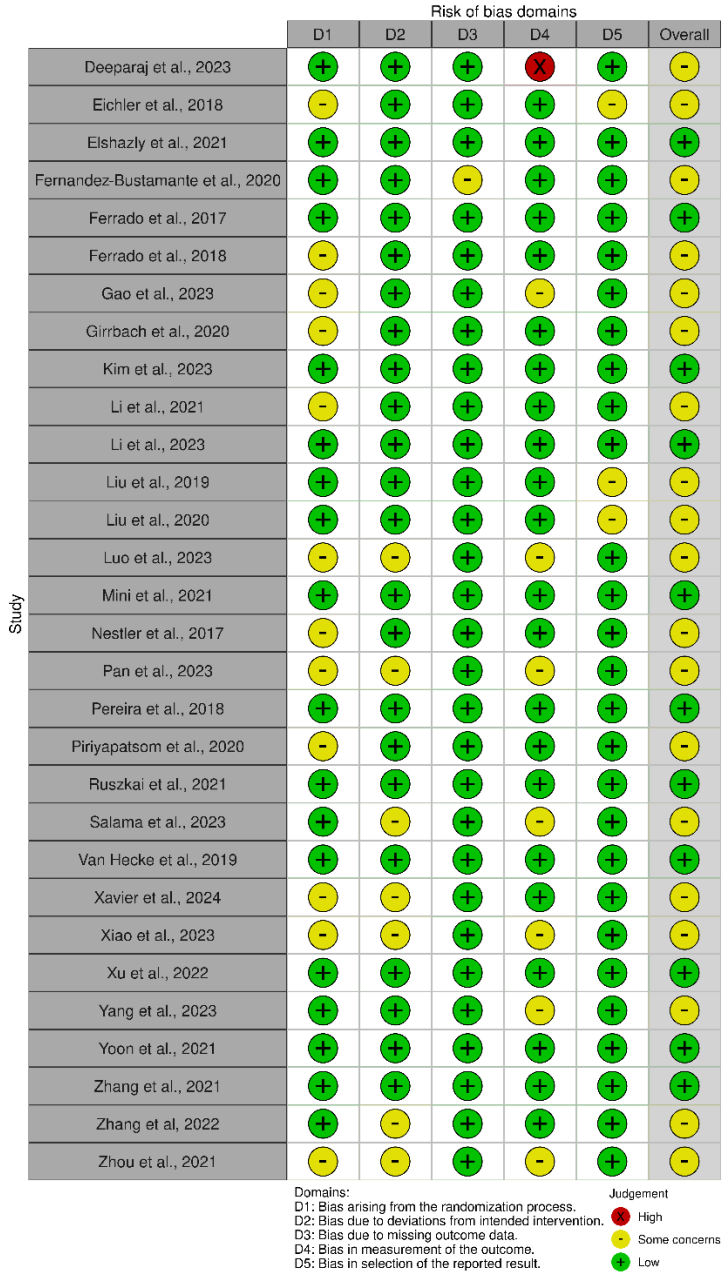
Individualised Positive End-Expiratory Pressure Settings Reduce the Incidence of Postoperative Pulmonary Complications - **Supplemental Digital Content**

Supplemental Digital Content, Figure S1 Results of the risk of bias assesment, using RoB-2 Tool



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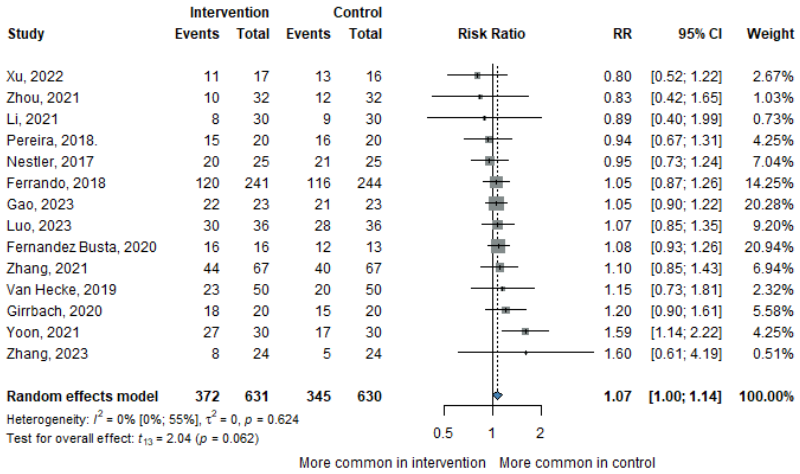
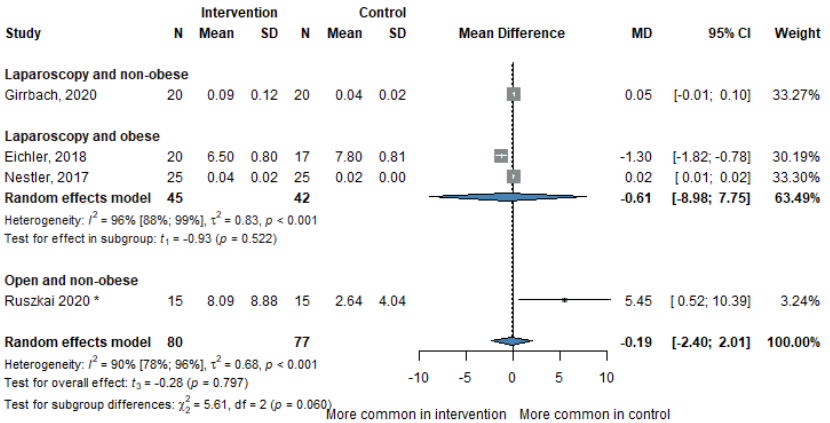
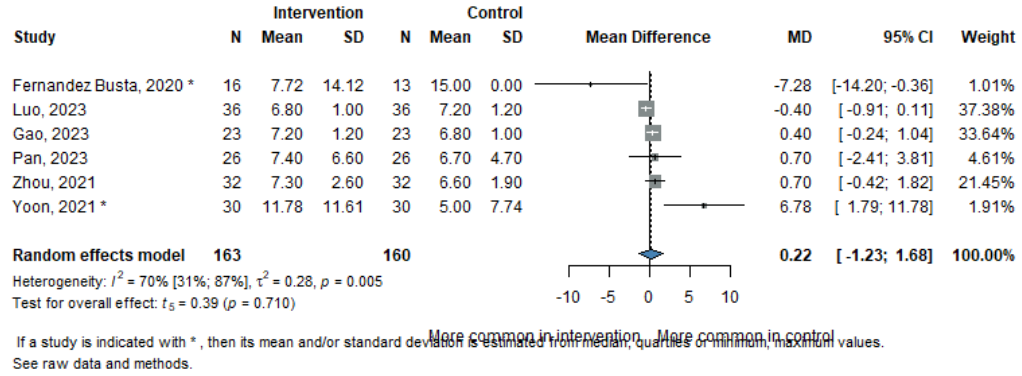
Supplemental Digital Content, Figure S2. Number of patients who needed vasopressor support.



