The impact of an education program and written guideline on adherence to low tidal volume ventilation

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ABSTRACT

Background: Low tidal volume ventilation reduces mortality in patients with acute lung injury (ALI) and may reduce the risk of ALI in ventilated patients. A previous audit of our ventilation practices showed poor adherence to low tidal volume ventilation, and we subsequently introduced written ventilation guidelines and an education program to change practice.

Objectives: To determine if adherence to low tidal volume ventilation (defined as mandatory tidal volumes of ≤ 6.5 mL/kg predicted body weight [PBW]) in ventilated patients was improved with a written guideline and staff education.

Design and setting: Retrospective analysis of recorded mandatory ventilator settings from the clinical information system of a tertiary referral intensive care unit from 1 January 2012 to 31 December 2015, involving analysis of mandatory ventilator settings in relation to PBW to determine adherence to guidelines, and interrupted time-series analysis to assess the impact of education.

Main outcome measure: Adherence to low tidal volume ventilation.

Results: The mean tidal volume for the cohort was 7.4 mL/kg (SD, 1.3 mL/kg) PBW, and 760 patients (26.9%) received an average tidal volume during mandatory ventilation of ≤ 6.5 mL/kg PBW. Interrupted time-series analysis showed improved adherence after education, with an increase in adherence of 29.4% (95% CI, 19.3%–39.5%) from baseline. Multivariate logistic analysis found height, weight and staff education, but not sex, were associated with adherence to low tidal volume ventilation.

Conclusion: Written protocols and education can influence clinician behaviour, with substantial improvements in adherence to low tidal volume ventilation. Efforts to improve adherence through ward-based education appear warranted and necessary. Adherence was strongly associated with patient height, which suggested that adherence was partly the result of chance rather than design.

Crit Care Resusc 2016; 18: 174-180

Mechanical ventilation is a fundamental intensive care therapy that, although life-saving, has the potential to harm if used indiscriminately. Following studies on the physiological mechanisms of harm related to mechanical ventilation[1] and small studies supporting tidal volume restriction,[2,3] the Acute Respiratory Distress Syndrome Network (ARDSNet) study definitively showed that ventilator settings influenced mortality in patients with lung injury.[4] This study showed that restricting tidal volume to 6 mL/kg resulted in reduced mortality and also reduced non-pulmonary organ failures, which supported theories that injudicious ventilation may not only harm the lungs but may also harm remote organ systems.

Subsequent studies have extended tidal volume restriction to patients with normal lungs at risk of injury. Gajic and colleagues showed in two studies that there is an association between tidal volume and the development of acute lung injury.[5,6] Neto and colleagues showed a 28% reduction in pulmonary complications with tidal volume ventilation ≤ 7 mL/kg predicted body weight (PBW) in the first 48 hours compared with ≥ 10 mL/kg PBW.[7] More recently, short-term ventilation in the operating theatre has been shown to influence post-operative outcome, with tidal volume restriction and positive end-expiratory pressure (PEEP) reducing post-operative lung complications.[8] This evidence has led to consideration of tidal volume restriction for all ventilated patients, although opinions vary.[9-13]

Despite this evidence, adherence to tidal volume restriction recommendations has been poor.[14-16] This may be due to many factors,[15,17,18] but an acceptance that certain volumes are within a normal range may result in a lack of scrutiny of ventilation settings and their relationship to PBW. Evidence for this comes from observational studies in which obese[16,19] and female patients[5,20] are more likely to receive excessive tidal volumes, perhaps because certain volumes have become normalised in clinicians' minds, based on their perceptions of an average patient.

We have previously audited our ventilation practices over a 14-year period.[21] In that study, we used the definition of adherent tidal volumes of ≤ 6.5 mL/kg PBW, as used by Needham and colleagues.[16] Our study showed that adherence was poor, with a median tidal volume of 8.15 mL/kg PBW (interquartile range [IQR], 7.15–9.34 mL/kg) and an overall adherence of 13.4%. Adherence was lower for women and obese patients, which suggests a failure to individualise ventilation for PBW.

