)	0.95 (0.84 to 1.08)	.42

Abbreviation: ICU, intensive care unit.
[a] Status at critical care unit discharge not available for 6 patients (3 early, 3 late).
[b] Status at hospital discharge not available for 39 patients (27 early, 12 late).
[c] Status at 1 y not available for 5 patients (5 late).
[d] Status at 2 y not available for 5 patients (5 late).

JAMA. 2013;309(20):2121-2129.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

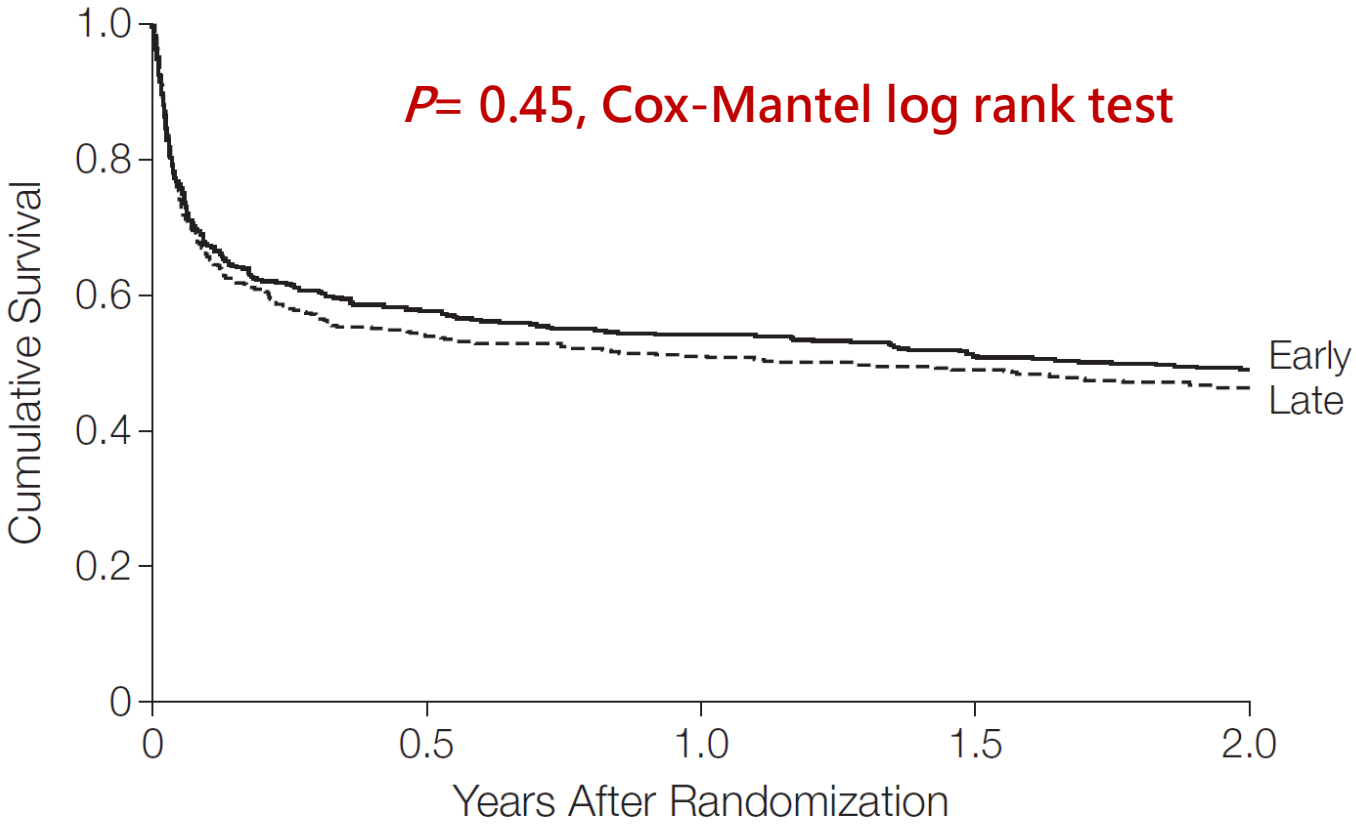
Mortality Outcome



JAMA. 2013;309(20):2121-2129.

Early vs Late Tracheotomy in Mechanically Ventilated Adult ICU Patients

2 Years After Randomization



No. at risk					
Early	451	261	244	230	221
Late	448	242	226	217	205

JAMA. 2013;309(20):2121-2129.

Early versus late tracheostomy for critically ill patients

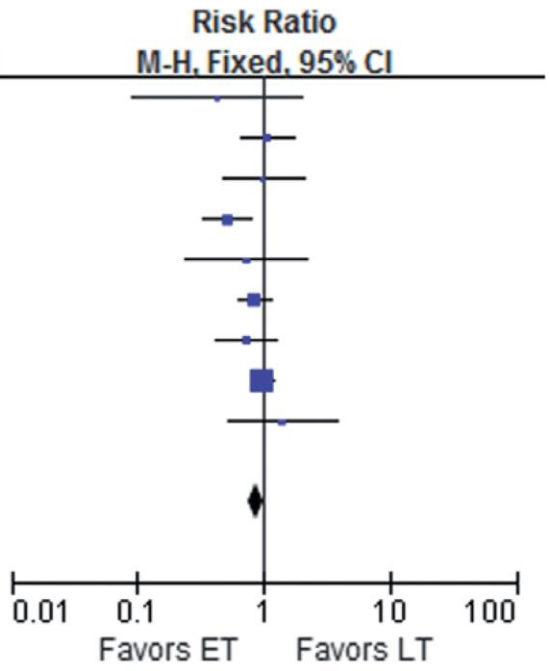
Mortality

Systemic review and meta-analysis, 9 RCTs, 2,040 patients

Study or Subgroup	ET Events	ET Total	LT Events	LT Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Barquist 2006	2	29	5	31	1.6%	0.43 (0.09, 2.03)
Blot 2008	21	61	20	62	6.4%	1.07 (0.65, 1.76)
Mohamed 2014	8	20	8	20	2.6%	1.00 (0.47, 2.14)
Rumbak 2004	19	60	37	60	11.9%	0.51 (0.34, 0.78)
Saffle 2002	4	21	6	23	1.8%	0.73 (0.24, 2.23)
Terragni 2010	55	209	66	210	21.1%	0.84 (0.62, 1.13)
Trouillet 2011	17	109	23	107	7.4%	0.73 (0.41, 1.28)
Young 2013	139	451	141	448	45.4%	0.98 (0.81, 1.19)
Zheng 2012	8	58	6	61	1.9%	1.40 (0.52, 3.80)
Total (95% CI)		**1018**		**1022**	**100.0%**	**0.88 (0.76, 1.00)**
Total events	273		312			

Heterogeneity: $Chi^2 = 10.42$, $df = 8$ ($P = 0.24$); $I^2 = 23\%$

Test for overall effect: $Z = 1.91$ ($P = 0.06$)



Clin Respir J. 2016 Nov;10(6):684-692.

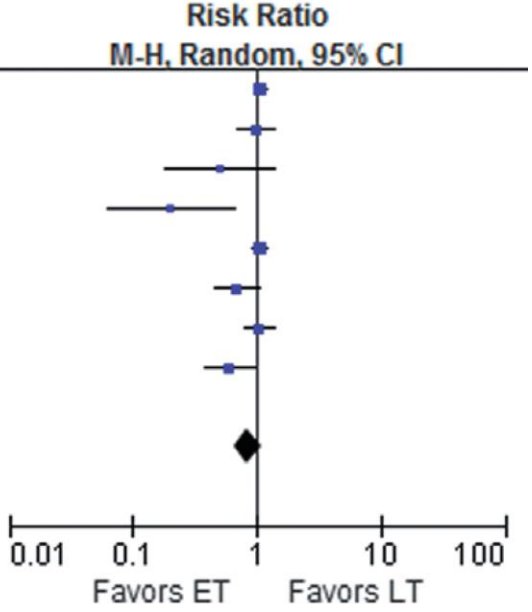
Early versus late tracheostomy for critically ill patients
Ventilator-associated pneumonia

Systemic review and meta-analysis, 9 RCTs, 2,040 patients

Study or Subgroup	ET Events	ET Total	LT Events	LT Total	Weight	Risk Ratio M-H, Random, 95% CI
Barquist 2006	28	29	28	31	18.9%	1.07 (0.93, 1.22)
Blot 2008	30	61	31	62	14.2%	0.98 (0.69, 1.40)
Mohamed 2014	4	20	8	20	4.5%	0.50 (0.18, 1.40)
Rumbak 2004	3	60	15	60	3.6%	0.20 (0.06, 0.66)
Saffle 2002	21	21	22	23	19.1%	1.04 (0.92, 1.18)
Terragni 2010	30	209	44	210	12.7%	0.69 (0.45, 1.05)
Trouillet 2011	50	109	47	107	15.6%	1.04 (0.78, 1.40)
Zheng 2012	17	58	30	61	11.6%	0.60 (0.37, 0.96)
Total (95% CI)		**567**		**574**	**100.0%**	**0.84 (0.66, 1.08)**
Total events	183		225			

Heterogeneity: $Tau^2 = 0.08$; $Chi^2 = 38.75$, $df = 7$ ($P < 0.00001$); $I^2 = 82\%$

Test for overall effect: $Z = 1.36$ ($P = 0.17$)



Clin Respir J. 2016 Nov;10(6):684-692.

Early versus late tracheostomy for critically ill patients

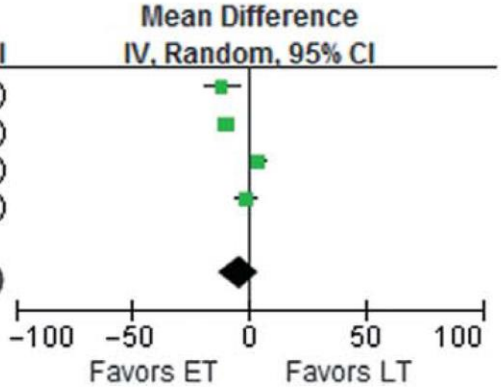
Systemic review and meta-analysis, 9 RCTs, 2,040 patients

Duration of mechanical ventilation

Study or Subgroup	ET Mean	ET SD	ET Total	LT Mean	LT SD	LT Total	Weight	Mean Difference IV, Random, 95% CI
Mohamed 2014	20.6	13.03	20	32.2	10.52	20	22.1%	−11.60 (−18.94, −4.26)
Rumbak 2004	7.6	4	60	17.4	5.3	60	26.7%	−9.80 (−11.48, −8.12)
Saffle 2002	35.5	4.5	21	31.4	5.2	23	26.1%	4.10 (1.23, 6.97)
Trouillet 2011	17.9	14.9	109	19.3	16.9	107	25.1%	−1.40 (−5.65, 2.85)
Total (95% CI)			**210**			**210**	**100.0%**	**−4.46 (−12.61, 3.69)**

Heterogeneity: Tau² = 64.13; Chi² = 74.05, df = 3 (*P* < 0.00001); I² = 96%

Test for overall effect: Z = 1.07 (*P* = 0.28)

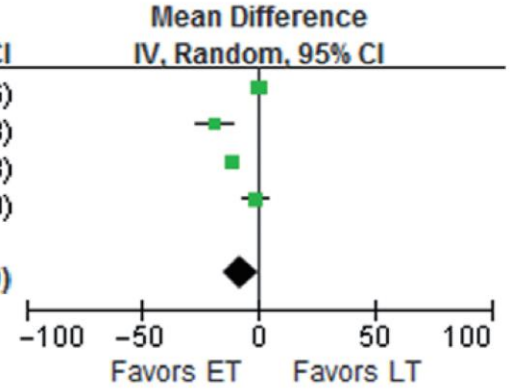


Length of ICU stay

Study or Subgroup	ET Mean	ET SD	ET Total	LT Mean	LT SD	LT Total	Weight	Mean Difference IV, Random, 95% CI
Barquist 2006	25.04	6	29	24.74	6.5	31	26.6%	0.30 (-2.86, 3.46)
Mohamed 2014	21.05	13.46	20	40.15	12.72	20	21.5%	−19.10 (−27.22, −10.98)
Rumbak 2004	4.8	1.4	60	16.2	3.8	60	27.7%	−11.40 (−12.42, −10.38)
Trouillet 2011	23.9	21.3	109	25.5	22.2	107	24.2%	−1.60 (−7.40, 4.20)
Total (95% CI)			**218**			**218**	**100.0%**	**−7.57 (−15.42, 0.29)**

Heterogeneity: Tau² = 57.63; Chi² = 60.65, df = 3 (*P* < 0.00001); I² = 95%

Test for overall effect: Z = 1.89 (*P* = 0.06)

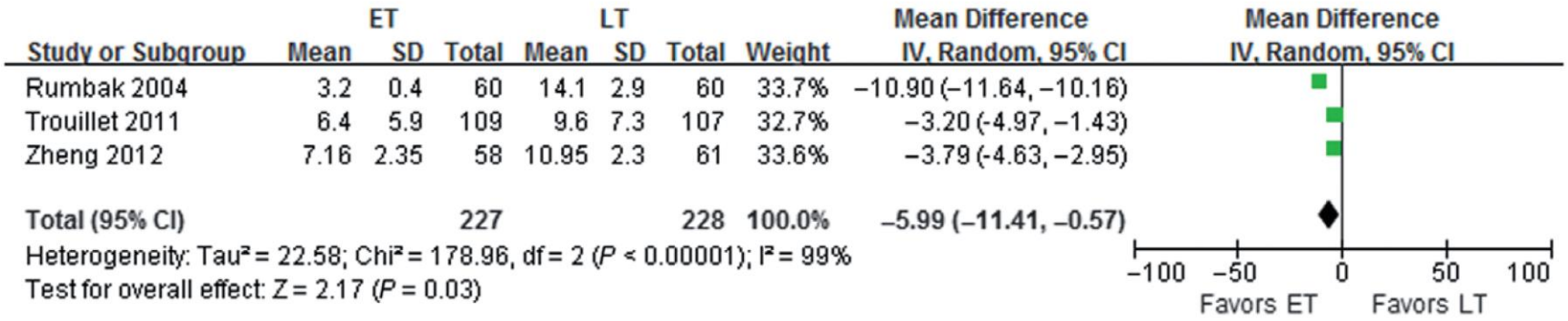


Clin Respir J. 2016 Nov;10(6):684-692.