Supplemental Digital Content, Figure S3 – Maximal dose of norepinephrine in mcg/kg/min

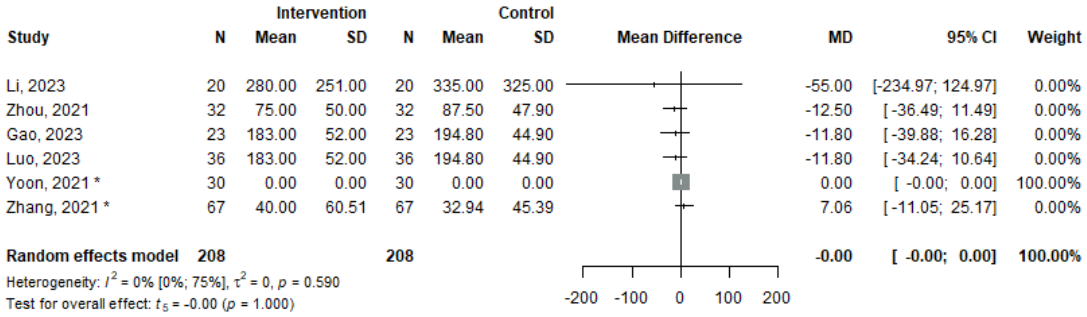


Supplemental Digital Content,Figure S4 – Total amount of ephedrine used (mg)



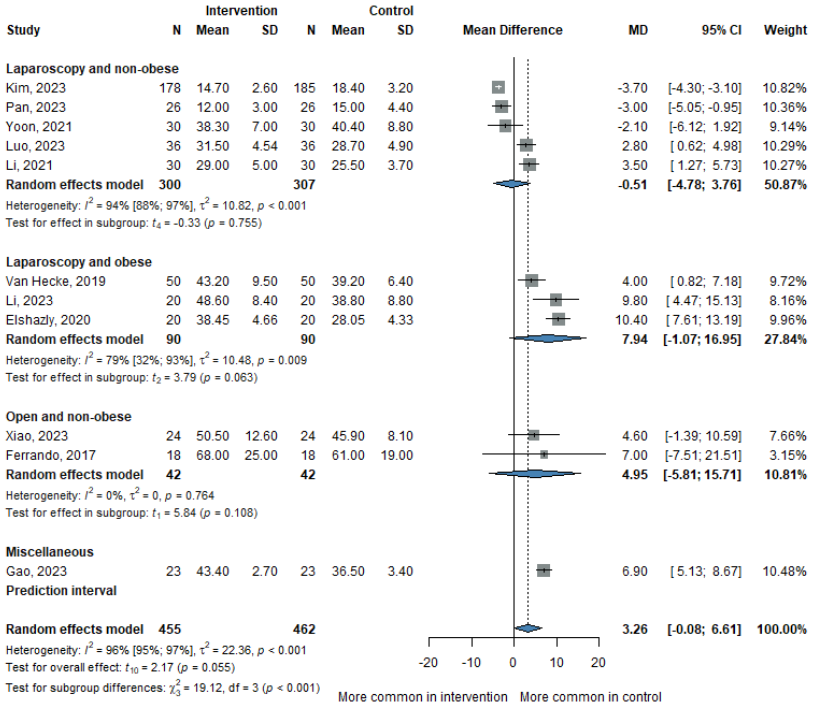
If a study is indicated with * , then its mean and/or standard deviation is estimated from median, quartiles or minimum, maximum values.
See raw data and methods.

Supplemental Digital Content,Figure S5 – Total amount of fenilephrine used (ug)

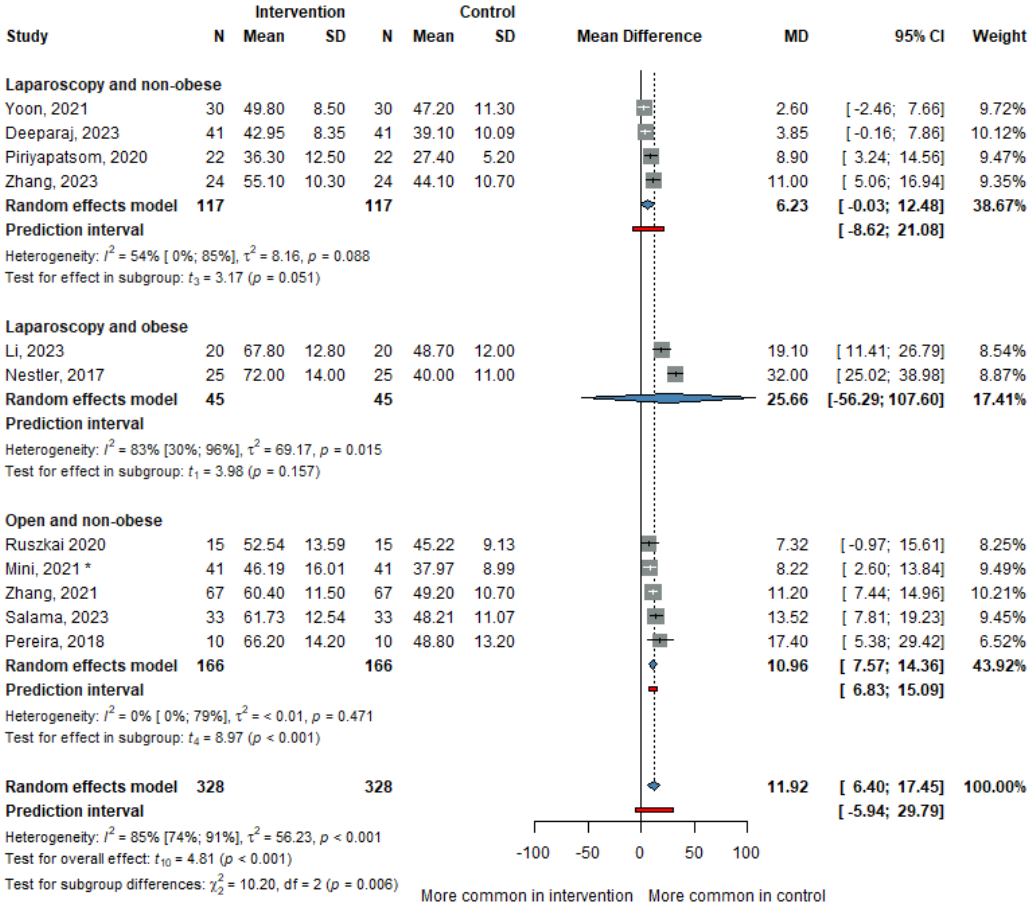


If a study is indicated with * , then its mean and/or standard deviation is estimated from median, quartiles or minimum, maximum values.
See raw data and methods.