In August 2013, we altered our written ventilation guidelines to recommend tidal volumes of ≤ 6.0 mL/kg PBW for all patients ventilated in a controlled mode in our intensive care unit. This change was discussed at consultant business meetings and disseminated to nursing staff and junior medical staff at teaching sessions and impromptu individual bedside tutorials. We present prospectively collected data before and after the education program to determine if adherence to recommended tidal volumes of ≤ 6.0 mL/kg PBW improved and whether sex and body mass index (BMI) continue to be associated with adherence.

Methods

We obtained ethics approval for the project from the research governance unit at St Vincent's Hospital Melbourne (QA 090/14). The ICU consists of 20 beds, with about 1600 admissions per year. Of these patients, 40% have undergone cardiac surgery and 60% require mechanical ventilation. Clinical observations and laboratory data are entered or imported into a clinical information system (CIS) (IntelliSpace Critical Care and Anesthesia [ICCA], Philips) in the ICU. We also maintain an ICU database of patient information (eg, demographic information, severity of illness and outcomes) that can be linked to the CIS.

Guideline changes

After our ICU audit of tidal volume delivery[21] and with agreement from senior medical staff, we amended our written ventilation guidelines (Appendix, online at cicm.org.au/Resources/Publications/Journal) in August 2013. They recommend ≤ 6.0 mL/kg PBW for tidal volume ventilation in all patients receiving controlled ventilation, with PEEP titration according to the PEEP table in the ARDSNet study.[4] We made these guidelines available on the hospital intranet and delivered education about the protocol changes to senior nursing staff (nurse unit managers, associate managers and nurse educators), who in turn educated other nursing staff. Junior medical staff received one-off education at their weekly formal education sessions. Nursing staff and junior medical staff received informal reinforcement from senior medical staff during ward rounds and impromptu ventilator rounds.

Patients and demographic data

The patient cohort comprised all patients admitted to the ICU and receiving mandatory mechanical ventilation using pressure or volume modes between 1 January 2012 and 31 December 2015. To be included in the analysis, height and sex had to be recorded in the CIS to allow calculation of PBW.

The demographic data we extracted included age, sex, height and weight, with calculation of BMI and PBW according to the ARDSNet study.[4] Ventilator parameters were recorded hourly in the CIS, and parameters extracted included mode of ventilation (broadly divided into pressure and volume mandatory modes), tidal volume, respiratory rate, PEEP and minute ventilation. We recorded tidal volumes for mandatory breaths and spontaneous breaths separately in our CIS and referred to the expired tidal volume as measured by the ventilator. We only included mandatory breaths in our analysis.

Guideline adherence

We defined adherent tidal volumes as ≤ 6.5 mL/kg PBW, as used by Needham and colleagues,[16] because it was the threshold used in the ARDSNet tidal volume trial to designate study site adherence to the goal tidal volume of 6.0 mL/kg PBW. We determined tidal volume adherence and analysed it in two ways, using average tidal volume for an individual over their entire period of mandatory ventilation, and also using individual ventilation recordings. Our outcome of interest was the rate of adherence to ventilation guidelines.

Statistical analysis

We performed univariate analysis of adherence using the following variables:

- sex
- height
- weight
- BMI, obese (> 30 kg/m^2) v non-obese (≤ 30 kg/m^2)
- ventilation mode, pressure v volume
- ventilation time, initial (first 12 hours of ventilation) v late (after 48 hours of ventilation).

We report categorical variables as frequencies and percentages, and continuous data as medians and IQRs if skewed, or as means and SDs if about normally distributed. We analysed differences between groups for continuous variables using the Student t test if normally distributed, and using non-parametric tests if data were skewed. We assessed contingency tables with the χ^2 or Fisher exact tests, as applicable. P values < 0.05 were considered statistically significant. Multivariate logistic regression, clustered by unique ICU admission identification number, was used to determine factors independently associated with adherence. We used interrupted time-series analysis[22] to show adherence before and after the guideline change, and quadratic prediction to show the relationship between height and adherence. Statistical analysis was performed using Stata/IC 14 (StataCorp).

Results

During the period 1 January 2012 to 31 December 2015, 3543 patients received mechanical ventilation. After exclusion of patients who did not receive mandatory ventilation (96 patients) or had missing records of height or sex (625 patients), 2822 remained for analysis. Patient demographics and ventilation parameters are shown in Table 1.