Early versus late tracheostomy for critically ill patients

Duration of sedation

Systemic review and meta-analysis, 9 RCTs, 2,040 patients



Study or Subgroup	ET Mean	ET SD	ET Total	LT Mean	LT SD	LT Total	Weight	Mean Difference IV, Random, 95% CI
Rumbak 2004	3.2	0.4	60	14.1	2.9	60	33.7%	−10.90 (−11.64, −10.16)
Trouillet 2011	6.4	5.9	109	9.6	7.3	107	32.7%	−3.20 (-4.97, −1.43)
Zheng 2012	7.16	2.35	58	10.95	2.3	61	33.6%	−3.79 (-4.63, −2.95)
Total (95% CI)			227			228	**100.0%**	**−5.99 (−11.41, −0.57)**

Heterogeneity: Tau² = 22.58; Chi² = 178.96, df = 2 (*P* < 0.00001); I² = 99%

Test for overall effect: Z = 2.17 (*P* = 0.03)

Mean Difference IV, Random, 95% CI

−100 −50 0 50 100

Favors ET Favors LT

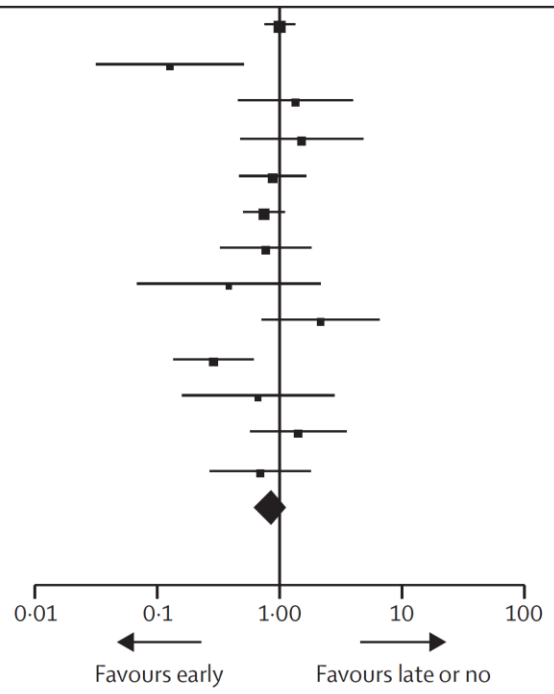
Clin Respir J. 2016 Nov;10(6):684-692.

Early versus late tracheostomy for critically ill patients

Mortality in the ICU

Systemic review and meta-analysis, 13 RCTs, 2,434 patients

	Early tracheostomy		Late or no tracheostomy		Weight	Odds ratio, random (95% CI)
	Deaths	Total	Deaths	Total		
Young et al 2013[3]	133	448	132	445	16·7%	1·00 (0·75–1·33)
Bösel et al 2013[15]	3	30	14	30	3·9%	0·13 (0·03–0·51)
Koch et al 2012[16]	9	50	7	50	5·8%	1·35 (0·46–3·96)
Zheng et al 2012[17]	8	58	6	61	5·5%	1·47 (0·48–4·52)
Trouillet et al 2011[4]	24	109	26	107	10·7%	0·88 (0·47–1·66)
Terragni et al 2010[5]	55	209	66	210	14·3%	0·78 (0·51–1·19)
Blot et al 2008[19]	12	61	15	62	7·8%	0·77 (0·33–1·81)
Barquist et al 2006[20]	2	29	5	31	2·8%	0·39 (0·07–2·16)
Bouderka et al 2004[21]	12	31	7	31	5·6%	2·17 (0·71–6·57)
Rumbak et al 2004[22]	19	60	37	60	9·1%	0·29 (0·14–0·61)
Saffle et al 2002[23]	4	21	6	23	3·8%	0·67 (0·16–2·79)
Sugerman et al 1997[24]	13	53	11	59	7·3%	1·42 (0·57–3·51)
Rodriguez et al 1990[25]	9	51	13	55	6·9%	0·69 (0·27–1·79)
Total		**1210**		**1224**	**100·0%**	**0·80 (0·59–1·09)**
Total deaths	303		345			



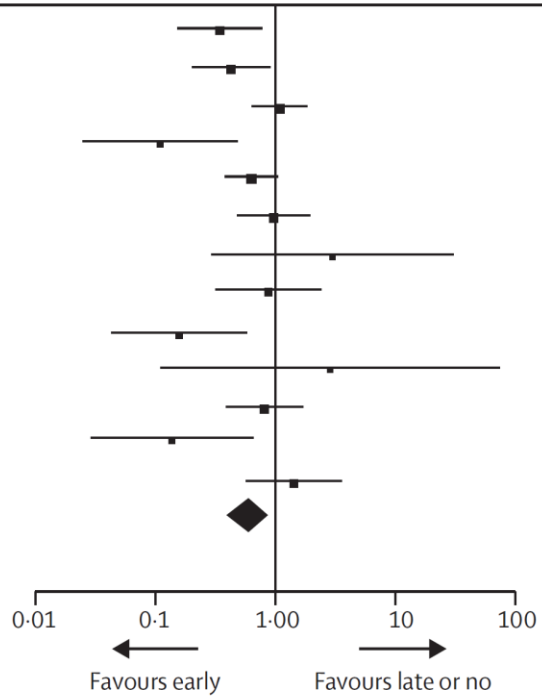
Lancet Respir Med 2015;3: 150–58.

Early versus late tracheostomy for critically ill patients

Ventilator associated pneumonia

Systemic review and meta-analysis, 13 RCTs, 2,434 patients

	Early tracheostomy		Late or no tracheostomy		Weight	Odds ratio, random (95% CI)
	Events of pneumonia	Total	Events of pneumonia	Total		
Koch et al 2012[16]	19	50	32	50	9·5%	0·35 (0·15–0·78)
Zheng et al 2012[17]	17	58	30	61	10·0%	0·43 (0·20–0·91)
Trouillet et al 2011[4]	50	109	47	107	12·2%	1·08 (0·63–1·85)
Bylappa et al 2011[18]	3	22	13	22	4·9%	0·11 (0·02–0·48)
Terragni et al 2010[5]	30	209	44	210	12·4%	0·63 (0·38–1·05)
Blot et al 2008[19]	30	61	31	62	10·5%	0·97 (0·48–1·96)
Barquist et al 2006[20]	28	29	28	31	2·5%	3·00 (0·29–30·62)
Bouderka et al 2004[21]	18	31	19	31	7·7%	0·87 (0·32–2·41)
Rumbak et al 2004[22]	3	60	15	60	5·8%	0·16 (0·04–0·58)
Saffle et al 2002[23]	21	21	22	23	1·4%	2·87 (0·11–74·28)
Sugerman et al 1997[24]	26	53	32	59	10·1%	0·81 (0·39–1·71)
Rodriguez et al 1990[25]	40	51	53	55	4·6%	0·14 (0·03–0·65)
Dunham & LaMonica 1984[26]	20	34	20	40	8·5%	1·43 (0·57–3·59)
Total		**788**		**811**	**100·0%**	**0·60 (0·41–0·90)**
Total events of pneumonia	305		386			



Lancet Respir Med 2015;3: 150–58.

LET'S PK

PDT vs.
Surgical
Tracheostomy

PDT versus surgical tracheostomy in critically ill patients

Outcomes and charges

RCT, 80 patients, 1 center in US, July 1997 and April 1999

Table 2. Outcomes comparing PDT with ST

	PDT	ST	*p* Value
Procedure time (mins)	20.1 ± 2.0	41.7 ± 4.0	<.0001
Days intubated	12.7 ± 1.2	15.6 ± 1.9	.20
ICU LOS (days)	24.5 ± 2.5	28.4 ± 3.1	.33
Hospital LOS (days)	46.7 ± 4.2	43.8 ± 3.5	.16

PDT, percutaneous dilational tracheostomy; ST, surgical tracheostomy; ICU, intensive care unit; LOS, length of stay. Values are mean ± SE.

Table 3. Patient charges comparing PDT and ST

	PDT	ST	*p* Value
Total charges	$1,569 ± 156	$3,172 ± 114	<.0001
Supply charges	$688 ± 103	$1,526 ± 87	<.0001
Professional charges	$880 ± 54	$1,647 ± 50	<.0001

PDT, percutaneous dilational tracheostomy; ST, surgical tracheostomy. Values are mean ± SE.

Crit Care Med. 2001 May;29(5):926-30.

PDT versus surgical tracheostomy in critically ill patients

Clinical demography data

RCT, 83 patients, Taipei VGH, May 1997 and April 1998

	No. of patients
Mean Age (years):	68.8 ± 14.9
Sex (male: female):	64:19
Days of pre-tracheostomy endotracheal intubation (days):	24.1 ± 15.9
Diagnosis:	
Abdominal sepsis	15
Respiratory failure, ARDS	14
Cerebral vascular accident	10
Head injury	6
Multiple trauma	5
Post-op. respiratory failure	15
Pneumonia	8
Soft tissue infection & sepsis	5
Post-cardiac arrest with hypoxia	4
Drug overdose	1
Total	83

J Chin Med Assoc 2003;66:467-473.

PDT versus surgical tracheostomy in critically ill patients

RCT, 83 patients, Taipei VGH, May 1997 and April 1998

	PDT group (n = 41)	OT group (n = 42)	*p* value
Mean age (years)	72.0 ± 14.4	65.6 ± 14.8	0.053 [c]
Sex (male: female)	31:10	33:9	
Days of pre-tracheostomy intubation (days)	21.5 ± 14.6	26.7 ± 17.0	0.139 [c]
Operation time (minutes)	22.0 ± 12.1	41.5 ± 5.9	< 0.001 [c]
Alive**	14	17	
Dead**	27*	25*	
Decannulation	15[a]	12[b]	
Op. mortality	0	0	
Complication rate	17%	19%	

* There is no difference in mortality by Chi-square with Yate's correction.

** Follow up till the end of Dec. 2000.

[a] One patient died of myocardiac infarction one month later after decannulation.

[b] Five patients are still on tracheostomy by the end of follow up in Dec. 2000.

[c] Independent t test.

J Chin Med Assoc 2003;66:467-473.

PDT versus surgical tracheostomy in critically ill patients

Operative complications

RCT, 83 patients, Taipei VGH, May 1997 and April 1998

	Complications	No. of Cases	
		PDT group	OT group
Perioperative	Premature extubation of translaryngeal tube	2	0
	Bleeding not requiring transfusion	1	1
	Instrument failure	1	0
Early	Bleeding/hemorrhage from wound	2	3
	Wound infection & granuloma	1	3
Late	Tracheal malacia	0	1
Total		7	8

* There is no difference between groups PDT and OT in complication by Chi-square with Yate's correction.

J Chin Med Assoc 2003;66:467-473.

PDT versus surgical tracheostomy in critically ill patients

Perioperative variables

RCT, 200 patients, Australia, September 1997 to August 2001

	Intention to Treat		
	Percutaneous (n = 100)	Surgical (n = 100)	*p* Value
Randomization to procedure, hrs[a]	3.8 (2.0–11.2)	6.3 (3.5–8.6)	.006
Anesthesia to procedure, mins[a]	15 (10–20)	13 (10–15)	.008
Duration of procedure, mins[a]	20 (15–30)	17 (15–20)	.58
Lowest Spo_2 during procedure, %[a]	99 (98–100)	99 (98–99)	.003
$Paco_2$ before TT insertion, torr[a]	43 (38–50)	48 (40–54)	.065
Patients with $Paco_2$ >50 before TT insertion, torr	18	32	.024
$Paco_2$ before procedure, torr[a]	50 (44–52)	52 (46–59)	.33
Size of tracheostomy tube, mm[a,b]	8.0 (8.0–9.0)	9.0 (8.0–9.0)	<.0001

Randomization to procedure, time from randomisation to procedure; anesthesia to procedure, time from start of anesthesia to start of procedure; Spo_2, pulse oximetry; TT, tracheostomy tube.

[a]Values expressed as median with interquartile range; [b]internal diameter.

Crit Care Med. 2006 Aug;34(8):2145-52.

PDT versus surgical tracheostomy in critically ill patients

Peri- and postoperative complications

RCT, 200 patients, Australia, September 1997 to August 2001

	Intention to Treat			
	Percutaneous (n = 100)	Surgical (n = 100)	Total (n = 200)	*p* Value
Operative				
Bleeding: operative				
Minimal	96	99	195	
Moderate	1	1	2	)
Severe	3	0	3	) .20
Pneumothorax	1	0	1	)
Accidental decannulation	0	1	1	)
Postoperative				
Bleeding: first 3 days				
Zero	67	64	131	)
Minimal	23	30	53	)
Moderate	4	1	5	) .12
Severe	3	4	7	)
Infection: day 3				
Zero	92	91	183	)
Minimal	3	4	7	) .15
Moderate	1	1	2	)
Severe	0	0	0	)
Infection: day 7				
Zero	90	80	170	)
Minimal	3	9	12	) .044
Moderate	1	5	6	)
Severe	0	0	0	)
Aggregate of significant complications[a]	14	13	27	NS

NS, not significant.
[a]Defined in data analysis.