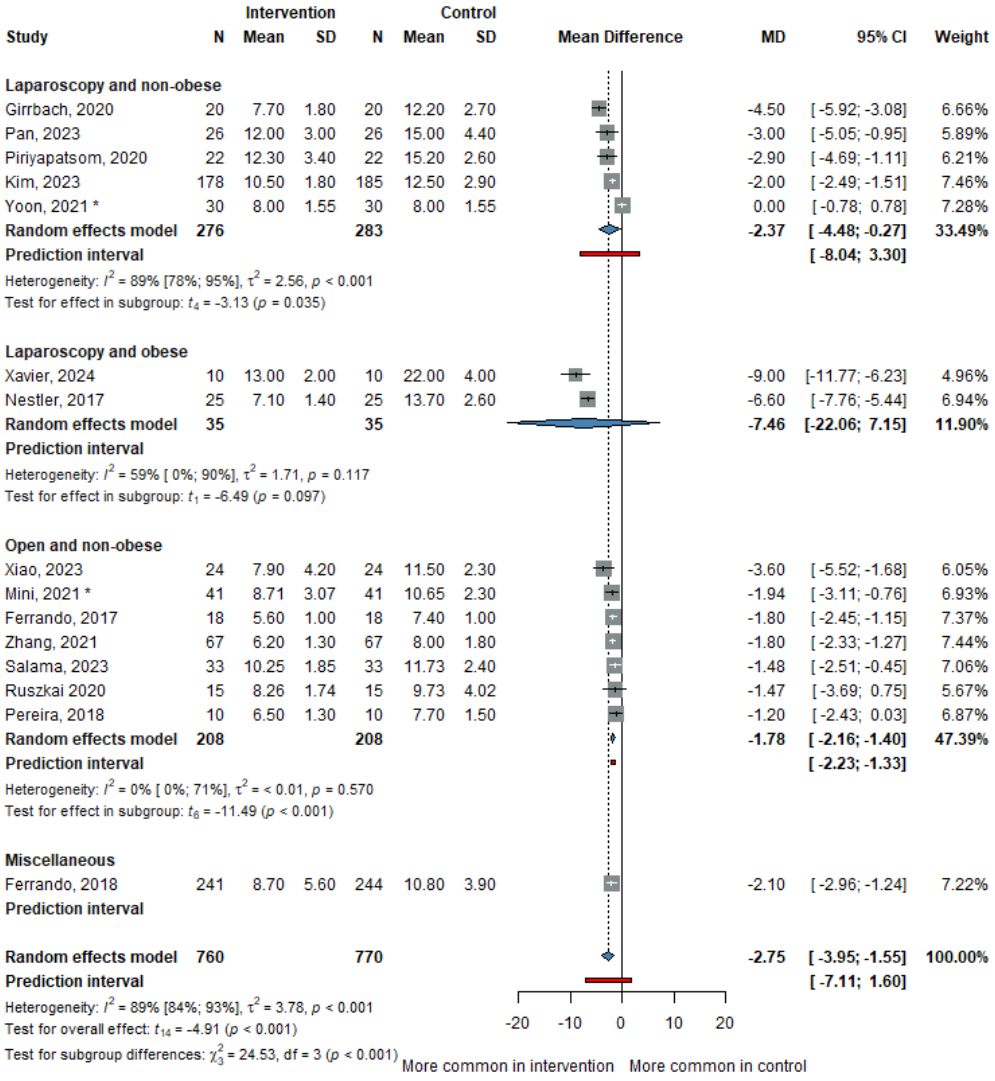
Supplemental Digital Content,Figure S6A Dynamic compliance (Cdyn) in ml/cm H_2O, at the end of the surgery.



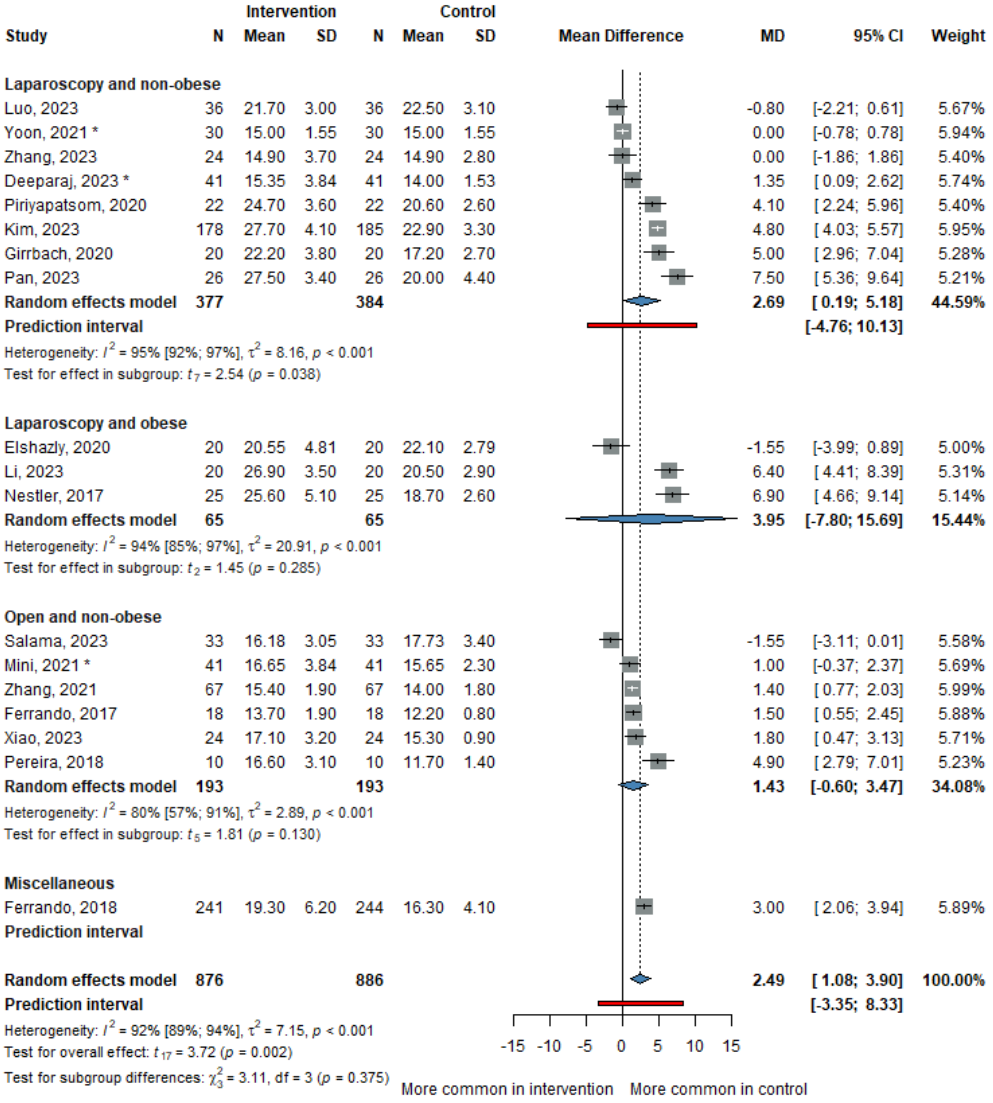
Supplemental Digital Content,Figure S6B Static compliance (Cstat) in ml/cm H_2O, at the end of the surgery.



Supplemental Digital Content,Figure S7A Driving pressure in cm H_2O, at the end of the surgery.