Mean age was 62.5 years (SD, 14.3 years), 1631 patients (57.8%) underwent cardiac surgery and 1962 patients

Table 1. Demographic characteristics and principal outcomes

Characteristic	Measure
Patients, *n*	2822
Men, *n* (%)	1962 (69.5%)
Mean age, years (SD)	62.5 (14.3)
Mean height, cm (SD)	169.6 (9.8)
Mean weight, kg (SD)	83.6 (20.2)
Mean predicted body weight, kg (SD)	64.3 (10.3)
Mean BMI, kg/m^2 (SD)	29.0 (6.3)
Total ventilator readings, *n*	62 743
Median duration of ventilation, hours (IQR)	17 (10–51)
Median APACHE II score (IQR)	16 (13–20)
Underwent cardiac surgery, *n* (%)	1631 (57.8%)
Admitted to ICU from operating theatre, *n* (%)	1940 (68.8%)
Primary diagnosis	
Sepsis, *n* (%)	132 (4.7%)
Respiratory, *n* (%)	243 (8.6%)
Hospital death	
ICU, *n* (%)	226 (8.0%)
Hospital, not ICU, *n* (%)	305 (10.8%)
Volume mode observations, *n* (%)	26 002 (41.4%)
Observation times during mandatory ventilation, *n* (%)	
≤ 12 h	23 885 (38.1%)
13–48 h	20 046 (32.0%)
> 48 h	18 812 (30.0%)
Observations ≤ 6.5 mL/kg (*n* = 27 413), *n* (%)	19 589 (31.2%)
Mean tidal volume, mL (SD)	470.2 (76.4)
Mean cohort tidal volume per predicted body weight, mL/kg (SD)	7.4 (1.3)
Patients with mean individual tidal volume ≤ 6.5 mL/kg, *n* (%)	760 (26.9%)
Patients with mean individual tidal volume ≤ 8 mL/kg, *n* (%)	2010 (71.2%)
Mean PEEP setting, cmH_20 (SD)	6.23 (2.2)

BMI = body mass index. IQR = interquartile range. APACHE = Acute Physiology and Chronic Health Evaluation. ICU = intensive care unit. PEEP = positive end-expiratory pressure.

Table 2. Univariate associations with adherence to tidal volume ≤ 6.5 mL/kg

Variable	Adherence	*P*
Sex, *n* (%)		
Men	647 (33.0%)	< 0.001
Women	113 (13.1%)	
BMI, *n* (%)		
≤ 30 kg/m^2	537 (30.1%)	
> 30 kg/m^2	223 (20.6%)	< 0.001
Ventilation mode, *n* (%)		
Volume	794 (30.4%)	
Pressure	44 (21.1%)	< 0.01
Underwent cardiac surgery, *n* (%)		
Yes	476 (29.2%)	
No	284 (23.9%)	< 0.01
Admitted from operating theatre, *n* (%)	534 (27.5%)	0.29
Timing relative to guideline change, *n* (%)		
Before	66 (6.2%)	
After	694 (39.6%)	< 0.001
Ventilation period,* *n* (%)		
≤ 12 h	669 (27.7%)	
13–24 h	43 (19.8%)	
24–48 h	28 (25.7%)	
> 48 h	20 (23.8%)	0.08
Mean tidal volume adherence, *n* (%)		
Ventilated ≤ 12 h (*n* = 1026)	355 (34.6%)	
Ventilated > 48 h (*n* = 740)	164 (22.2%)	< 0.05

BMI = body mass index. * Controlled ventilation during intensive care unit admission.

(69.5%) were men. The mean PBW was 64.3 kg (SD, 10.3 kg), and mean BMI was 29.0 (SD, 6.3). There were 62 743 ventilator readings for analysis. The mean tidal volume for the period was 470.2 mL (SD, 76.4 mL), which translated to a mean tidal volume for the cohort of 7.4 mL/kg (1.3 mL/kg) PBW. The number of patients whose average tidal volume during mandatory ventilation was ≤ 6.5 mL/kg was 760 (26.9%).