Crit Care Med. 2006 Aug;34(8):2145-52.

PDT versus surgical tracheostomy in critically ill patients

Outcomes at hospital discharge

RCT, 200 patients, Australia, September 1997 to August 2001

	Intention to Treat		
	Percutaneous (n = 100)	Surgical (n = 100)	*p* Value
Tracheostomy outcome			
Tube removed	78	74	)
Discharged with tracheostomy	7	8	) .80
Died with tracheostomy	15	18	)
Decannulated patients			
Tracheostomy period, days[a]	19 (11–28)	21 (11–27)	.71
Dressing period, days[a]	6 (3–9)	7 (4–11)	.47
Infection when removed			
Zero	57	49	)
Minimal	4	12	) .079
Moderate	3	5	)
Severe	0	0	)
Death in ICU	9	6	.59
Death in hospital	26	23	.74

Tube removed, tracheostomy tube removed in hospital; tracheostomy period, duration tracheostomy tube *in situ*; dressing period: time that dressing was required after tracheostomy removal; ICU, intensive care unit.

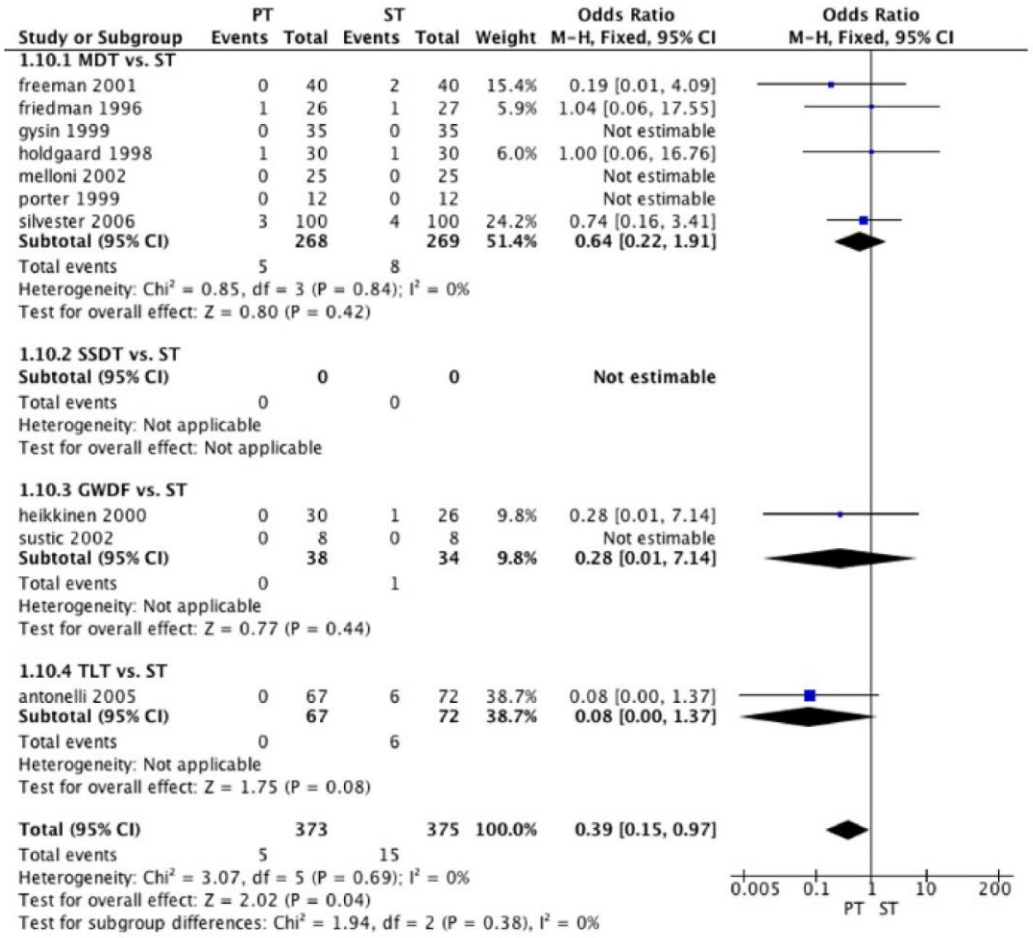
[a]Values expressed as median with interquartile range.

Crit Care Med. 2006 Aug;34(8):2145-52.

Percutaneous tracheostomy versus surgical tracheostomy in critically ill patients

Major postprocedure bleeding

Meta-analysis, 14 RCTs, 973 patients



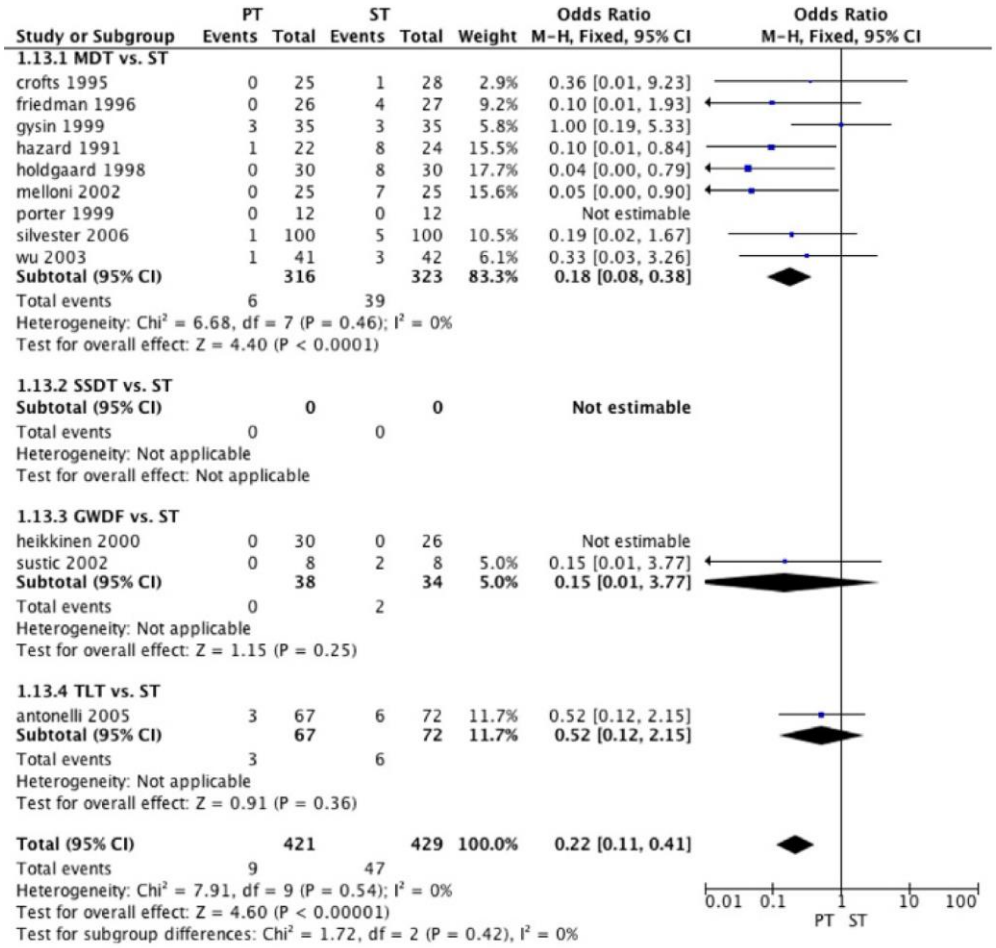
Study or Subgroup	PT Events	PT Total	ST Events	ST Total	Weight	Odds Ratio M-H, Fixed, 95% CI
1.10.1 MDT vs. ST						
freeman 2001	0	40	2	40	15.4%	0.19 [0.01, 4.09]
friedman 1996	1	26	1	27	5.9%	1.04 [0.06, 17.55]
gysin 1999	0	35	0	35		Not estimable
holdgaard 1998	1	30	1	30	6.0%	1.00 [0.06, 16.76]
melloni 2002	0	25	0	25		Not estimable
porter 1999	0	12	0	12		Not estimable
silvester 2006	3	100	4	100	24.2%	0.74 [0.16, 3.41]
Subtotal (95% CI)		**268**		**269**	**51.4%**	**0.64 [0.22, 1.91]**
Total events	5		8			
Heterogeneity: $Chi^2 = 0.85$, df = 3 (P = 0.84); $I^2 = 0\%$						
Test for overall effect: Z = 0.80 (P = 0.42)						
1.10.2 SSDT vs. ST						
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
1.10.3 GWDF vs. ST						
heikkinen 2000	0	30	1	26	9.8%	0.28 [0.01, 7.14]
sustic 2002	0	8	0	8		Not estimable
Subtotal (95% CI)		**38**		**34**	**9.8%**	**0.28 [0.01, 7.14]**
Total events	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.77 (P = 0.44)						
1.10.4 TLT vs. ST						
antonelli 2005	0	67	6	72	38.7%	0.08 [0.00, 1.37]
Subtotal (95% CI)		**67**		**72**	**38.7%**	**0.08 [0.00, 1.37]**
Total events	0		6			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.75 (P = 0.08)						
Total (95% CI)		**373**		**375**	**100.0%**	**0.39 [0.15, 0.97]**
Total events	5		15			
Heterogeneity: $Chi^2 = 3.07$, df = 5 (P = 0.69); $I^2 = 0\%$						
Test for overall effect: Z = 2.02 (P = 0.04)						
Test for subgroup differences: $Chi^2 = 1.94$, df = 2 (P = 0.38), $I^2 = 0\%$						

Crit Care. 2014 Dec 19;18(6):544.

Percutaneous tracheostomy versus surgical tracheostomy in critically ill patients

Stomal infection

Meta-analysis, 14 RCTs, 973 patients

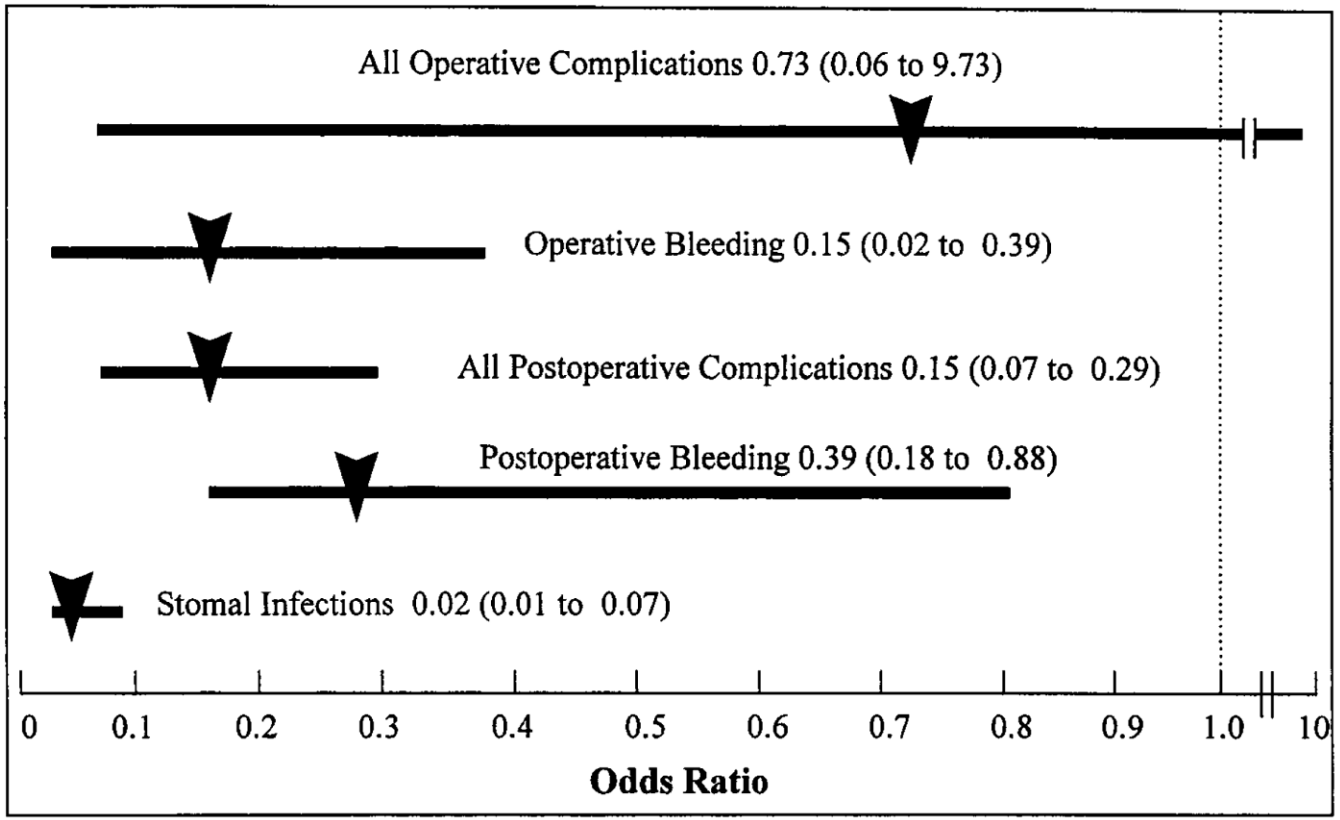


Crit Care. 2014 Dec 19;18(6):544.