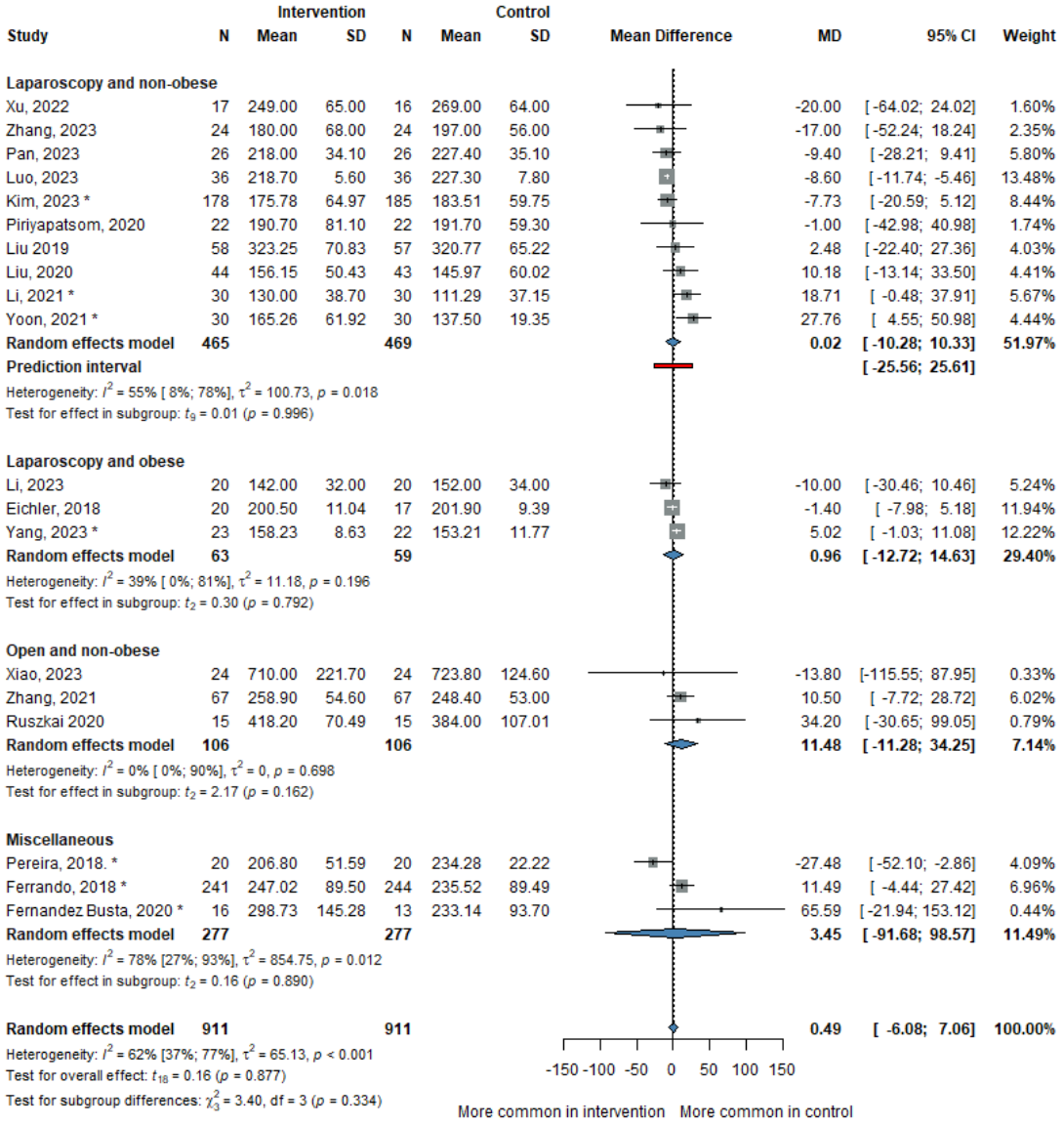


Supplemental Digital Content, Figure S7B. Plateau pressure in cm H_2O, at the end of the surgery.

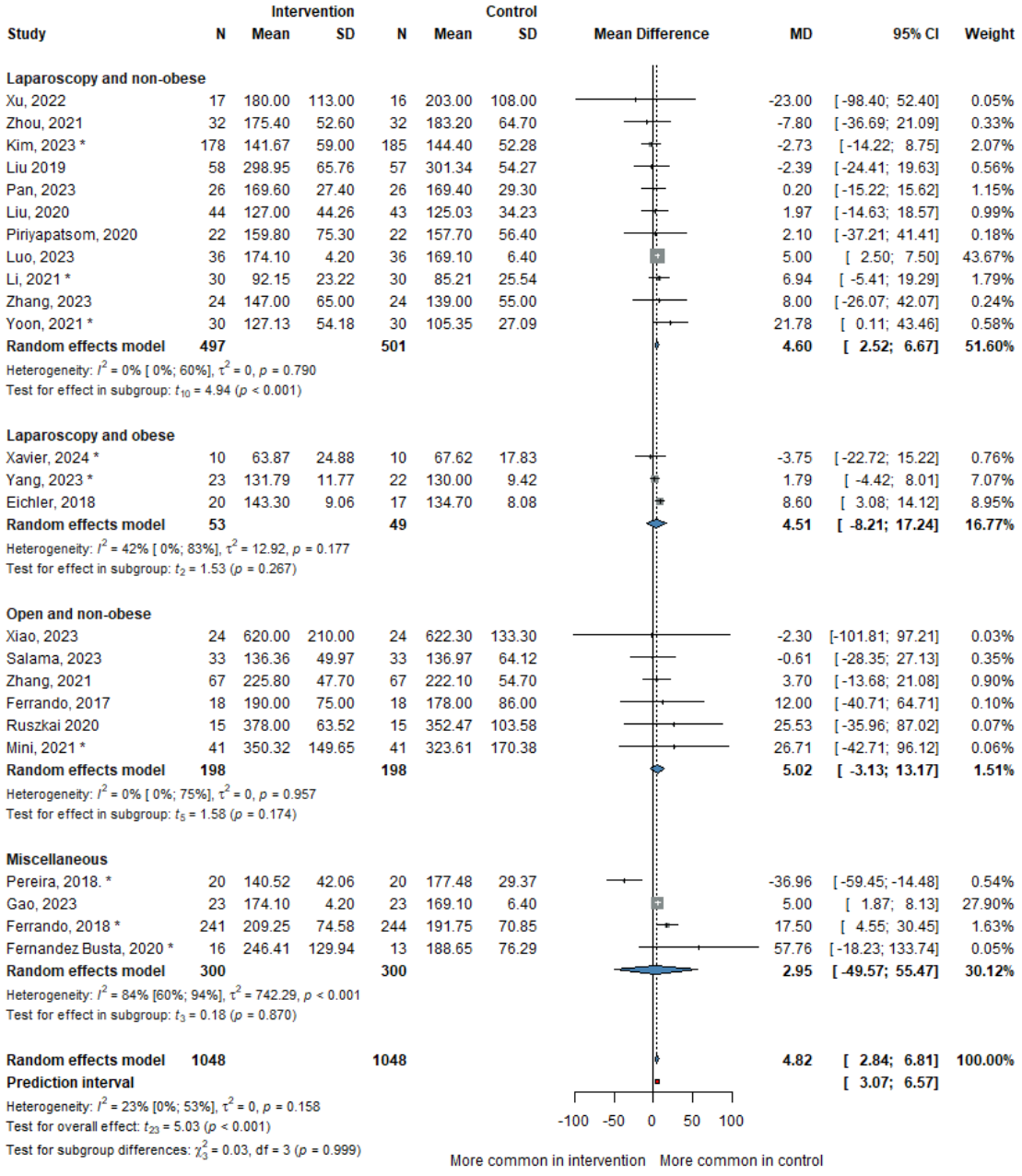


If a study is indicated with * , then its mean and/or standard deviation is estimated from median, quartiles or minimum, maximum values.
See raw data and methods.