In univariate analysis, male sex, volume control and BMI ≤ 30 kg/m^2 were associated with tidal volume adherence (Table 2). An interrupted time-series analysis of adherence against study time showed that adherence improved after the guideline introduction, with an increase in adherence of 29.4% (IQR, 19.3%–39.5%) from baseline and a post-intervention linear trend of 0.23% (IQR, –0.11% to 0.58%) improvement per month (Figure 1).

The mode of ventilation was predominantly volume-controlled in the first 24 hours (in 21 250 of 33 661 ventilator readings [63.1%]), but after 24 hours, pressure-controlled modes were more frequently used (in 24 330 of 29 082 ventilator readings [83.7%]). Adherence was greatest in the first 12 hours of ventilation.

In the multivariate logistic regression model, height, weight, minute ventilation, guideline introduction and education in August 2013, cardiac surgery, PEEP level and a diagnosis of sepsis or respiratory disease were associated with tidal volume adherence (Table 3). Sex was not independently associated with adherence. The area

Figure 1. Adherence rates over time

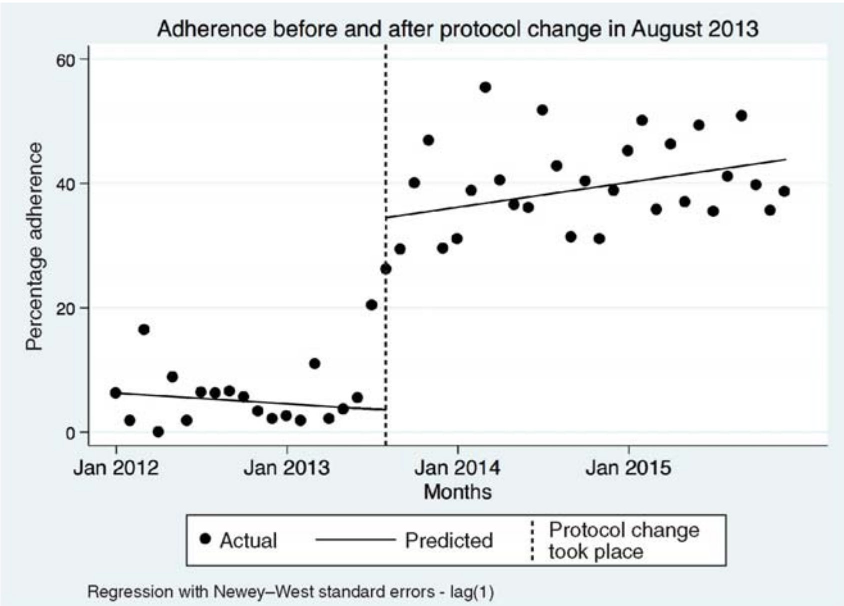


Table 3. Logistic regression model for adherence to tidal volume ≤ 6.5 mL/kg*

Variable	Odds ratio	95% CI	P
Weight, per kg	0.98	0.98–0.99	< 0.001
Men	0.99	0.72–1.37	0.95
Height, per cm	1.14	1.13–1.16	< 0.001
After protocol change	6.38	5.01–8.01	< 0.001
Minute ventilation, per L/min	0.70	0.66–0.73	< 0.001
Sepsis†	2.00	1.33–3.02	< 0.001
Respiratory diagnosis†	1.80	1.28–2.52	< 0.01
Cardiac surgery	1.35	1.06–1.71	< 0.05
PEEP	1.13	1.09–1.16	< 0.001

PEEP = positive end-expiratory pressure. APACHE = Acute Physiology and Chronic Health Evaluation. * Area under receiver operating characteristic curve: 0.83. Hosmer–Lemeshow goodness-of-fit: *P* = 0.44. † Based on APACHE III diagnostic codes.

under the receiver operating characteristic curve for the model was 0.83, and the Hosmer–Lemeshow statistic was not significant (*P* = 0.44). There was a strong association between height and adherence, with a 14% increase in adherence for every centimetre of increase in height. Figure 2 shows the relationship between height and tidal volume adherence.