Percutaneous dilatational tracheostomy versus surgical tracheostomy in critically ill patients

Operative and postoperative complications

Meta-analysis, 5 RCTs, 236 patients



Operative time PDT vs. surgical

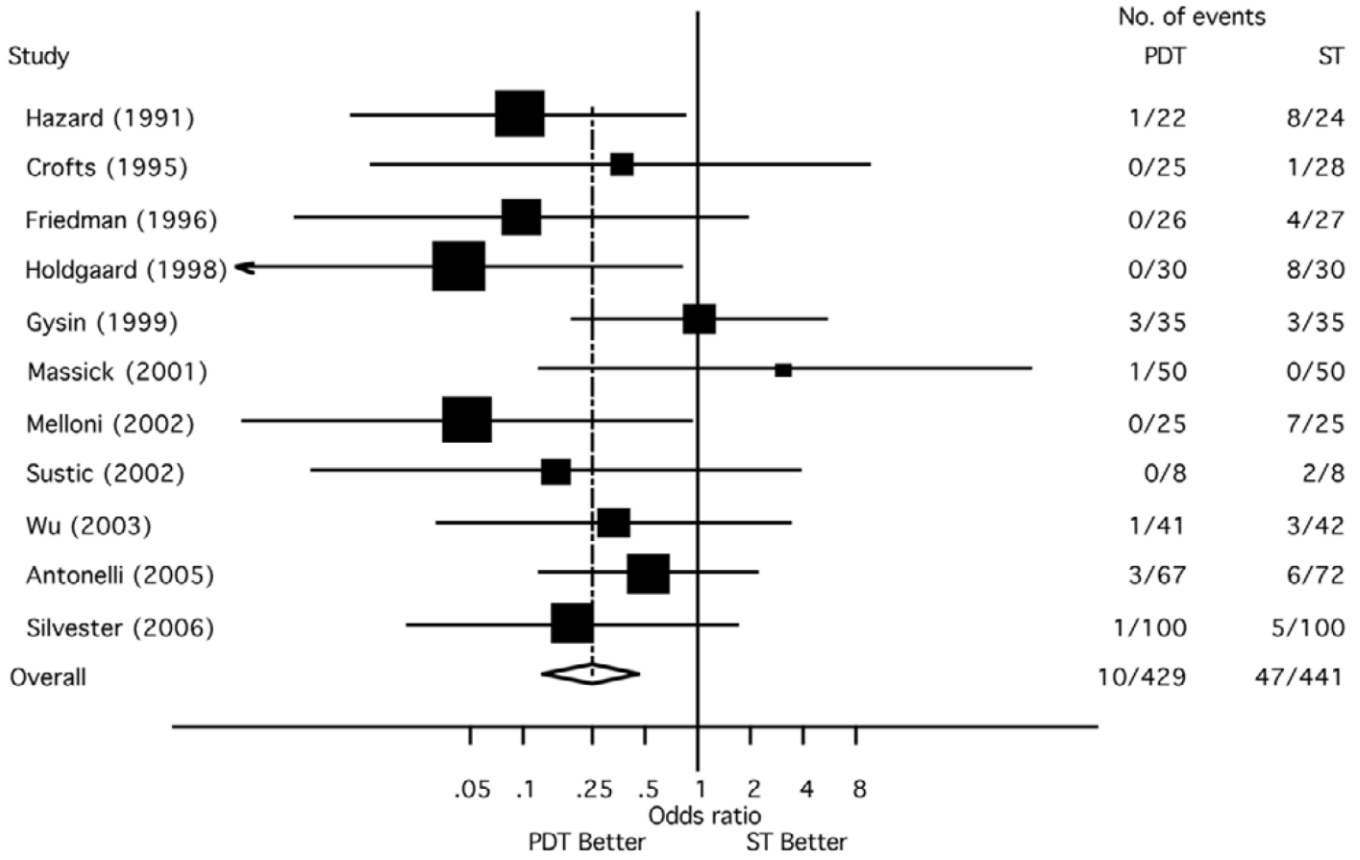
Absolute difference with 95% CI, 9.84 min (7.83 to 10.85 min)

CHEST 2000; 118:1412–1418.

Percutaneous dilatational tracheostomy versus surgical tracheostomy in critically ill patients

Incidence of wound infection

Systemic review and meta-analysis, 17 RCTs, 1,212 patients



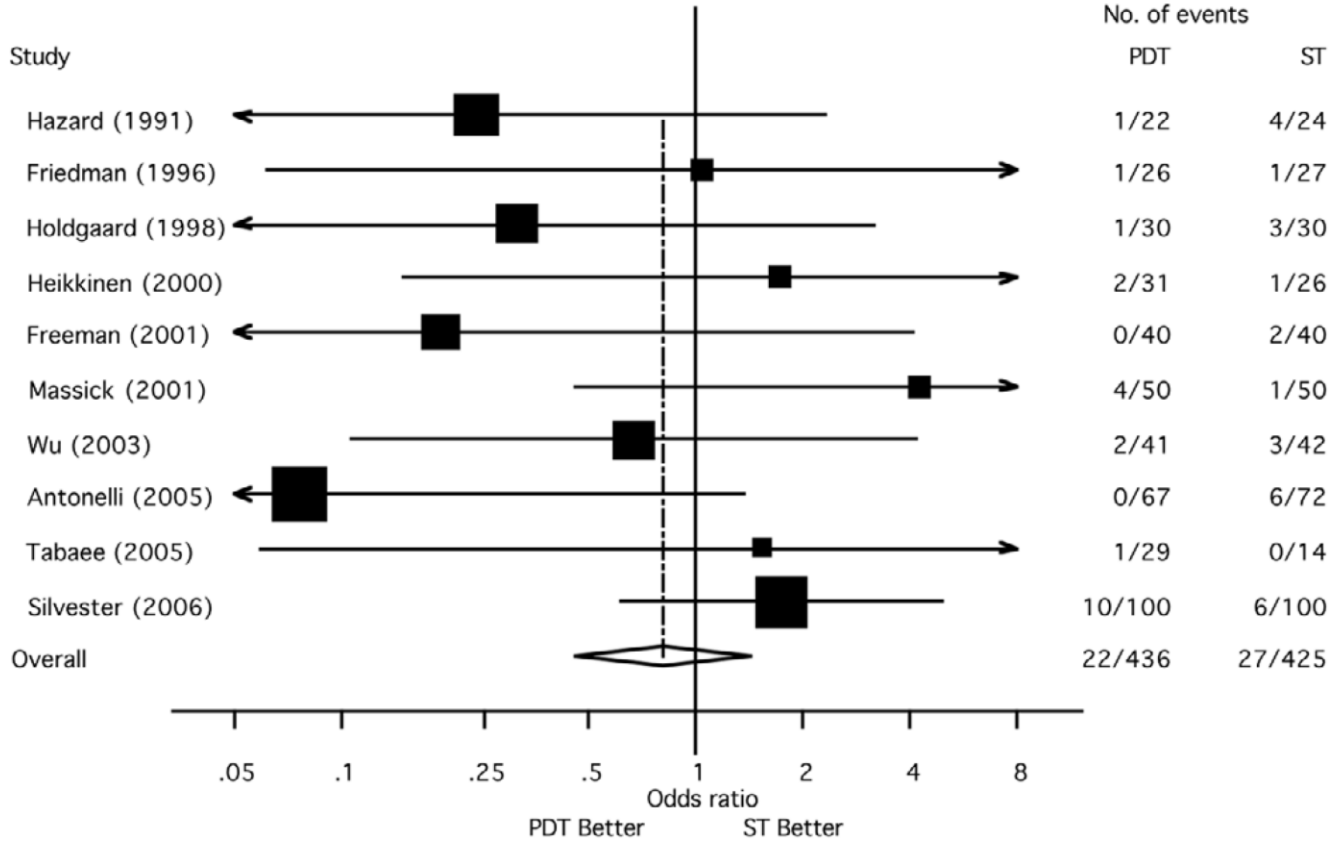
Pooled estimate of OR = 0.28 (95% CI 0.16 to 0.49, p<0.0005)

Crit Care. 2006;10(2):R55.

Percutaneous dilatational tracheostomy versus surgical tracheostomy in critically ill patients

Incidence of significant bleeding

Systemic review and meta-analysis, 17 RCTs, 1,212 patients



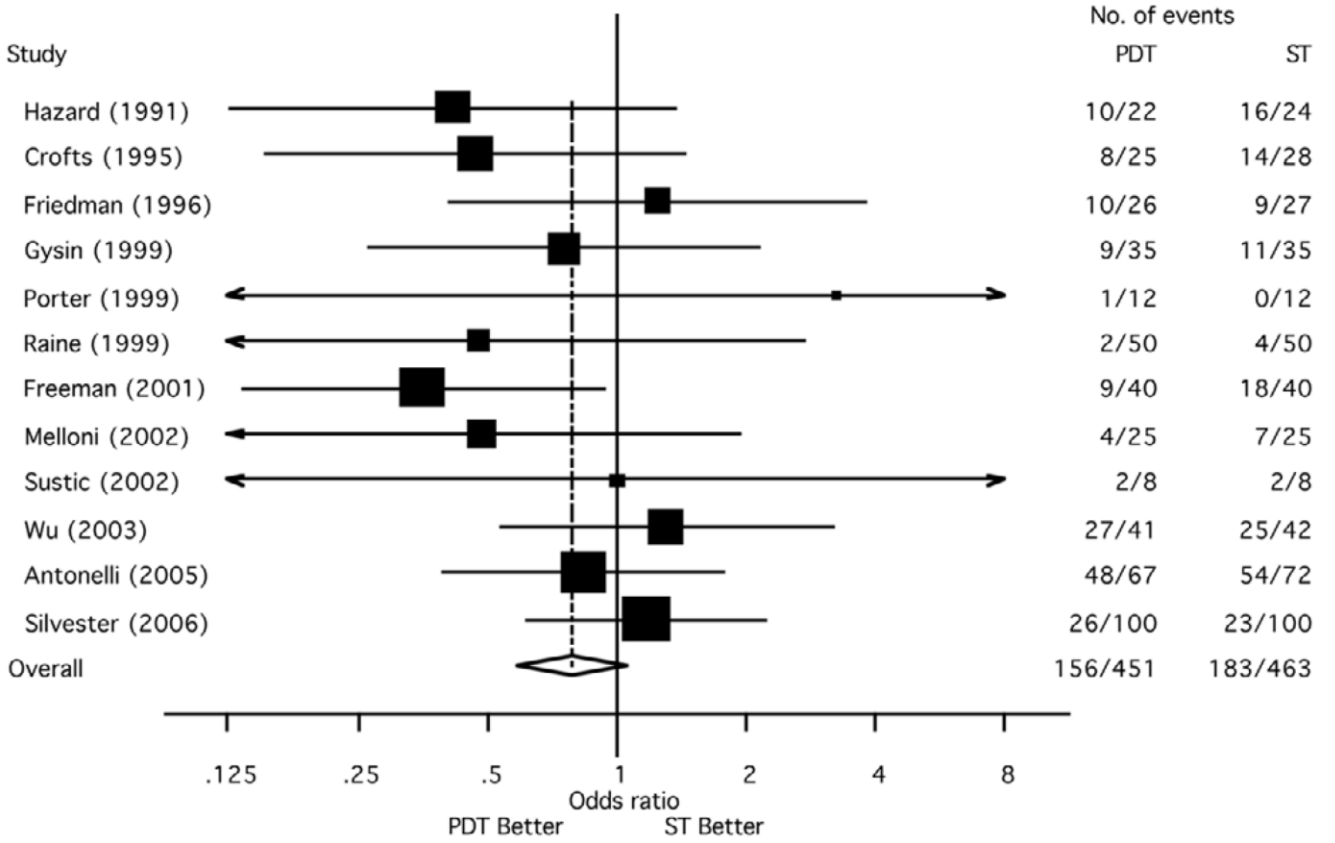
Pooled estimate of OR = 0.80 (95% CI 0.46 to 1.41) p=0.44

Crit Care. 2006;10(2):R55.

Percutaneous dilatational tracheostomy versus surgical tracheostomy in critically ill patients

Incidence of mortality

Systemic review and meta-analysis, 17 RCTs, 1,212 patients

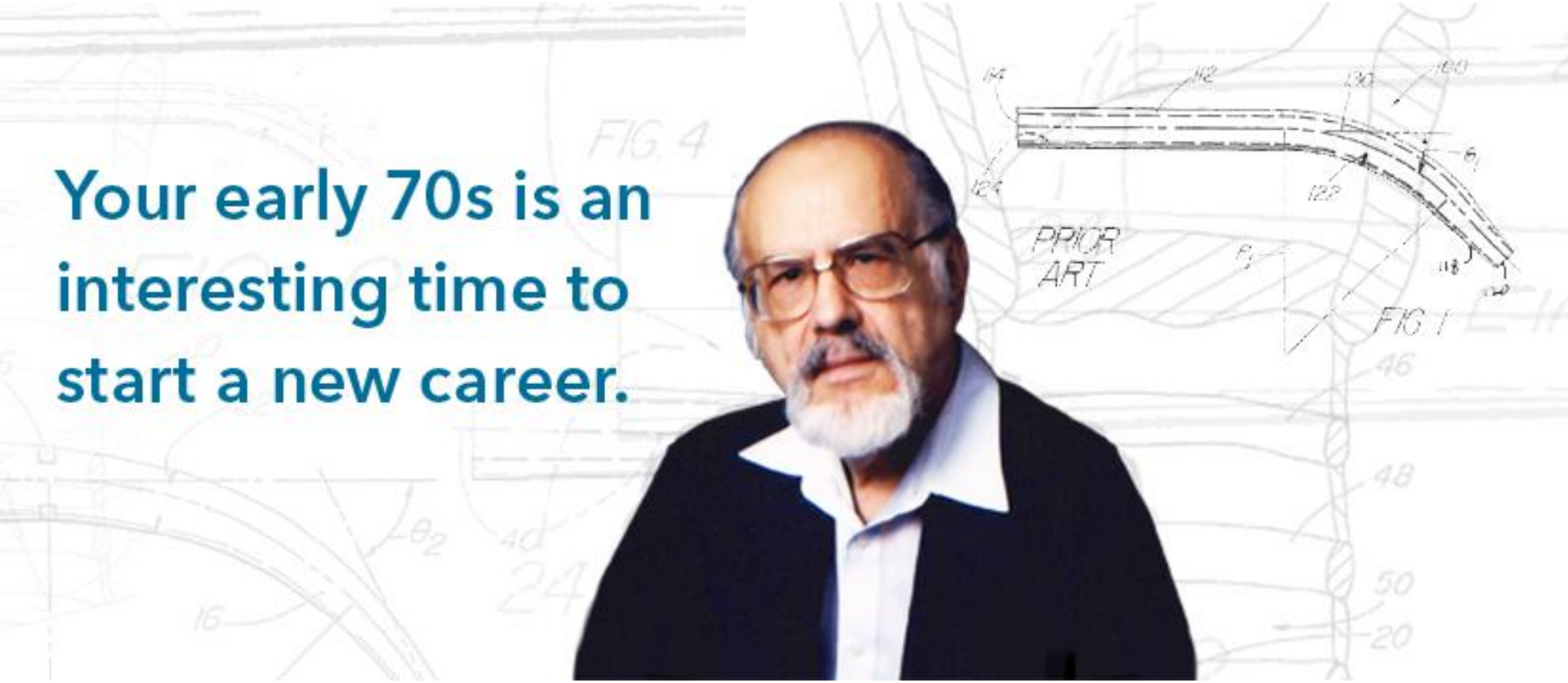


Pooled estimate of OR = 0.79 (95% CI 0.59 to 1.07, p=0.13)

Crit Care. 2006;10(2):R55.