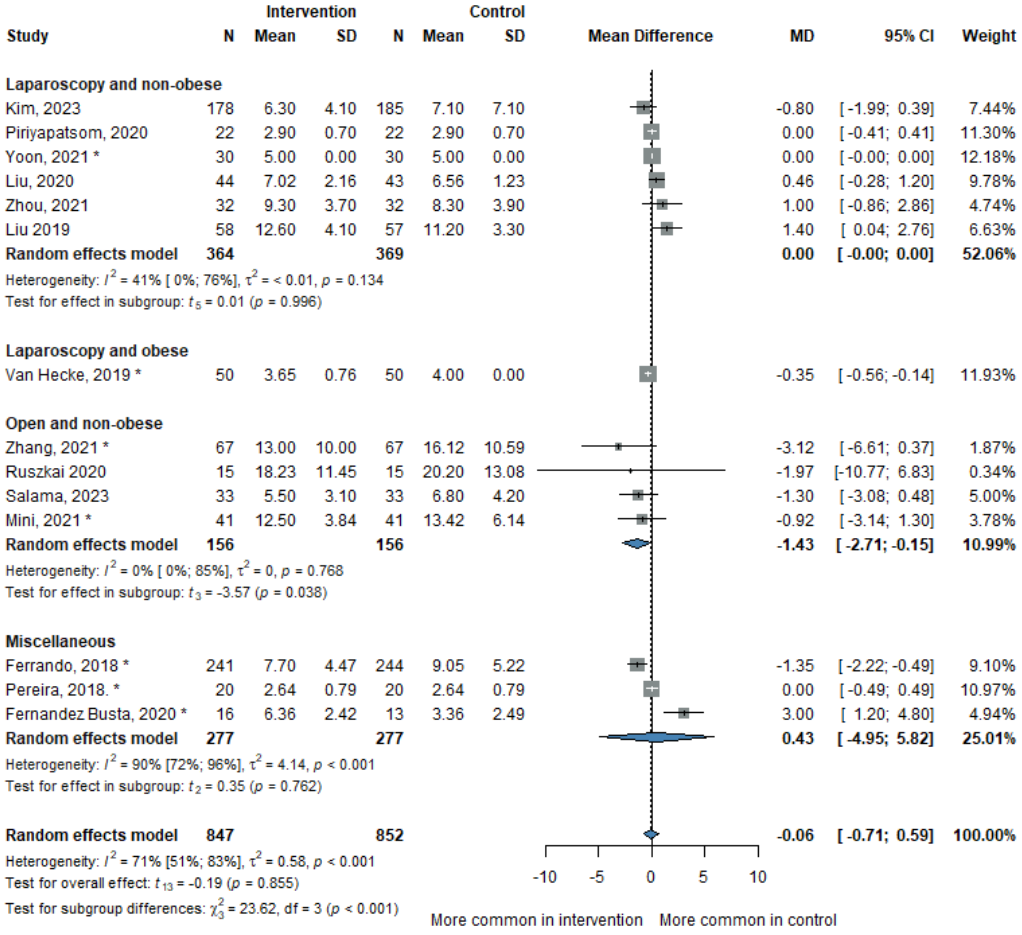
Supplemental Digital Content,Figure S8A Duration of anesthesia in minutes.



Supplemental Digital Content, Figure S8B Duration of surgery in minutes.

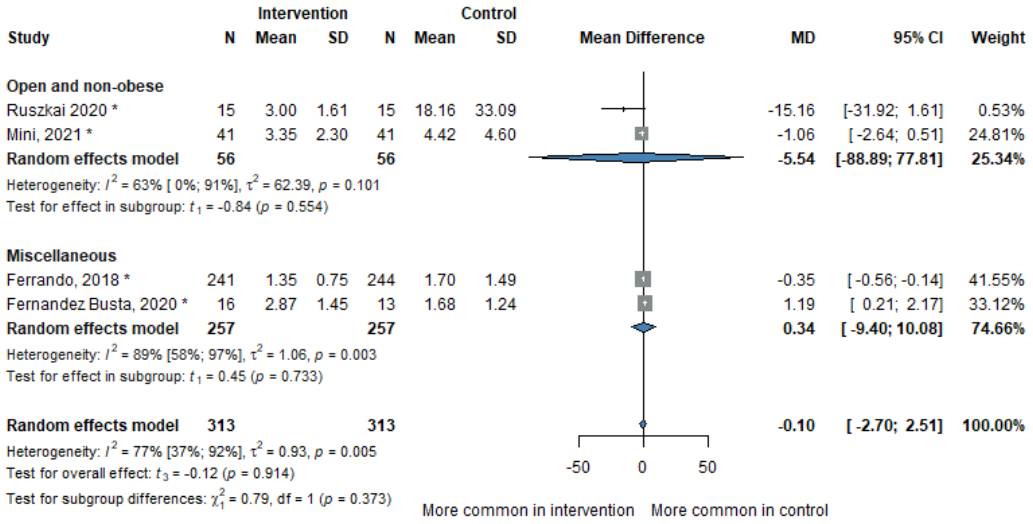


Supplemental Digital Content,Figure S9A Length of hospital stay in days.



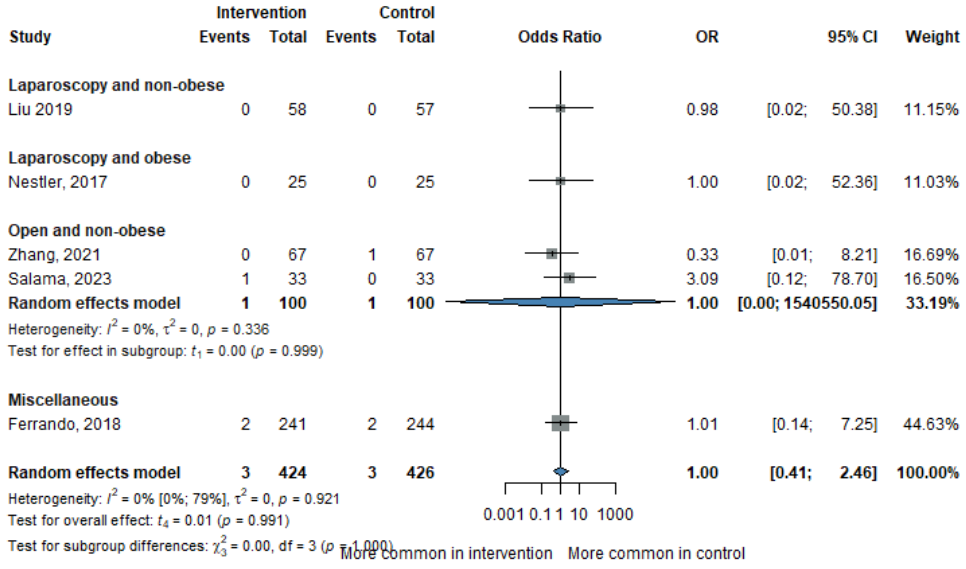
If a study is indicated with * , then its mean and/or standard deviation is estimated from median, quartiles or minimum, maximum values.
See raw data and methods.