Discussion

In our analysis of ventilator practices in a tertiary referral ICU, we showed that implementation of a written ventilation protocol with group education of nursing and junior medical staff, in addition to ad hoc bedside education, substantially influenced ventilation practice. The strong association between adherence and patient height suggests that some of the adherence may be the result of chance rather than design.

Our analysis studied tidal volume delivery for patients receiving mechanical ventilation in a mandatory mode. We found that overall adherence to low tidal volume ventilation, defined as ≤ 6.5 mL/kg PBW, for patients in mandatory ventilation modes was low. Although only 39.6% of the post-intervention cohort received an average tidal volume that was adherent, that was a substantial improvement compared with our previous audit.[21] However, this relatively low adherence after our intervention highlights the need for continuing education, auditing of outcomes and investigation of alternative methods for improving adherence. We found that height, weight and introduction of a written guideline with education were all independently associated with tidal volume adherence.

Comparison with previous studies

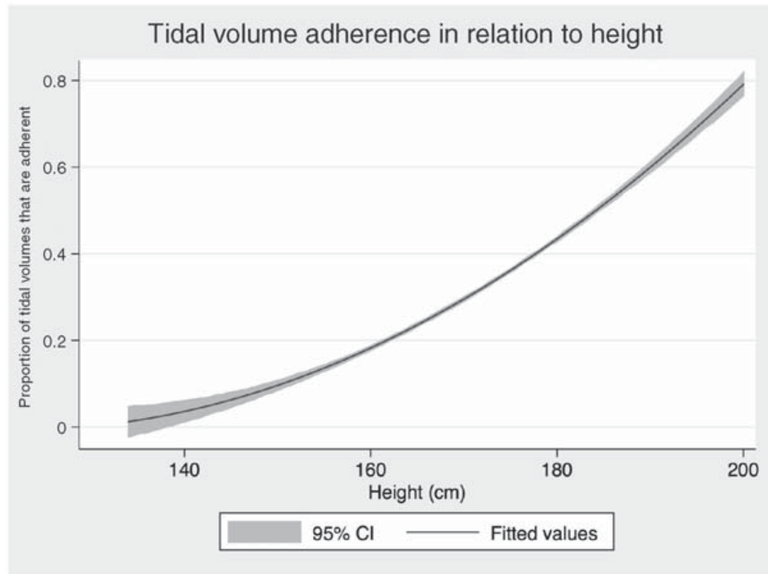
Unlike previous studies, we did not find an independent association between sex and adherence to low tidal volumes. Gajic and colleagues[5] reported that women were more likely to receive higher tidal volumes and were at higher risk of developing ventilator-associated lung injury. Other studies have also reported a tendency for women to receive higher tidal volumes.[20,23] It is possible that clinical staff accept tidal breaths of a fixed volume to be normal and apply these without reference to patient height, resulting in excessive volumes for smaller people. This is shown in Figure 2, where a positive association between adherent tidal volumes and increasing height is seen.

Adherence related to PBW

Indiscriminately delivered tidal volumes are more likely to be adherent to the guidelines in taller people, as PBW is a function of height. The PBW for a woman 180 cm tall is 70.6 kg (which corresponds to an adherent tidal volume of 459 mL), and the PBW for a man of the same height is 75.1 kg (corresponding to an adherent tidal volume of 488 mL). It is therefore likely that the discrepancy between adherence for men and women in our univariate analysis is simply related to the average heights of the sexes. Mean height in our study for men was 173.6 cm (SD, 7.9 cm), and for women was 161.0 cm (SD, 8.4 cm), giving average adherent tidal volumes of 462 mL and 347 mL, respectively.

If the clinicians in our study were used to acting on the belief that tidal volumes in the 400–500 mL range were normal or acceptable, it is much more likely that the women in our study would have received an excessive tidal volume compared with men. The logical extension of this hypothesis is that adherence in our study was likely to have been partly due to chance rather than to clinician intention.