1985 A New Simple Bedside Procedure

Percutaneous dilational tracheostomy

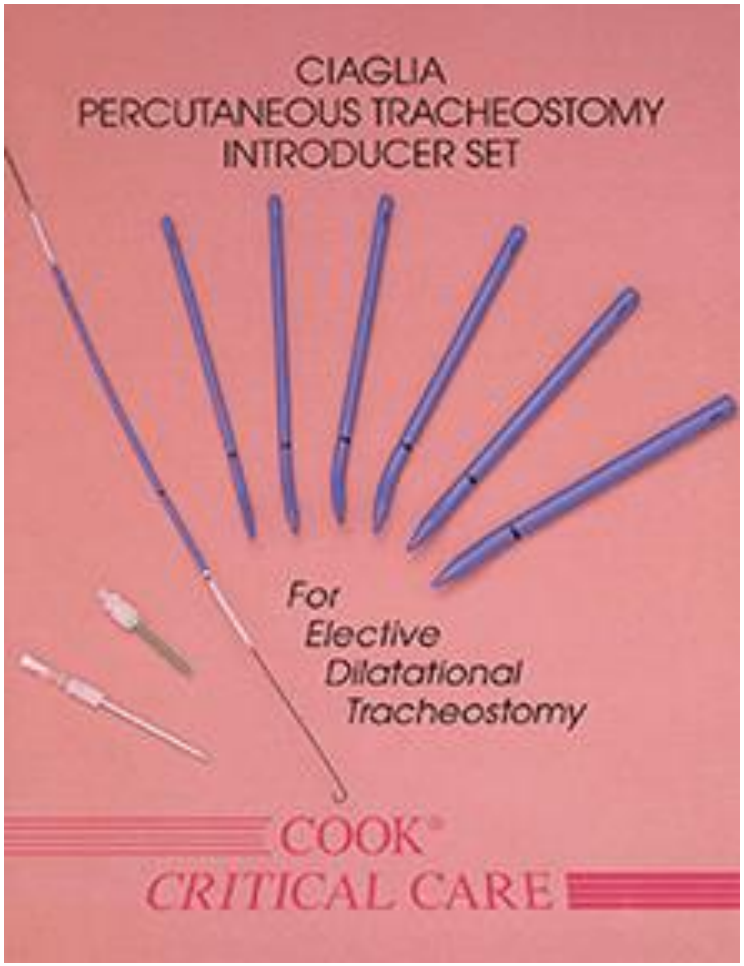


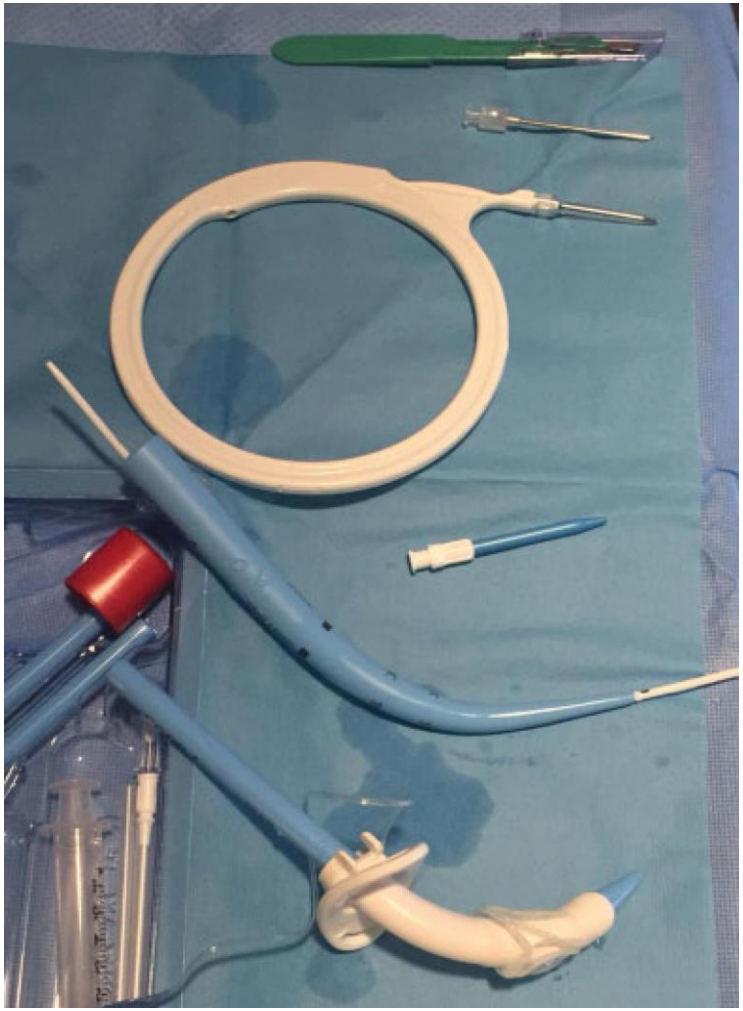
Pasquale Ciaglia

Chest. 1985 Jun;87(6):715-9.
https://reurl.cc/G5Ap3

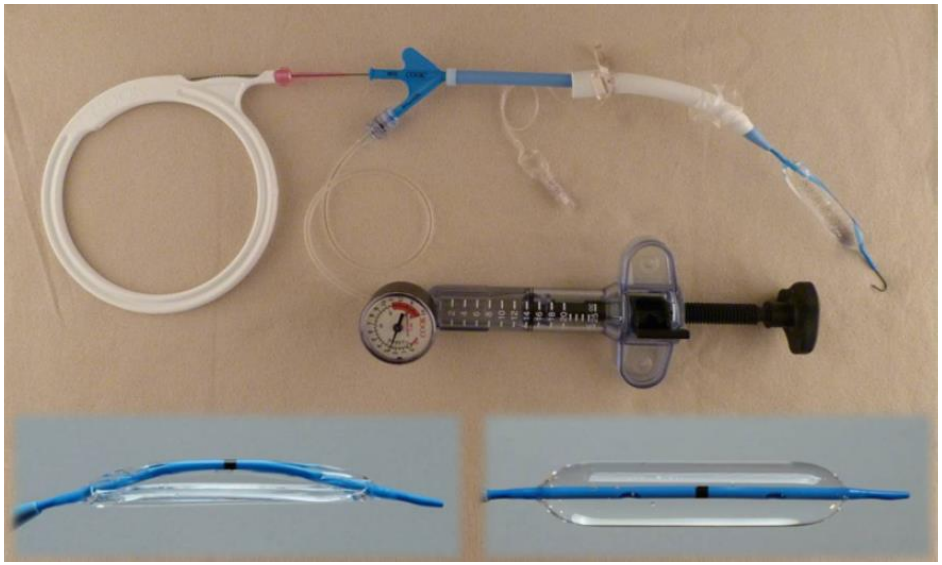
1985 A New Simple Bedside Procedure

Percutaneous dilational tracheostomy

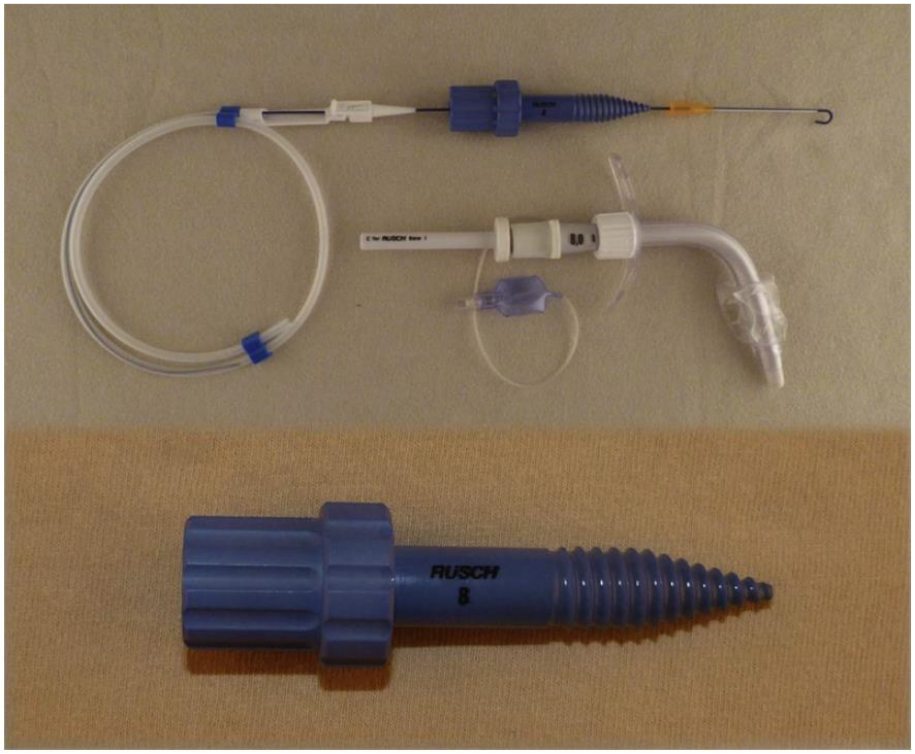




Semin Respir Crit Care Med 2018;39:720–730.
https://reurl.cc/G5Ap3



Blue Dolphin balloon-assisted dilation system



PercuTwist" screw-like dilation system

Griggs percutaneous Technique set

Int J Res Med Sci. 2015 Mar;3(3):738-742.
Clin Chest Med 34 (2013) 515–526.

Absolute Contraindications for Percutaneous Tracheostomy

Absolute contraindications to consider:

- Patient age younger than 8 years
- Necessity of emergency airway access because of acute airway compromise
- Gross distortion of the neck anatomy due to the following:
  Hematoma
  Tumor
  Thyromegaly
  High innominate artery

Chest. 2019 Mar;155(3):639-644.

Relative Contraindications for Percutaneous Tracheostomy

Relative contraindications to consider:

- Patient obesity with short neck that obscures neck landmarks
- Medically uncorrectable bleeding diatheses
- Prothrombin time or activated partial thromboplastin time > 1.5 times the reference range
- Platelet count < 50,000/μL
- Bleeding time > 10 min
- Need for positive end-expiratory pressure > 20 cm H_2O
- Evidence of infection in the soft tissues of the neck at the prospective surgical site

Chest. 2019 Mar;155(3):639-644.

A comprehensive multidisciplinary tracheostomy team

Physician to manage airway and bronchoscope

Physician to perform the tracheostomy tube insertion

Respiratory therapist

Tracheostomy coordinator

Nurse

Speech-language pathologist

Clin Chest Med 39 (2018) 211–222.

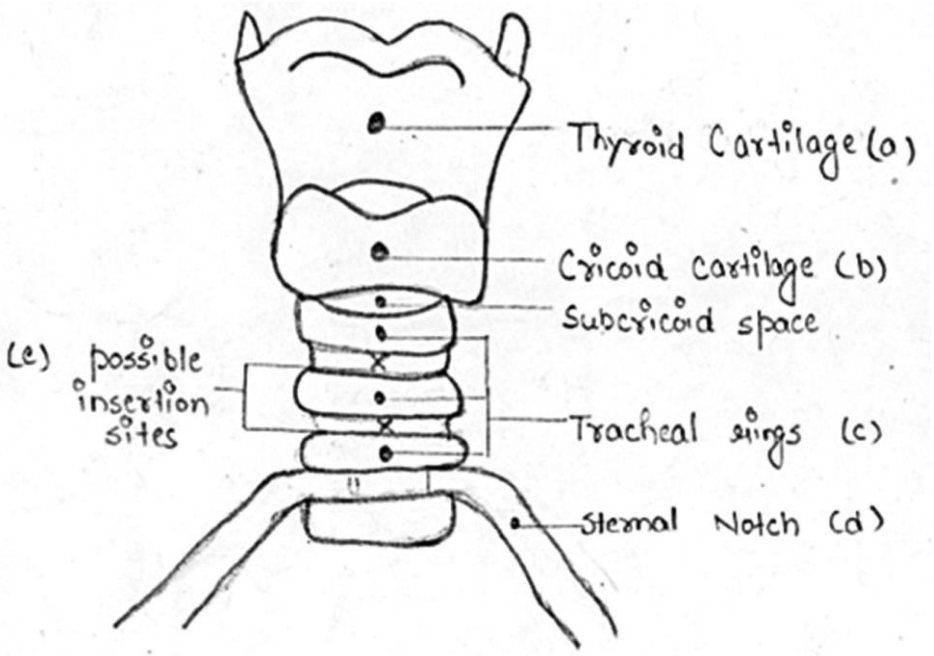
Complications of Percutaneous Tracheostomy

Immediate	Early	Late
Bleeding	Tracheal ring fracture	Subglottic stenosis
Loss of airway	Tracheal tube obstruction	Unplanned decannulation
Hypoxia	Paratracheal placement	Tracheoinnominate artery bleed
Pneumothorax	Posterior tracheal wall injury	Displaced tracheal tube
False tract	Pneumothorax/pneumomediastinum	Delayed healing after decannulation
Pneumomediastinum	Surgical emphysema	Tracheoesophageal fistula
Posterior tracheal wall injury	Atelectasis	Stromal infection
Esophageal injury	Raised intracranial pressure	Scarring of the neck
Surgical emphysema		Swallowing difficulty
Needle damage to bronchoscope		Permanent voice changes
Raised intracranial pressure		

Ann Card Anaesth 2017;20:S19-25.