Supplemental Digital Content, Figure S9B Length of ICU stay in days.

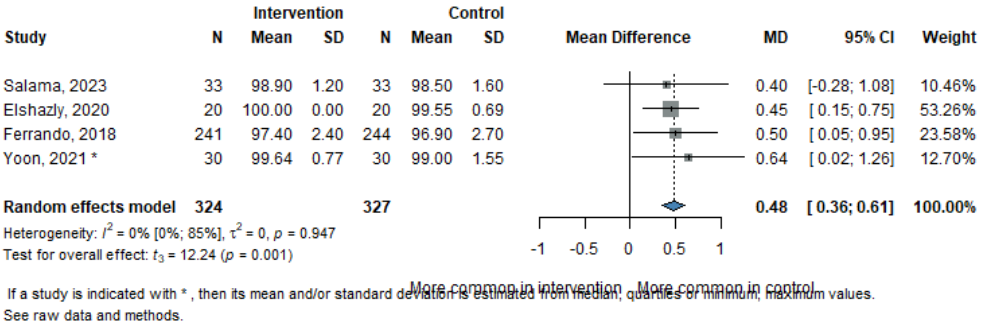


If a study is indicated with * , then its mean and/or standard deviation is estimated from median, quartiles or minimum, maximum values.
See raw data and methods.

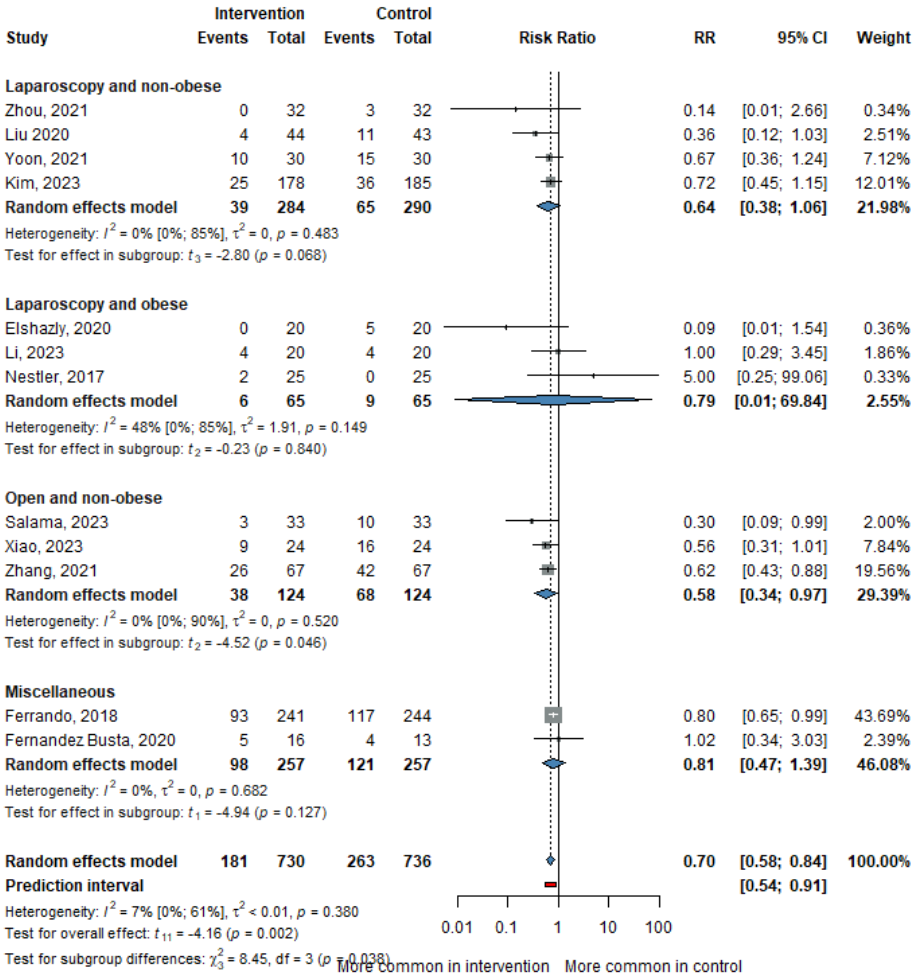
Supplemental Digital Content, Figure S10. Mortality



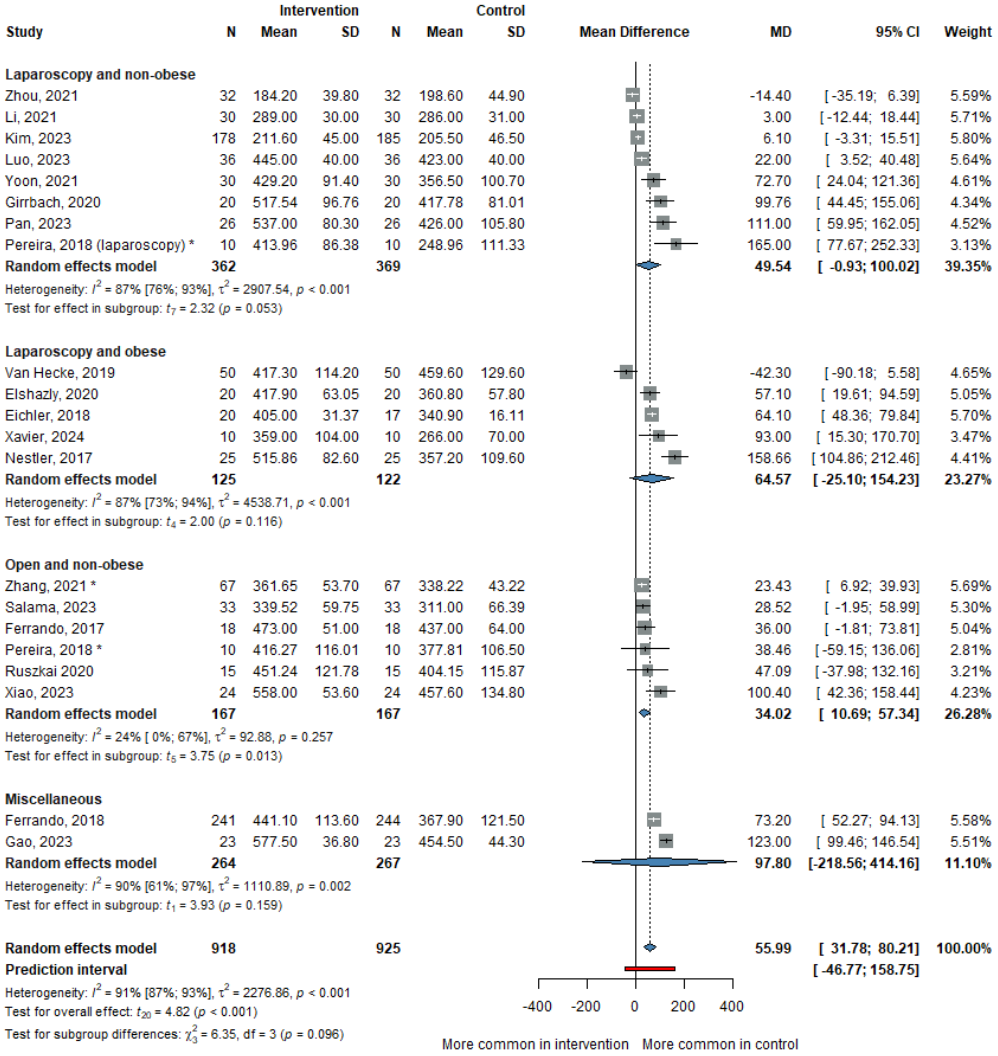
Supplemental Digital Content, Figure S11. SpO2 measured at the end of the surgery