Figure 2. Adherence rates, by patient height



Low adherence

Although our intervention improved adherence and achieved some continued improvement over time, our overall adherence remained low. Routinely measuring the demispan for all ventilated patients and documenting an absolute tidal volume for mandatory ventilation on the patient's chart may help change practice. Some ventilator machines now allow the input of PBW when ventilation is initiated, prompting its calculation as well as providing a breath-by-breath display of tidal volumes in mL/kg PBW. The protocol known as FAST HUGS (feeding and fluids, analgesia, sedation, thromboprophylaxis, head-up position, ulcer prophylaxis, glycaemic control, spontaneous breathing trial, bowel care, indwelling catheter removal, and de-escalation of antibiotics) adopted by many ICUs does not specifically address ventilator settings.[24] The introduction of a similar checklist for ventilation parameters that included measurement of demispan, calculation of ideal body weight, and calculation and documentation of the tidal volume target may be worthwhile. Introduction of a daily-round checklist that included tidal volume recommendations has been shown to improve adherence to tidal volume restriction.[25]

The Large Observational Study to Understand the Global Impact of Severe Acute Respiratory Failure (LUNG-SAFE) study[26] highlighted the need for such interventions. In this international, observational audit, the authors found that acute respiratory distress syndrome (ARDS) often went unrecognised and even when it was recognised there was little impact on tidal volumes delivered. This suggests that the introduction of tidal volume restriction for all ventilated patients might result in better management of patients with ARDS. In the LUNG-SAFE study, fewer than 20% of patients with ARDS received a tidal volume of 6 mL/kg and 35% received a tidal volume greater than 8 mL/kg. By contrast, in our cohort of ventilated patients, 39.6% and 84.6% had tidal volumes of ≤ 6.5 mL/kg and ≤ 8 mL/kg, respectively, after our intervention.

Our study showed an independent association between patient weight and tidal volume adherence, with higher weight associated with lower adherence. This is in agreement with a previous retrospective review that found that obese patients received higher tidal volumes compared with patients with a normal BMI.[27] The study found that after risk adjustment, excess body weight was not independently associated with increased mortality but that tidal volume restriction benefited obese and non-obese patients similarly. A retrospective study of ventilation in the emergency department found that obese patients were more likely to receive inappropriate tidal volumes (defined as > 10 mL/kg PBW) and that volume increased with increasing obesity.[19] Deane and colleagues[20] found that although women received larger tidal volumes in relation to ideal body weight than did men, there was no difference when actual body weight was used to calculate tidal volumes. This suggests that clinicians used actual rather than ideal bodyweight.

Lower adherence for later ventilation

We hypothesised that there would be less adherence to tidal volumes during early ventilation because the tidal ventilation was more likely to have been initiated by nursing staff or junior medical staff than by senior staff, who may only make rounds several times per day. In contrast to this, we found that adherence to low tidal volumes was highest in the first 12 hours. We noted that volume-controlled ventilation was predominant in early ventilation, with pressure-controlled ventilation predominating later on. The default mode in our ICU is volume-controlled ventilation, which explains the predominant use of this mode for early ventilation.

In Australia, the bedside nurse is responsible for much of the manipulation of the ventilator.[28] The ease of setting volumes with volume control, and the fact that nurses may be more compliant with guidelines than doctors,[29] may explain the early adherence. In the case of pressure-controlled ventilation, setting a volume is more complex and requires staff to modify pressure settings until an appropriate tidal volume is reached. Also, as patients wake from sedation or anaesthesia, or respiratory system compliance changes, constant vigilance is required to maintain tidal volume restriction.

Other possible explanations for the reduction in compliance after the first 12 hours may include manipulation of ventilation to achieve other clinical goals, such as the correction of acidosis. Clinicians may not have felt that low tidal volume restriction applied to their patient cohort, despite bedside education and written guidelines, or there may have been a discrepancy between perceived adherence and actual clinical practice among clinicians. In a German study, ICU directors were interviewed about the frequency of adherence to various medical therapies in patients with sepsis, and one therapy under discussion was low tidal volume ventilation in patients with ARDS.[30] The authors compared perceptions of practice with patient medical file data, and showed that 79.9% of ICU directors perceived that they had adhered to low tidal volume ventilation, but that only 2.6% of patients had received low tidal volume ventilation.