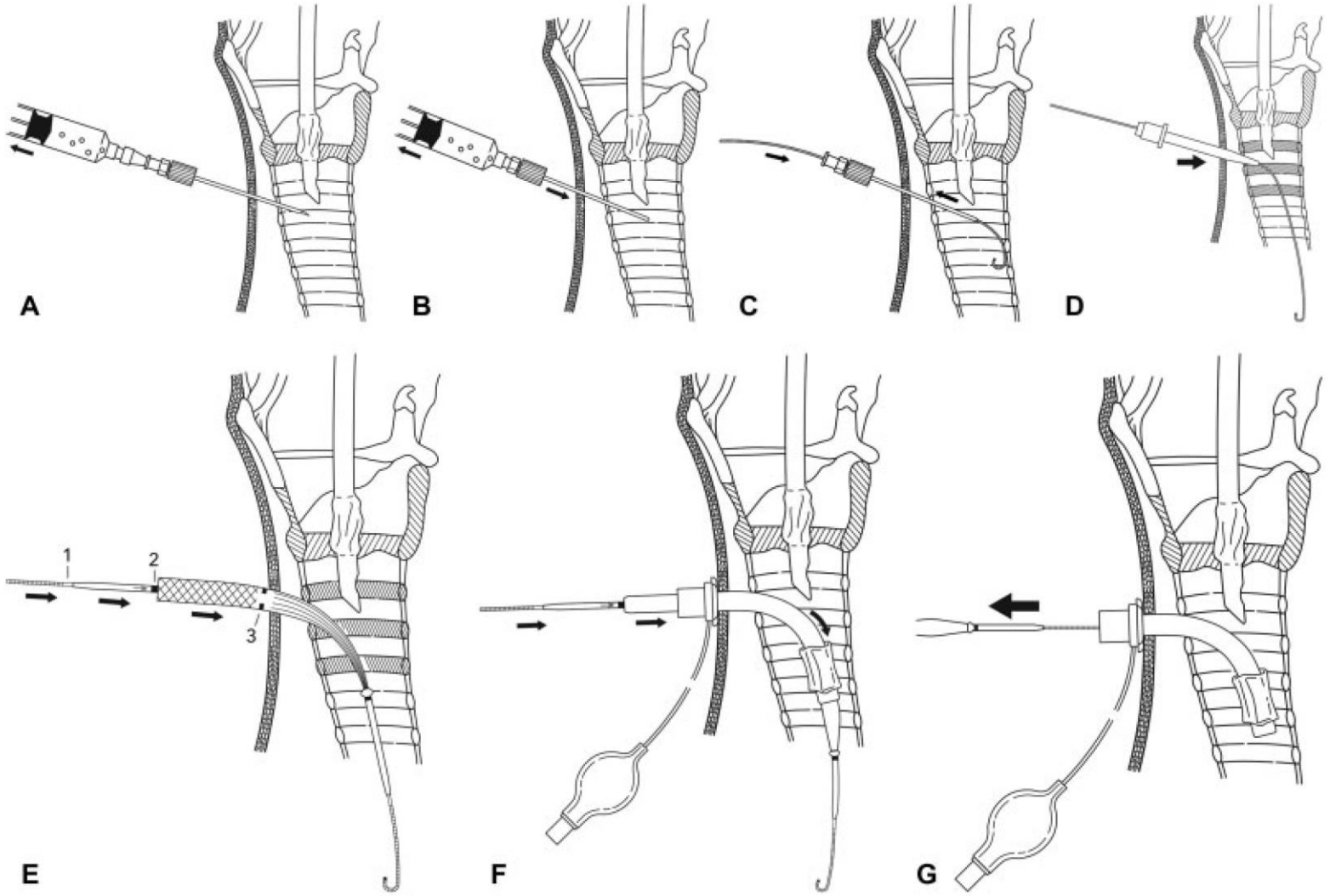
Percutaneous dilational tracheostomy

Preoperative landmarks



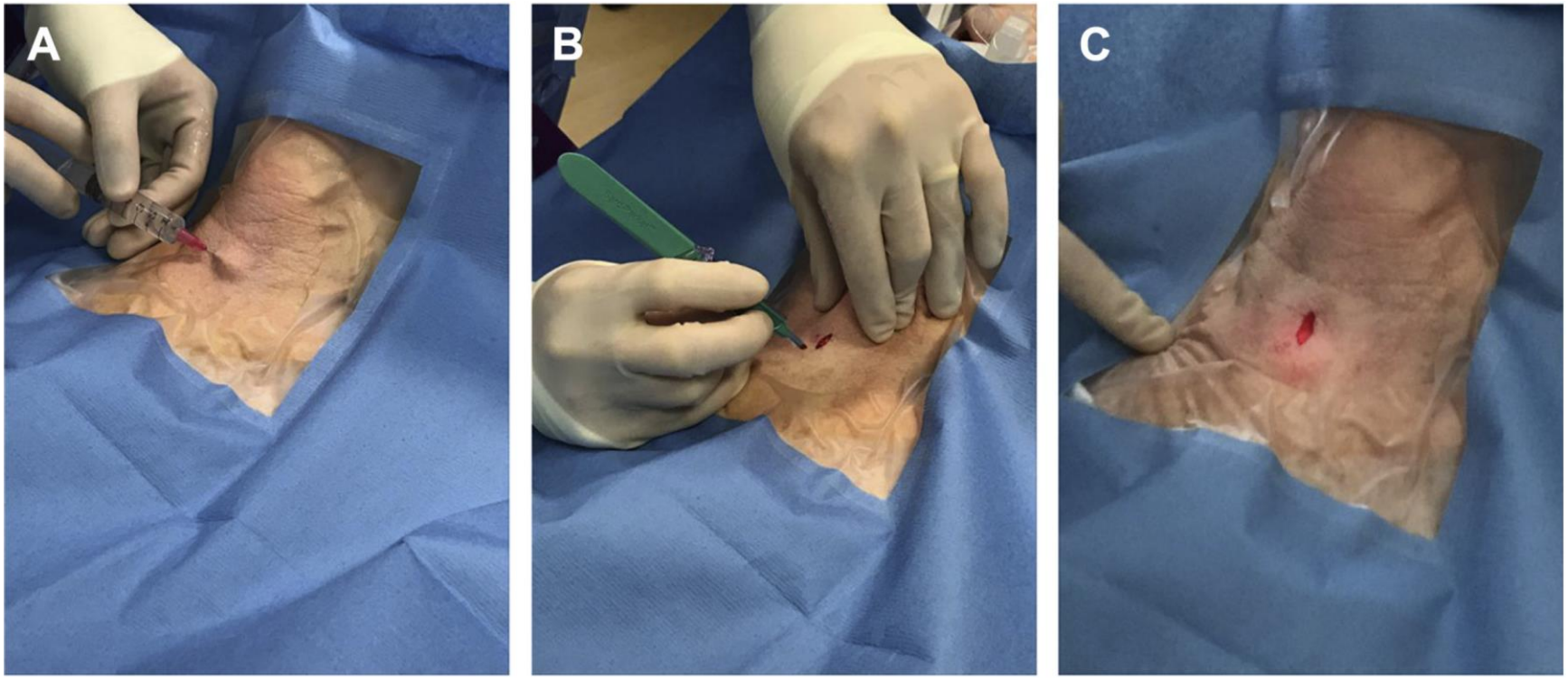
Ann Card Anaesth 2017;20:S19-25.
Clin Chest Med 39 (2018) 211–222.

Schematic drawings of Ciaglia single tapered dilator method of percutaneous dilational tracheostomy



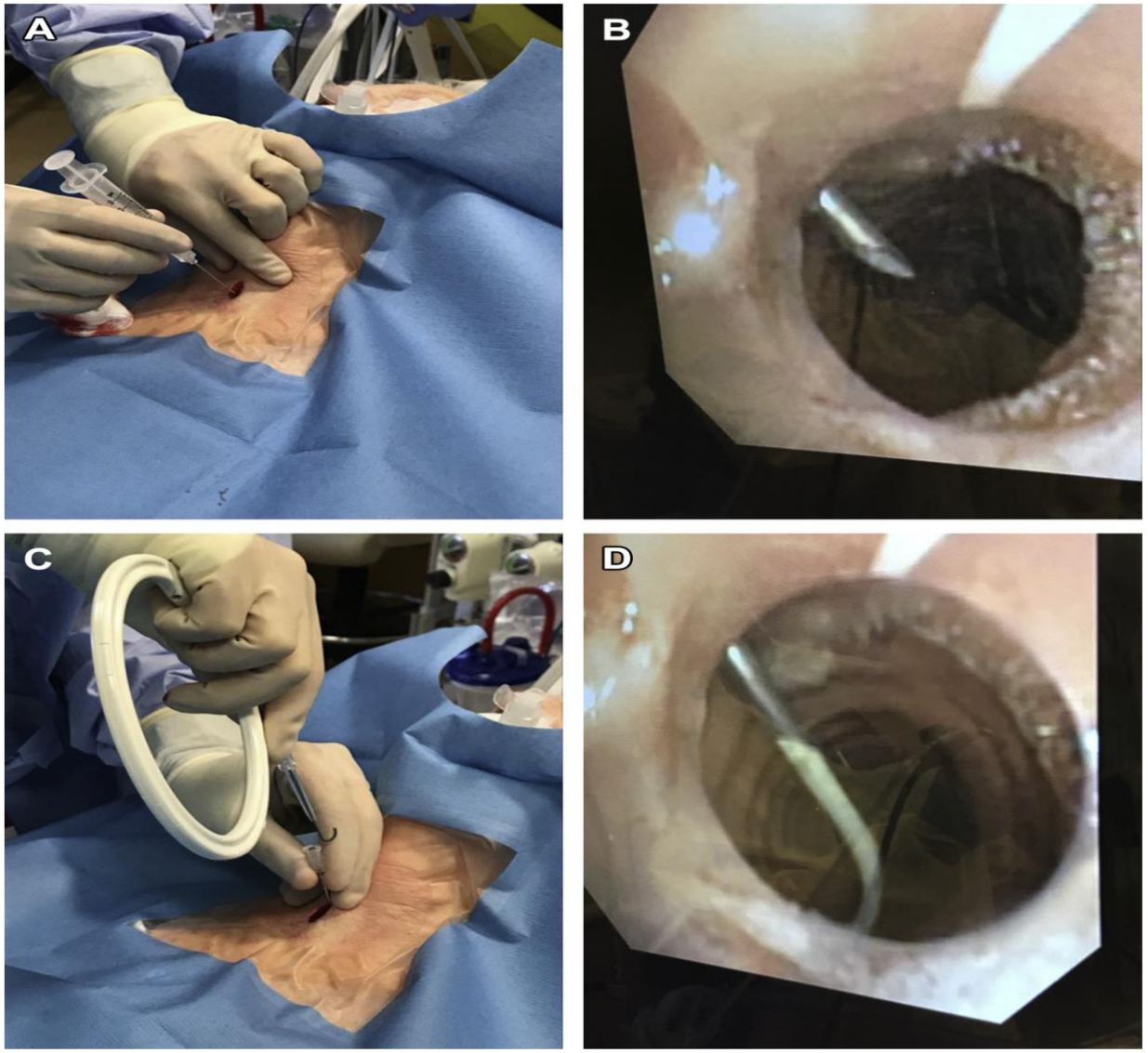
Semin Respir Crit Care Med 2018;39:720–730.