Supplemental Digital Content, Figure S12 – PPCs, subgroup analysis



Supplemental Digital Content, Figure S13 – P/F ratio subgroup analysis



If a study is indicated with * , then its mean and/or standard deviation is estimated from median, quartiles or minimum, maximum values.
See raw data and methods.

Supplemental Digital Content, Figure S14 – PEEP values, subgroup analysis (cmH2O)

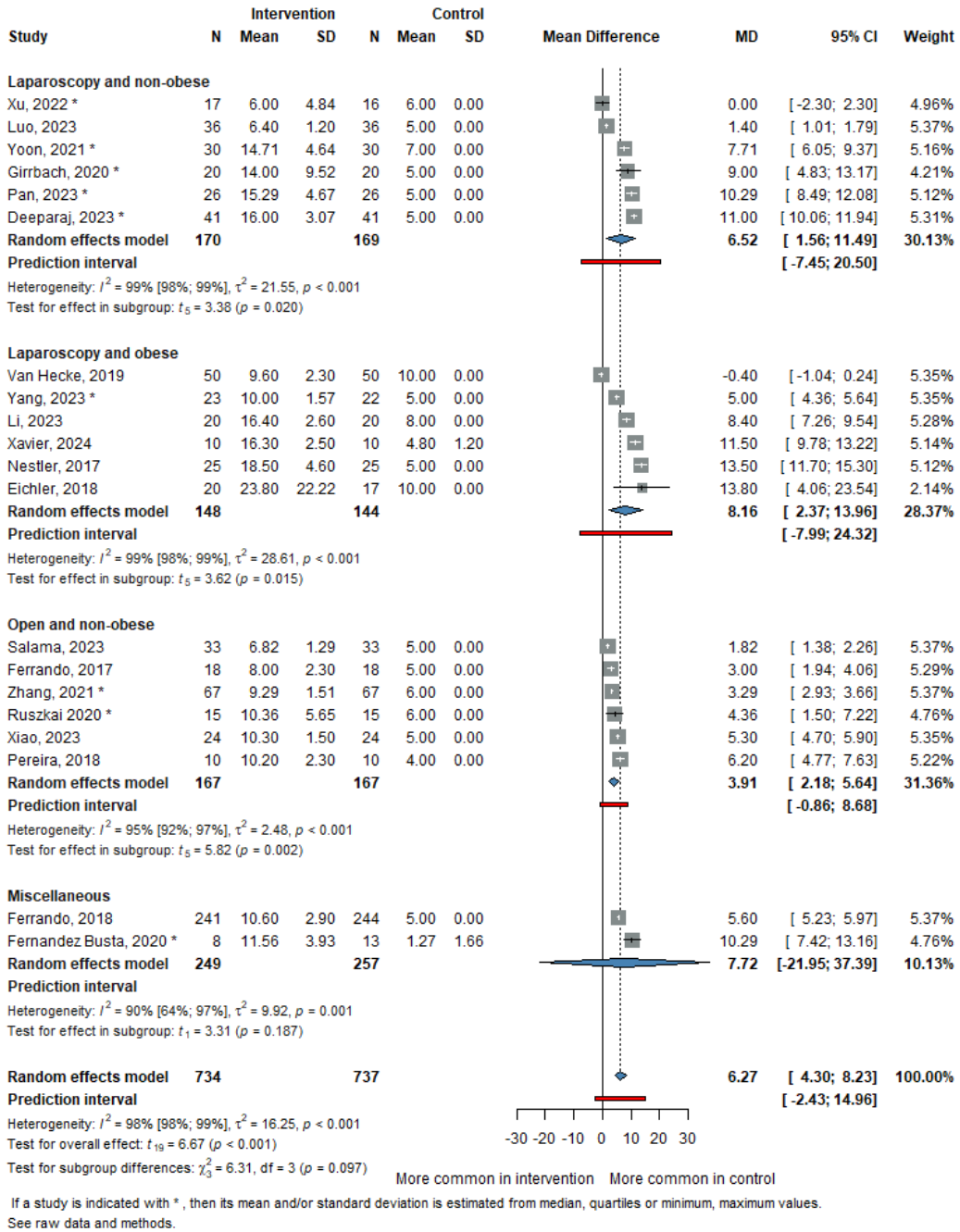


Figure S15 Searching strategy used in the four medical databases on 14 Oct 2021 and 26 Apr 2024.:

Search key for MEDLINE (via Pubmed), Web of Science, and CENTRAL:

(("electric impedance" OR "electrical tomography" OR "electric impedance tomography" OR "electrical impedance tomography" OR impedance or EIT or ultrasound or "ultra sound" or "ultrasound-guided" or "esophageal pressure" or "oesophageal pressure" or "esophageal catheter" or "oesophageal catheter" or "lung ultrasonography" or "lung ultrasound" or "transpulmonary pressure" or "best compliance" or "respiratory compliance" or "lung compliance" or "static compliance" or "PEEP/FIO2" or "dynamic compliance" or "driving pressure" or "Compliance-guided" or "PaO2/FIO2" or "PES-guided" or "individualized" or "individually" or "titrat*") AND (surgery or abdominal or laparasc* or laparosc* or surgical or surgerys or surgeries or pneumoperitoneum) AND (peep or "positive end-expiratory pressure" or "positive end expiratory pressure" or "PEEP-titration")) and random*

Searching strategy in Embase:

('electric impedance'/exp OR 'electric impedance' OR 'electrical tomography' OR 'electric impedance tomography' OR 'electrical impedance tomography'/exp OR 'electrical impedance tomography' OR 'impedance'/exp OR impedance OR eit OR 'ultrasound'/exp OR ultrasound OR 'ultra sound'/exp OR 'ultra sound' OR 'ultrasound-guided' OR 'esophageal pressure'/exp OR 'esophageal pressure' OR 'oesophageal pressure'/exp OR 'oesophageal pressure' OR 'esophageal catheter'/exp OR 'esophageal catheter' OR 'oesophageal catheter'/exp OR 'oesophageal catheter' OR 'lung ultrasonography'/exp OR 'lung ultrasonography' OR 'lung ultrasound'/exp OR 'lung ultrasound' OR 'transpulmonary pressure'/exp OR 'transpulmonary pressure' OR 'best compliance' OR 'respiratory compliance' OR 'lung compliance'/exp OR 'lung compliance' OR 'static compliance'/exp OR 'static compliance' OR 'peep/fio2' OR 'dynamic compliance'/exp OR 'dynamic compliance' OR 'driving pressure'/exp OR 'driving pressure' OR 'compliance-guided' OR 'pao2/fio2' OR 'pes-guided' OR 'individualized' OR 'individually' OR 'titrat*') AND ('surgery'/exp OR surgery OR abdominal OR laparasc* OR laparosc* OR surgical OR surgerys OR surgeries OR 'pneumoperitoneum'/exp OR pneumoperitoneum) AND ('peep'/exp OR peep OR 'positive end-expiratory pressure'/exp OR 'positive end-expiratory pressure' OR 'positive end expiratory pressure'/exp OR 'positive end expiratory pressure' OR 'peep-titration') AND random*

Table S1 – PICO framework

Patients/Population	**Inclusion criteria**	**Exclusion criteria**
	Adult patients (≥18 yrs, both sexes) undergoing major gastrointestinal, gynecological, urological surgery under general anesthesia. Both laparoscopic and open; elective and non-elective surgeries, regardless of duration will be accepted.	-Children (<18 yrs) -Patients ventilated for other reasons than abdominal surgery (e.g. ARDS, respiratory failure).
Intervention	Mechanical ventilation with individually titrated PEEP setting regardless of the chosen titration method.	
Comparator	Conventional (fixed) PEEP setting or zero PEEP (ZEEP) strategy.	
Outcomes	Primary outcome: Incidence of postoperative pulmonary complications (PPCs), as reported by the individual studies. 1) proportion of patients with PPC 2) total number of PPCs occurring in each group 3) number of complications included in the definition of PPC (e.g atelectasis, respiratory infection, ARDS, pleural effusion) Secondary outcomes: 1) Intraoperative oxygenation (PaO2/FiO2 ratio; oxygen saturation) 2) respiratory mechanics (dynamic and static compliance, driving and plateau pressure), 3) vasopressor need (number of patients requiring vasopressor treatment intraoperatively; total amount of vasopressors administered per treatment group) 4) duration of surgery (hours) 5) postoperative inflammatory response (procalcitonin, C-reactive protein, interleukins) 6) length of stay (ICU, hospital) 7) overall mortality	

Supplemental Digital Content,Table S2: **GRADE Assessment - Summary of findings**

Individualized PEEP compared to fixed PEEP for patients undergoing abdominal surgery

Patient or population: patients undergoing abdominal surgery

Intervention: individualized PEEP

Comparison: fixed PEEP

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with fixed PEEP	**Risk with individualized PEEP**				
Postoperative pulmonary complications (PPCs) follow-up: 7 days	357 per 1000	**250 per 1000** (207 to 300)	**RR 0.70** (0.58 to 0.84)	1466 (12 RCTs)	⨁⨁⨁◯ Moderate[a]	
End of surgery PaO2/FiO2 (P/F) ratio (P/F ratio)	The mean end of surgery PaO2/FiO2 (P/F) ratio was **0** mmHg	MD **55.99 mmHg higher** (31.78 higher to 80.21 higher)	-	1843 (20 RCTs)	⨁⨁⨁◯ Moderate[b]	
PEEP values used (PEEP)	The mean PEEP values used was **0** cmH2O	MD **6.27 cmH2O higher** (4.3 higher to 23.54 higher)	-	1471 (20 RCTs)	⨁⨁◯◯ Low[b]	
Number of patients need vasopressor	548 per 1000	**586 per 1000** (548 to 624)	**RR 1.07** (1.00 to 1.14)	1261 (14 RCTs)	⨁⨁⨁◯ Moderate	
Maximum dose of norepinephrine	The mean maximum dose of norepinephrine was **0** ug/kg/min	MD **0.19 ug/kg/min lower** (2.4 lower to 2.01 higher)	-	157 (4 RCTs)	⨁⨁◯◯ Low	
Lung compliance (dynmic) (Cdyn)	The mean lung compliance (dynmic) was **0** cmH2O	MD **3.26 cmH2O higher** (0.08 lower to 6.61 higher)	-	917 (11 RCTs)	⨁⨁◯◯ Low[b]	
Lung compliance (static) (Cstat)	The mean lung compliance (static) was **0** cmH2O	MD **11.92 cmH2O higher** (6.4 higher to 17.45 higher)	-	656 (11 RCTs)	⨁⨁◯◯ Low[b]	
Driving pressure (Pdriving)	The mean driving pressure was **0** cmH2O	MD **2.75 cmH2O lower** (3.95 lower to 1.55 lower)	-	1530 (15 RCTs)	⨁⨁◯◯ Low[b]	
Plateau pressure (Pplateau)	The mean plateau pressure was **0** cmH2O	MD **2.49 cmH2O higher** (1.08 higher to 3.9 higher)	-	1762 (18 RCTs)	⨁⨁◯◯ Low[b]	

Supplemental Digital Content,Table S2: **GRADE Assessment - Summary of findings**

Individualized PEEP compared to fixed PEEP for patients undergoing abdominal surgery

Patient or population: patients undergoing abdominal surgery

Intervention: individualized PEEP

Comparison: fixed PEEP

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with fixed PEEP	**Risk with individualized PEEP**				
Duration of anesthesia (min)	The mean duration of anesthesia (min) was **0** min	MD **0.49 min higher** (6.08 lower to 7.06 higher)	-	1822 (19 RCTs)	⨁⨁⨁⨁ High	
Duration of surgery (min)	The mean duration of surgery (min) was **0** min	MD **6.24 min higher** (2.16 lower to 14.64 higher)	-	1299 (13 RCTs)	⨁⨁⨁◯ Moderate	
Length of hospital stay	The mean length of hospital stay was **0** days	MD **0.06 days higher** (0.71 lower to 0.59 higher)	-	1699 (14 RCTs)	⨁⨁◯◯ Low[a]	
Length of ICU stay	The mean length of ICU stay was **0** days	MD **0.1 days lower** (2.7 lower to 2.51 higher)	-	626 (4 RCTs)	⨁⨁◯◯ Low[a]	
28-day mortality	7 per 1000	**7 per 1000** (3 to 17)	**OR 1.00** (0.41 to 2.46)	850 (4 RCTs)	⨁◯◯◯ Very low[b]	
Total amoung of ephedrine used (mg)	The mean total amoung of ephedrine used (mg) was **0** mg	MD **0.22 mg higher** (1.23 lower to 1.68 higher)	-	323 (6 RCTs)	⨁⨁⨁◯ Moderate[b]	
Total amount of phenilephrine used (mcg)	The mean total amount of phenilephrine used (mcg) was **0** mcg	MD **0 mcg** (0 to 0)	-	416 (6 RCTs)	⨁⨁◯◯ Low[b]	

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **MD:** mean difference; **RR:** risk ratio

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

Explanations

a. Selection bias may be present

b. Statistical heterogeneity