Association of adherence with education

Our study showed a significant association between our educational intervention and delivery of adherent tidal volumes. We showed that within our current audit period, adherence increased from 6.2% before to 39.6% after the intervention. Adherence in our previous audit was 10%.[21] This finding is in agreement with a previous study on the impact of a written protocol on low tidal volume ventilation, which showed a significant reduction in tidal volumes prescribed (from 10.1 mL/kg PBW to 7.1 mL/kg PBW).[31] This study also found that the use of a written protocol was strongly associated with adherence to low tidal volumes, showing that a standard protocol for administering complex therapies can improve translation of research evidence into clinical practice.[31]

In an observational study from the Netherlands, feedback and education about the importance of lower tidal volume ventilation led to a reduction in tidal volumes within 6 months of the intervention (from 84% of patients receiving > 8 mL/kg PBW to 48% receiving > 8 mL/kg PBW). Lower tidal volumes were still being implemented 12 months after the education sessions.[32] A more recent study by the same authors, investigating the effect of feedback and education on the use of low tidal volume ventilation in Dutch ICUs, again found that mean tidal volume improved following the intervention, from 10.9 mL/kg PBW to 7.6 mL/kg PBW.[33]

Strengths and weaknesses

Our study has several strengths and weaknesses. The availability of an ICU CIS allowed access to high-quality prospective data for analysis of ventilation settings, although the data quality depended on staff accuracy, and settings were only recorded hourly. Because our study was retrospective, we were limited in the data collected and therefore the variables available for analysis. Patients without recorded heights were excluded from the study, as were patients whose sex was not recorded, so not all patients receiving mandatory ventilation were analysed. It is possible that particular patient groups were less likely to have had their height recorded (eg, admissions from the emergency department) and this may have biased our results towards elective surgical patients or ward patients, for whom ventilation practices may have been different. We observed a change in adherence after the introduction of our education intervention, and, although we believe that the two are causally linked, we cannot exclude the possibility that other factors not analysed in our study influenced adherence. Lastly, ours was a single-centre study and our results may not apply in ICUs elsewhere that have different staffing structures or patient mixes.

Conclusion

Our results suggest that the use of a written ventilation guideline and staff education changes practice, improving adherence to low tidal volume ventilation. Efforts to improve adherence through ward-based education appear warranted and necessary. Adherence was strongly associated with patient height, suggesting that some of the adherence was the result of chance rather than clinician design.

Competing interests

None declared.

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Appendix 1. This appendix was part of the submitted manuscript and has been peer reviewed. It is posted as supplied by the authors.

St Vincent's Hospital Department of Critical Care ventilation Guidelines

Mechanical Ventilation – General

- Tidal volume ≤6 mL/kg PBW
  Men: 50 + 0.91 (Height in cm – 152.4 cm)
  Women: 45.5 + 0.91 (Height in cm – 152.4)
- Respiratory frequency for pH
- PEEP as required for FiO_2 ≤0.50

Mechanical Ventilation – Acute Respiratory Distress Syndrome

Definition ARDS ('Berlin' definition, JAMA June 20 2012 Vol 307;23):

- Timing: within 1 week of a known clinical insult
- Bilateral infiltrates on CXR
- Origin of oedema and respiratory failure not fully explained by cardiac/fluid overload
- PaO_2/FiO_2 ratio:
  Mild 200-300 with PEEP >5cm$H_2$0
  Moderate 100-200 with PEEP >5cm$H_2$0
  Severe <100 with PEEP >5cm$H_2$0

Components:

- Pressure control mode (BiPAP, BiPAP/SIMV, PCV, PRCV, Bivent)
- Tidal volume ≤6 mL/kg PBW
- Reduce further to minimum 4 mL/kg if plateau pressure >30 cmH_2O
- Increase to 7-8 mL/kg if dyspnoea and plateau pressure <30 cmH_2O
- Frequency for pH > 7.15
- Plateau pressure > 30 cm H_2O only if:
  - Tidal volume <4 mL/kg
  - pH <7.15
- Standard PEEP combinations:

FiO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	5	5	8	8	10	10	10	12	14	14	14	16	18	18-24

- Aim for PaO2 55-80, SpO2 88-95.
- PEEP adjustments on order of consultant, the above table is a guide only.