Percutaneous dilational tracheostomy



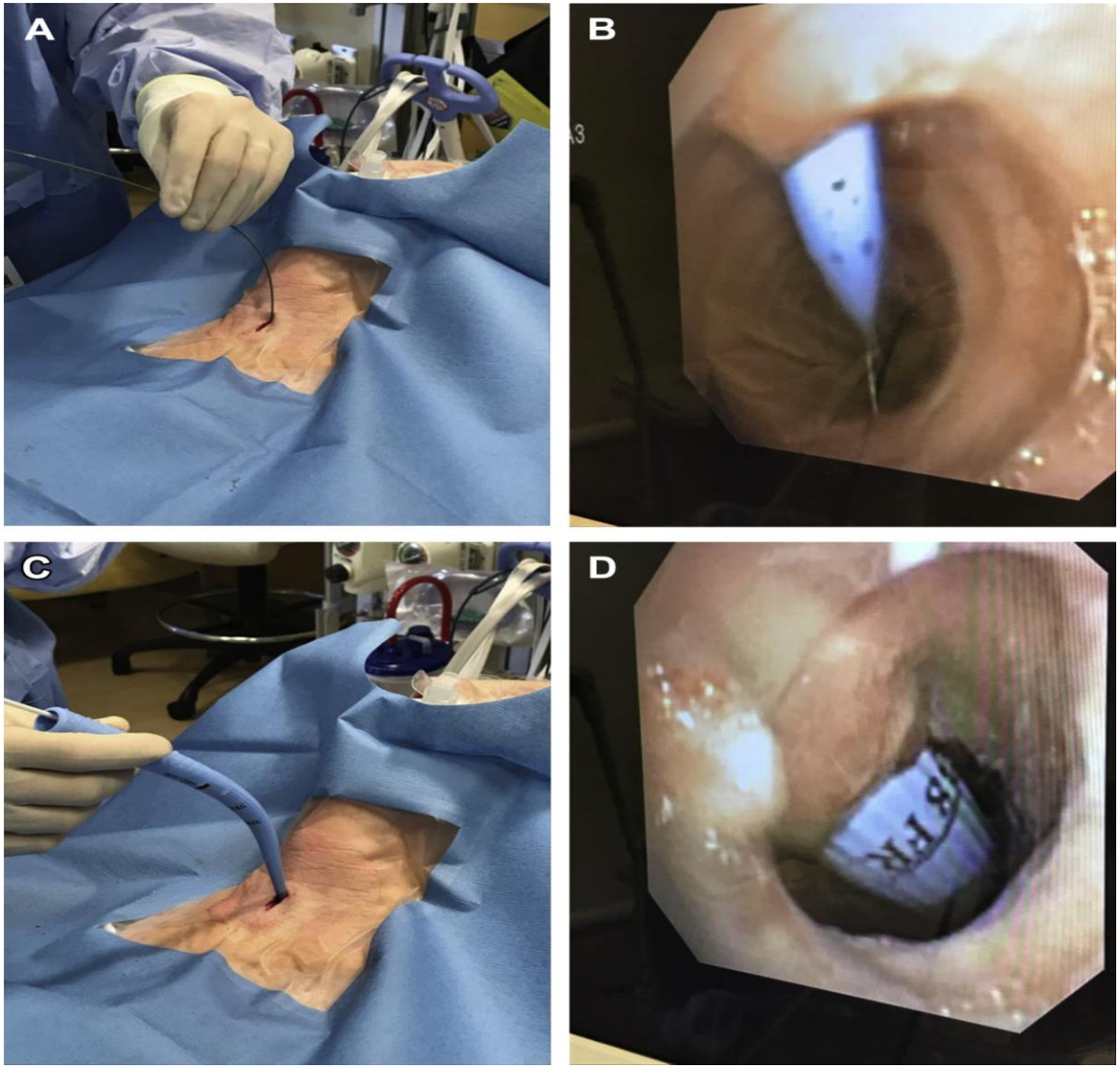
Clin Chest Med 39 (2018) 211–222.

Percutaneous dilational tracheostomy



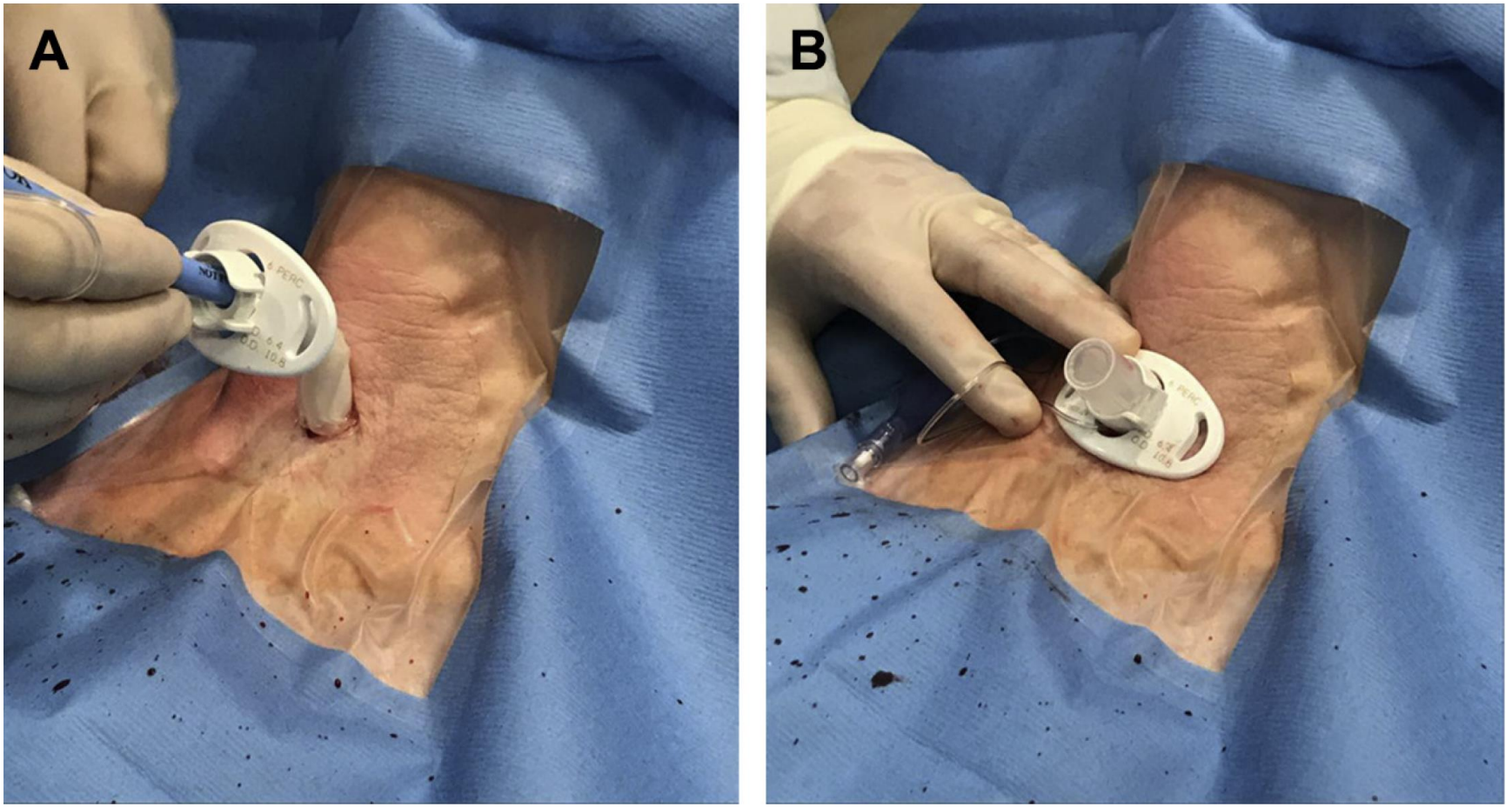
Clin Chest Med 39 (2018) 211–222.

Percutaneous dilational tracheostomy



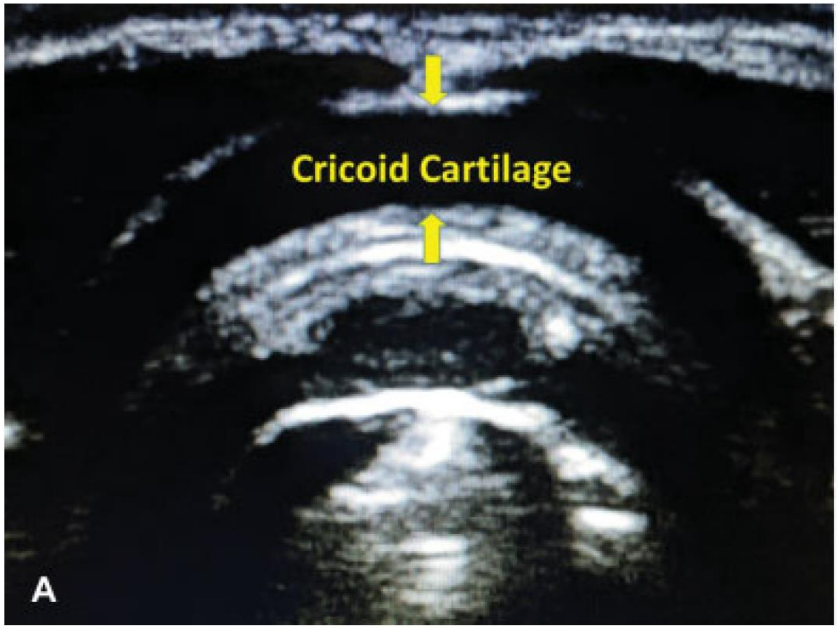
Clin Chest Med 39 (2018) 211–222.

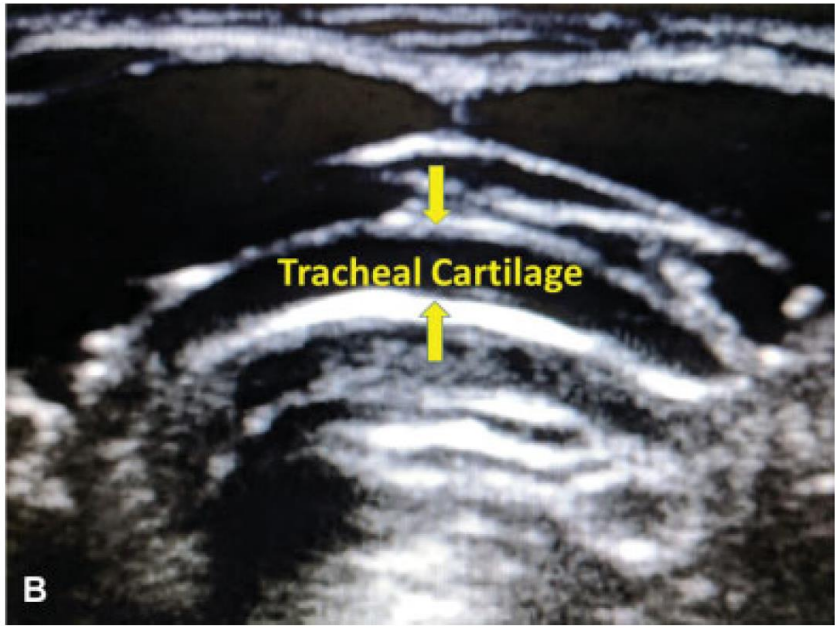
Percutaneous dilational tracheostomy

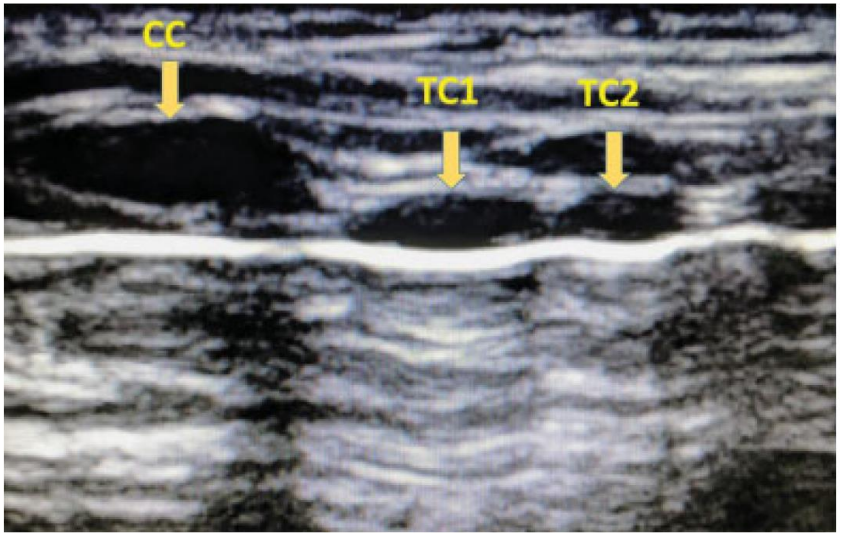


Clin Chest Med 39 (2018) 211–222.

