**Supplemental Materials**

**Appendix 1** **Details of the search strategy**

**PubMed**

#1 " Positive End-expiratory Pressure " [Mesh]

#2 " positive end-expiratory pressure " [tw]

#3 "positive pressure respirat\*"[tw]

#4 "positive pressure ventil\*"[tw]

#5 "PEEP"[tw]

#6 #1 or #2 or #3 or #4 or #5

#7 “anesthesia”[Mesh]

*#*8 “anesthe\*”[tw]

#9 #7 or *#*8

#10 (randomized controlled trial[pt] OR randomized controlled trials[mh] OR random allocation[mh] OR random allocat\* [tw] OR randomly allocat\* [tw]

OR double-blind method[mh] OR single-blind method [mh] OR double blind\* [tw] OR single blind\* [tw] OR triple blind\* [tw] OR clinical trial [pt] OR clinical

trials [mh]) NOT (animal [mh] NOT human [mh]))

#11 #6 and #9 and #10

**Embase**

#1 'positive‐end‐expiratory‐pressure'/exp OR 'positive‐end‐expiratory‐pressure'

#2 'positive pressure respiration'/exp OR 'positive pressure respiration'

#3 'positive pressure ventilation'/exp OR 'positive pressure ventilation'

#4 PEEP

#5 #1 or #2 or #3 or #4

#6 ' anesthesia '/exp OR anesthesia

#7 #5 and #6

#8 [randomized controlled trial]/lim AND [humans]/lim

#9 #7 and #8

**Cochrane Register of Controlled Trials**

#1 Positive End-expiratory Pressure:ME

#2 positive pressure respirat\*

#3 positive pressure ventil\*

#4 PEEP

#5 #1 OR #2 OR #3 OR #4

#6 anesthesia:ME

#7 anesthe\*

#8 #6 or #7

#9 #5 and #8

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| **Supplemental Table 1 (as supplied by the authors):** **Demographic characteristics of the patients and ventilatory settings** **in each study (mean ±SD or median)** |  |
| Study | Age,years | Weight,kg | Respiratory rate,Per miute | Mode ofvetilation | Inspired fraction ofOxygen,% | Inspiratory/Exiratory ratio | Duration of mechanicalVentilation,h | Plateau airwaypressure, cm H2O | airway instrumentation method |
| PEEP | ZEEP | PEEP | ZEEP | PEEP | ZEEP | PEEP | ZEEP | PEEP | ZEEP | PEEP | ZEEP | PEEP | ZEEP | PEEP | ZEEP | ETT |
| Azab TO et al28., 2005 | 42.3 ± 5.3 | 44.3 ± 4.5 | NS | NS | Adjusted by PaCO2 | VCV | VCV | NS | NS | NS | NS | NS | NS | NS | NS | ETT |
| Choi G et al29., 2006 | 62 ±9.8 | 61±9.5 | 79 ± 14.4 | 76 ± 13.7 | Adjusted by PaCO2 | VCV | VCV | 0.4 | 0.4 | 1：2 | 1：2 | 304± 35 | 308± 52 | NS | NS | ETT |
| Pang CK et al30., 2003 | 49.14±13.91 | 52.16±13.63 | 56.28±8.46 | 54.71±20.89 | Adjusted by PaCO2 | VCV | VCV | 0.35 | 0.35 | 1：2 | 1：2 | NS | NS | NS | NS | ETT |
| Talab HF et al32., 2009 | 20-50 | 20-50 | NS | NS | Adjusted by PaCO2 | VCV | VCV | 0.5 | 0.5 | NS | NS | NS | NS | NS | NS | ETT |
| Tusman G et al33., 1999 | 70.7±7.3 | 72.3±7.7 | NS | NS | 10-12 | 10-12 | VCV | VCV | 0.4 | 0.4 | NS | NS | NS | NS | NS | NS | ETT |
| Wetterslev J et al35., 2001 | 58 | 60 | NS | NS | 10-12 | 10-12 | VCV | VCV | 0.33 | 0.33 | NS | NS | NS | NS | NS | NS | ETT |
| Severgnini P et al31., 2013 | 65.5±11.4 | 67.0±9.0 | NS | NS | Adjusted by PaCO2 | VCV | VCV | 0.4 | 0.4 | 3：1 | 3：1 | NS | NS | 18 | 16 | ETT |
| Weingarten TN et al34., 2010 | 73.8 | 72.1 | NS | NS | 8 | 8 | VCV | VCV | 0.5 | 0.5 | 1：2 | 1：2 | NS | NS | NS | NS | ETT |
| Futier E et al13., 2013 | 61.6±11.0 | 63.4±10.0 | 71.4±14.2 | 71.3±13.9 | Adjusted by PaCO2 | VCV | VCV | NS | NS | NS | NS | 319±139.4 | 344±127.9 | 15.2±2.6 | 16.6±3.5 | ETT |
| Park SJ et al38., 2016 | 52.8 ± 16.5 | 57.4 ± 10.1 | 64.7 ± 15.8 | 66.6 ± 11.4 | Adjusted by PaCO2 | VCV | VCV | 0.5 | 0.5 | 1：2 | 1：2 | NS | NS | NS | NS | ETT |
| Edmark L et al37., 2014 | NS | NS | NS | NS | Adjusted by PaCO2 | VCV | VCV | 0.6/0.8 | 1 | NS | NS | NS | NS | NS | NS | ETT |
| [Marret E](http://nc.yuntsg.com/pubmed/?term=Marret%20E%5BAuthor%5D&cauthor=true&cauthor_uid=29561278) et al36., 2018  | 62 ± 11 | 63 ± 9 | 70± 14 | 73± 14 | Adjusted by PaCO2 | VCV | VCV | NS | NS | NS | NS | NS | NS | 15.4±3.9 | 16.6±4.6 | ETT |
| Soh S et al39., 2017 | 73.7± 3.5 | 71.3± 4.6 | 62.8± 11.0 | 60.3± 9.5 | Adjusted by PaCO2 | VCV | VCV | NS | NS | 3：1 | 3：1 | NS | NS | 15.3 | 15 | ETT |
| Östberg E et al40., 2017 | 54 | 57 | NS | NS | Adjusted by PaCO2 | VCV | VCV | 1 | 1 | 1：2 | 1：2 | NS | NS | NS | NS | ETT |
| *Note: NS= not specified, VCV = volume-controlled ventilation., ETT =*  *Endotracheal intubation。* |  |