Ultrasound guided percutaneous tracheostomy

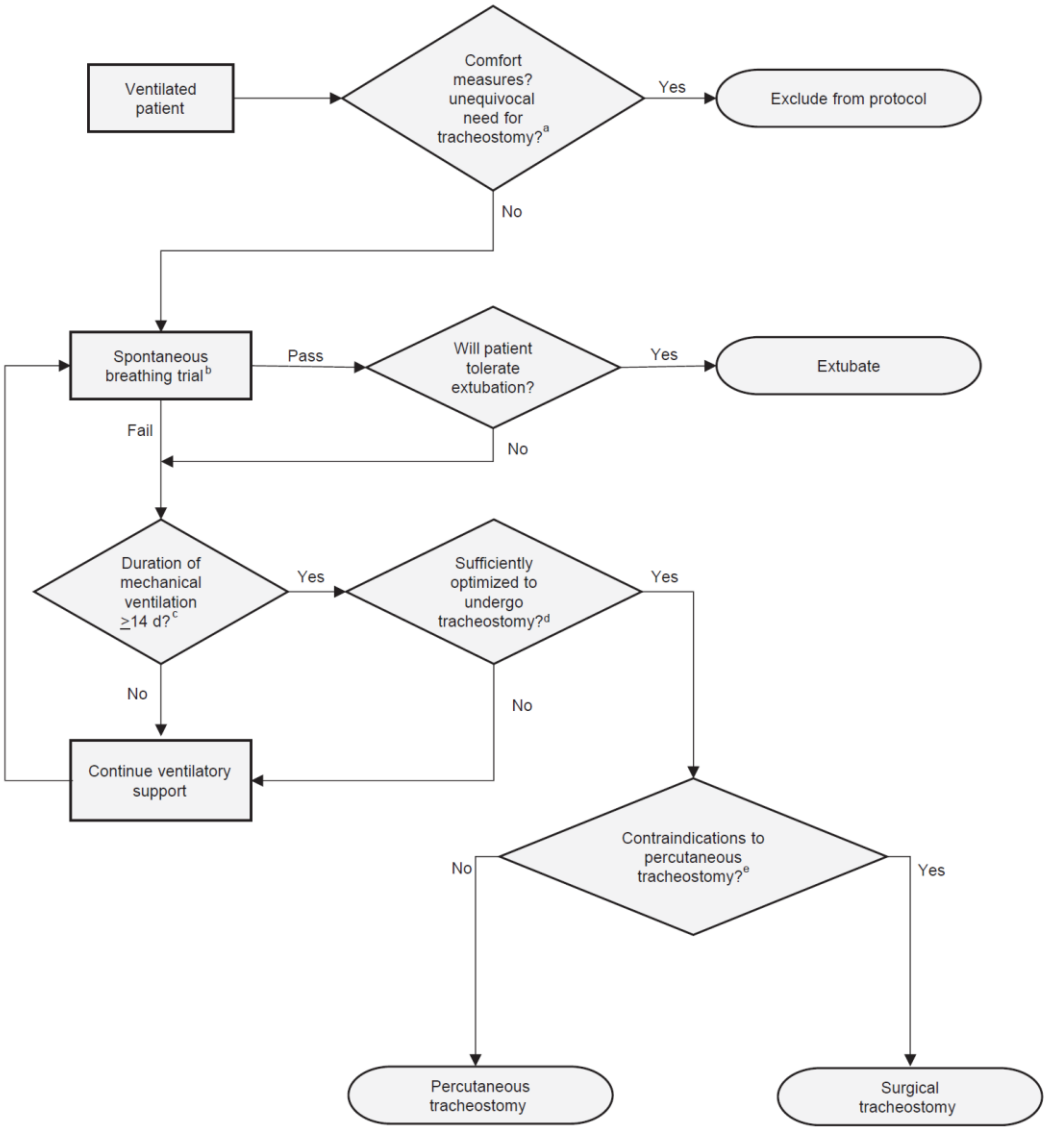






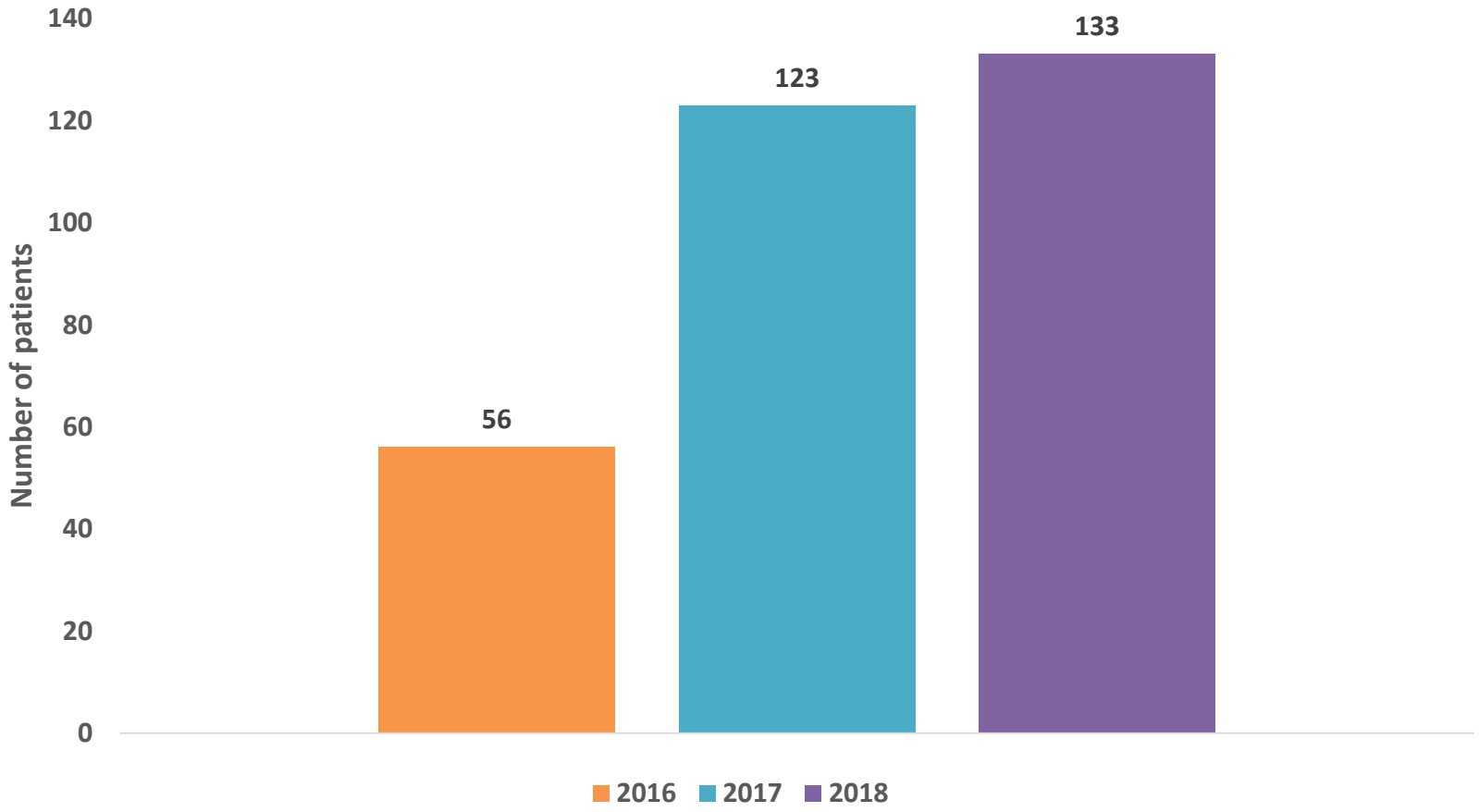
Semin Respir Crit Care Med 2018;39:720–730.

Tracheostomy decision-making protocol

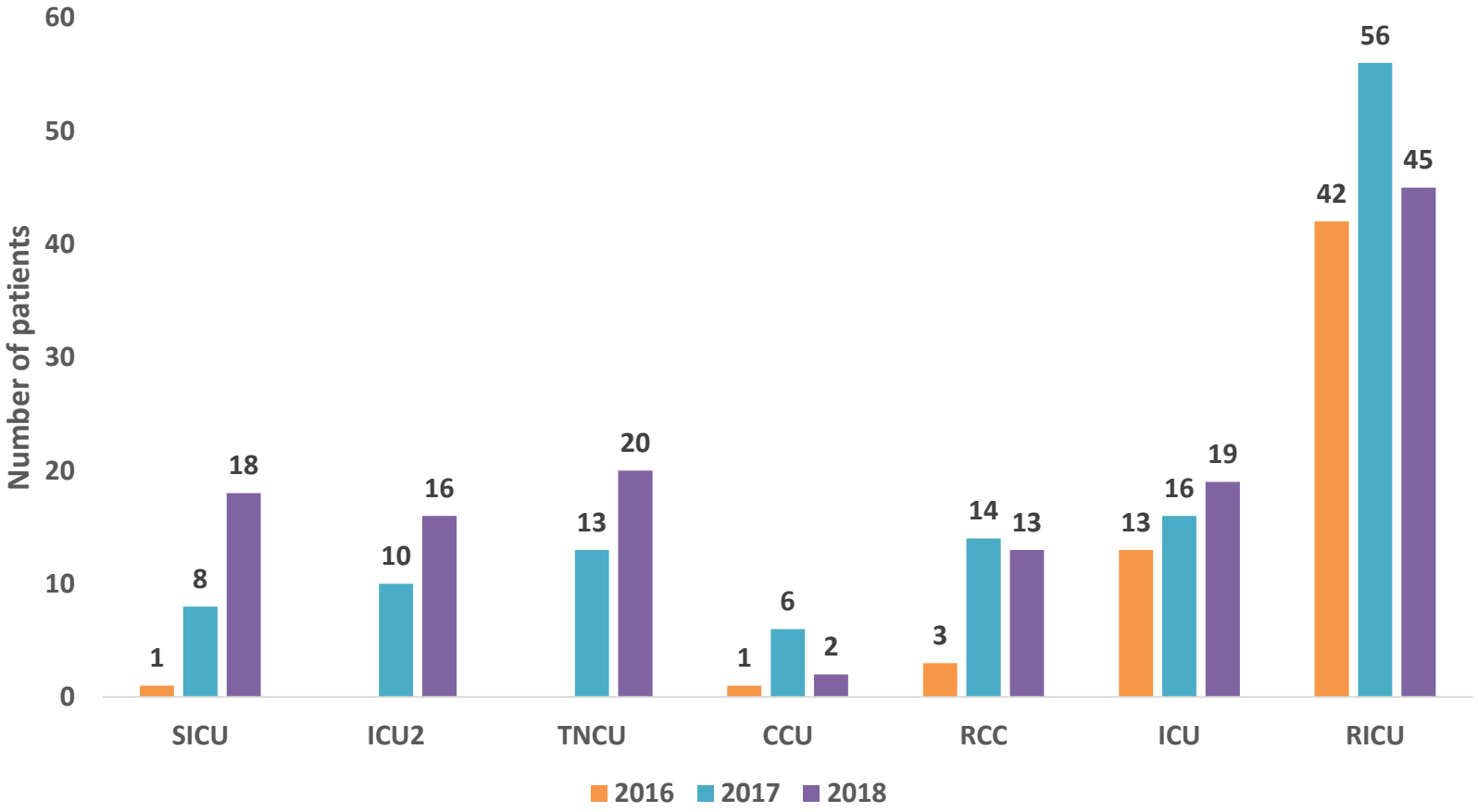


Crit Care Clin 33 (2017) 311–322.

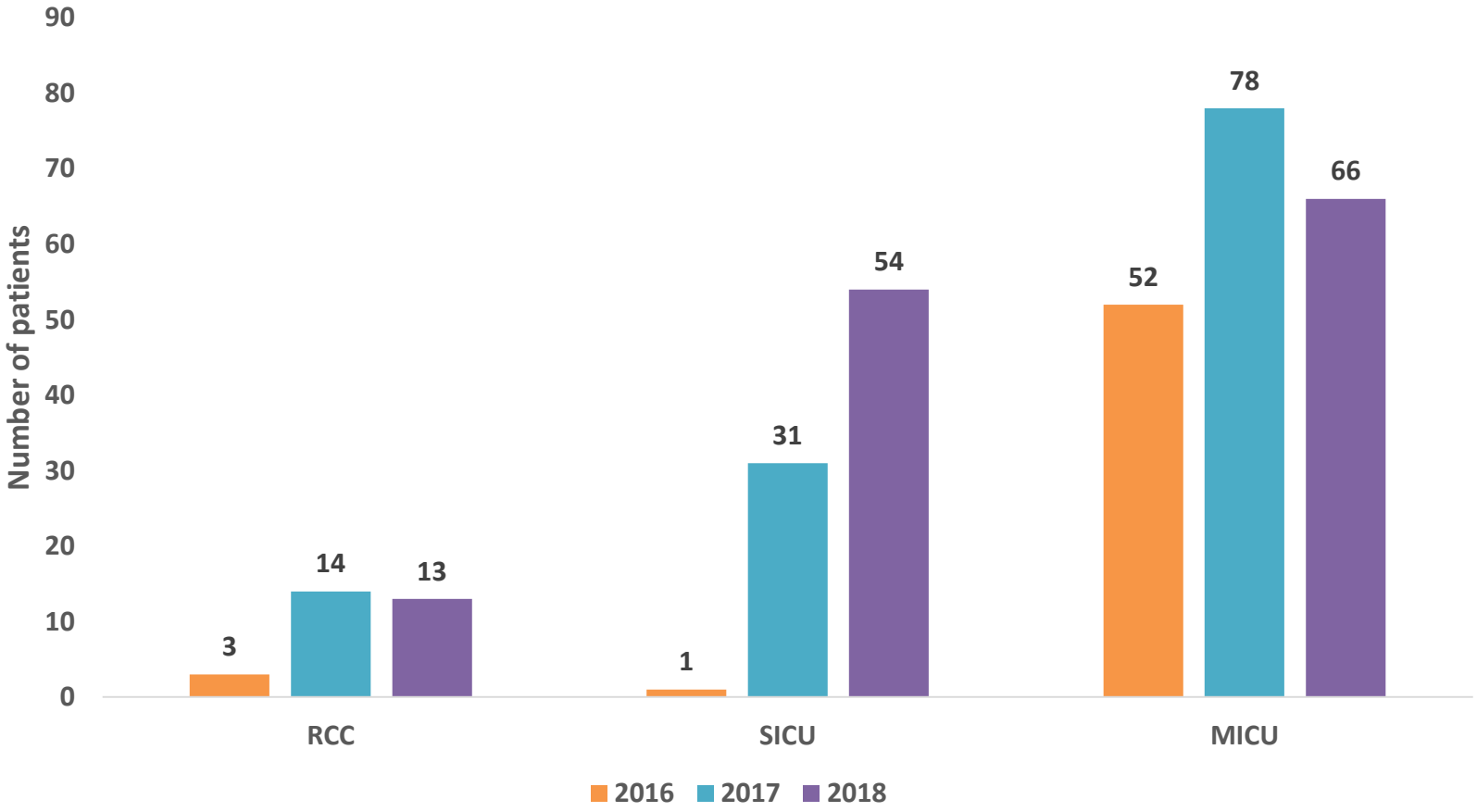
The Experience of PDT in VGHTC



The Experience of PDT in VGHTC



The Experience of PDT in VGHTC




Thanks for your attention
waynehuang0622@gmail.com