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| **Supplemental Table 2. Summary of the findings including GRADE quality assessment of evidence** |
| **Outcomes** | **Quality assessment** | **No of patients** | **Effect** | **Quality** | **Importance** |
| **No of studies** | **Design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Other considerations** | **PEEP****group** | **ZEEP****group** | **Relative(95% CI)** | **Absolute** |
| Atelectasis | 5 | RCTS | no serious  | no serious  | no serious  | serious  | reporting bias1 | 51/476 (10.7%) | 83/451 (18.4%) | 0.51 (0.1 to 2.55) | 90 fewer per 1000 (166 fewer to 285 fewer) | LOW | CRITICAL |
| Pneumonia | 6 | RCTS | no serious  | no serious  | no serious  | serious  | reporting bias1 | 25/474 (5.3%) | 52/458 (11.4%) | 0.48 (0.05 to 4.86) | 59 fewer per 1000 ( 108 fewer to 438 fewer) | LOW | CRITICAL |
| mortality | 6 | RCTS | no serious  | no serious  | no serious  | Serious4 | reporting bias1 | 8/454 (1.8%) | 4/441 (0.9%) | 1.78 (0.55 to 5.70) | 7 more per 1000 (4 fewer to 43 more) | LOW | CRITICAL |
| *CI : confdence interval, RCT: randomised clinical trial, RR: risk ratio, RRI: relative risk increase.*1. *Publication bias*
2. *I2 = 88% for heterogeneit*
3. *Precision was very low because of the small numbers (only 96 participants)*
4. *Precision was very low because of the small numbers and the low rate of events (only 895 participants and 12 events)*
5. *The two trials assessing adverse event rates with different surgical methods of the adverse event*
6. *The two trials assessing adverse event rates with different surgical methods of the adverse event*

*Precision was very low because of the small numbers and the low rate of events (only 383 participants and 3 events).* |

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| **Supplemental Table 3. Subgroup analyses of dichotomous outcome data** |
| Stratification | No. ofTrials | No. ofPatients | Risk Ratio(95% CI) | PValue | Heterogeneity,Q |
| **Atelectasis** |
| Risk of bias |
| Low | 3 | 783 | 0.50 (0.30-0.84) | <0.01 | 0.36 |
| Unclear/high | 2 | 144 | 1.00 (0.10-9.97) | 1.00 | 0.62 |
| Test for subgroup differences: | - | - | - | 0.57 | 0.27 |
| Surgical setting |
| abdominal surgery | 3 | 506 | 0.41 (0.28-0.61) | <0.01 | 0 |
| nonabdominal surgery | 2 | 421 | 1.07(0.24-4.77) | 0.93 | 0.35 |
| Test for subgroup differences: | - | - | - | 0.23 | 0.27 |
| PEEP gradient, cmH2O |
| ≤5 | 2 | 84 | 0.56 (0.33-0.96) | 0.03 | 0 |
| >5 | 4 | 865 | 0.50 (0.27-0.93) | 0.03 | 0.53 |
| Test for subgroup differences: | - | - | - | 0.79 | 0.32 |
| **Pneumonia** |
| Risk of bias |
| Low | 4 | 823 | 0.42 (0.25-0.70) | <0.01 | 0.23 |
| Unclear/high | 1 | 78 | 1.00 (0.13-7.48) | 1.0 | Not applicable |
| Test for subgroup differences: | - | - | - | 0.40 | 0.13 |
| Surgical setting |
| abdominal surgery | 3 | 480 | 0.23 (0.09-0.57) | <0.01 | 0 |
| nonabdominal surgery | 2 | 421 | 0.68 (0.40-1.17) | 0.17 | 0 |
| Test for subgroup differences: | - | - | - | 0.04 | 0.13 |
| PEEP gradient, cmH2O |
| ≤5 | 1 | 40 | 0.30 (0.01-7.02) | 0.46 | Not applicable |
| >5 | 4 | 861 | 0.46 (0.23-0.92) | 0.03 | 0.33 |
| Test for subgroup differences: | - | - | - | 0.80 | 0.13 |
| **Mortality** |
| Risk of bias |
| Low | 2 | 383 | 1.44 (0.18-11.65) | 0.73 | 0.38 |
| Unclear/high | 2 | 82 | 1.59 (0.21-12.38) | 0.66 | 0 |
| Test for subgroup differences: | - | - | - | 0.95 | 0 |
| Surgical setting |
| abdominal surgery | 3 | 122 | 0.97 (0.17-5.41) | 0.97 | 0 |
| nonabdominal surgery | 1 | 343 | 2.98 (0.61-14.57) | 0.18 | Not applicable |
| **Supplemental Table 3. Continue** |
| Test for subgroup differences: | - | - | - | 0.35 | 0 |
| PEEP gradient, cmH2O |
| ≤5 | - | - | - | - | Not applicable |
| >5 | 4 | 465 | 1.78 (0.55-5.70) | 0.33 | 0 |
| Test for subgroup differences: | - | - | - | - | Not applicable |