FCV® PRESENTED AT ESAIC 2022

SATURDAY, 04 JUNE 2022

10:30 - 18:00 — **VIRTUAL PLATFORM**

11AP04 Respiratory and Airway Management (4)

11AP04-07 Tritube use in 12 year girl underwent scheduled laryngeal papilloma resection
Lucia Martinez Botet (Spain)

12:30 - 14:00 — **POSTER EBOARD 4**

07AP01 Cardiac, Thoracic and Vascular Anaesthesiology (1)

07AP01-02 Flow-controlled versus pressure-controlled ventilation in on-pump cardiac surgery procedures
Lisa-Marie Wichelhaus (Germany)

07AP01-11 Gender differences in applied tidal volume with compliance titrated flow-controlled ventilation during cardiac surgery – a subgroup analysis of a randomized clinical trial
Patrick Spraider (Austria)

14:30 - 16:00 — **POSTER EBOARD 5**

09AP02 Intensive Care medicine (2)

09AP02-06 Flow controlled ventilation as a novel useful strategy in weaning from extracorporeal membrane oxygenation therapy in critical course of COVID-19 in parturient – case presentation
Paweł Piwowarczyk (Poland)

SUNDAY, 05 JUNE 2022

10:25 - 11:55 — **POSTER EBOARD 1**

11AP03 Respiratory and Airway Management (3)

11AP03-10 Mechanical power and ventilatory efficiency during flow-controlled ventilation in severe COVID-19 ARDS
Alberto Grassetto (Italy)

MONDAY, 06 JUNE 2022

10:30 - 11:30 — **POSTER EBOARD 2**

07AP05 Cardiac, Thoracic and Vascular Anaesthesiology (5)

07AP05-03 Flow-controlled ventilation versus pressure-controlled ventilation in thoracic surgery requiring one-lung ventilation – a randomized, controlled, single-center trial
Julia Abram (Austria)

07AP05-08 Flow-controlled ventilation improved gas exchange during one-lung ventilation: a randomised experimental cross over study
John Diaper (Switzerland)

11AP04
Respiratory and Airway Management (4)

>> https://esaic2022.abstractserver.com/program/#/details/presentations/1241

Tritube use in 12 year girl underwent scheduled laryngeal papilloma resection

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Background

Recurrent respiratory papillomatosis (RRP), caused by human papillomavirus, is the most common benign laryngeal tumor in children. It may cause symptons such as aphonia and respiratory distress. It is usually placed in the vocal cords and it often requires surgery, challenging airway control.

Case Report

A 12-year-old girl diagnosed with RRP was scheduled for resection of laryngeal papillomas due to dysphonia. She had been operated four times due to recurrence. In the last intervention the diameter of the TET prevented the visualization and removal of the lesions located in the medial aspect of the arytenoids. In this surgery we placed the tritube, TET with an external diameter of 4.4 mm, in combination with the Evone continuous flow ventilator, allowing the surgeons to resect all the lesions.

Discussion

There are few publications on the use of tritube TET in cases of laryngeal papillomatosis, mostly on its use for severe stenosis and not for previous failure of surgery. Here we describe how by using tritube we achieve an adequate ventilation as well as an optimal visualization of the surgical field, allowing a better access to the laryngeal lesions, which increases the possibilities of complete resection of the lesions.

References

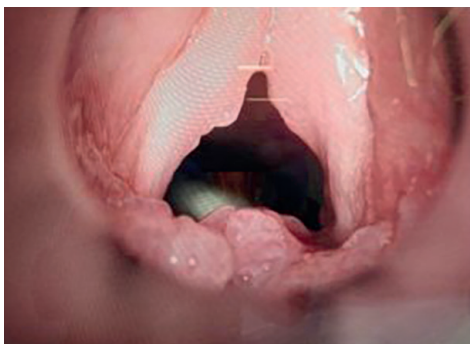
Carifi, M., Napolitano, D., Morandi, M., & Dall'Olio, D. (2015). Recurrent respiratory papillomatosis: current and future perspectives. Therapeutics and clinical risk management,11, 731.

Piosik, Z. M., Todsen, T., Balle, J. S., Abildstrøm, H., & Kristensen, M. S. (2018). Ultra-narrow 2.4 mm id Tritube® together with Evone® ventilation allows surgical access and controlled ventilation even in case of severe stenosis. Trends in Anaesthesia and Critical Care,23, 20.

Learning points:

In space-occupying lesions of the larynx, we must use an anesthetic technique that facilitates the surgeon's work by visualizing the tumors to be treated and being able to ensure their correct ventilation.

We consider the use of the tritube ETT with continuous flow ventilation as the only effective alternative in the case described.



07AP01
Cardiac, Thoracic and Vascular Anaesthesiology (1)

>> https://esaic2022.abstractserver.com/program/#/details/presentations/756

Flow-controlled versus pressure-controlled ventilation in on-pump cardiac surgery procedures

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Background

Postoperative pulmonary complications like mild hypoxemia are common after on-pump cardiac surgery and partly due to dys-/atelectasis formation. In animal studies and clinical cross-over trials, flow-controlled ventilation (FCV) with constant and continuous airway flows during both ins- and expiration, improved regional ventilation distribution compared to conventional ventilation modes [1,2].

As an ongoing, explorative, ancillary study integrated with the randomised-controlled trial FLOWVENTIN HEARTSURG [3], the effect of FCV or best clinical practice pressure-controlled ventilation (PCV) on perioperative lung aeration is assessed by Electrical Impedance Tomography (EIT).

Methods

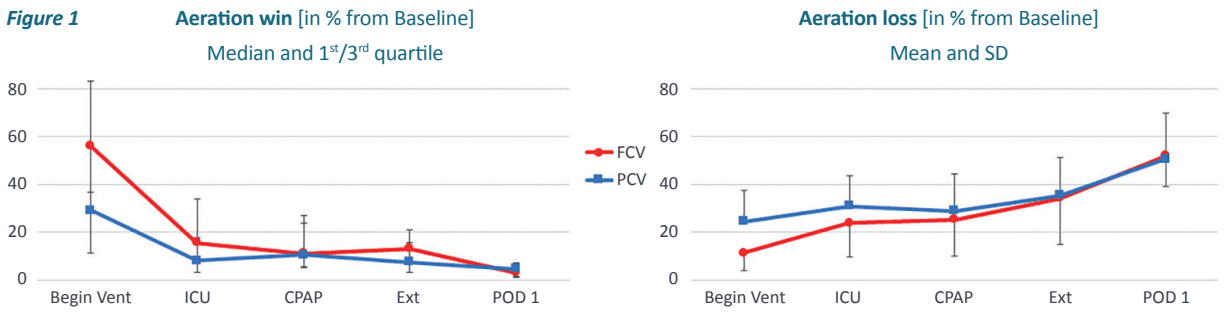
EIT-data is recorded on six serial perioperative times with an EIT-belt positioned between the 4-6th intercostal space; Baseline: preoperative patient breathing spontaneously; Begin vent: preoperative ventilation; ICU: on postoperative ICU admission; CPAP: on assisted ventilation during weaning; Ext: 1 hour after extubation, POD1: on postoperative day 1.

As preliminary results the percentage of aeration win and loss compared to “Baseline” during the subsequent times was analysed in 60 consecutive patients (FCV:n=30; PCV:n=30) with the PC-version of PulmoVista® (Draeger Medical GmbH, Lübeck, Germany).

Results

Preoperative median aeration win was higher and mean aeration loss lower in FCV compared to PCV after onset of ventilation. However, group differences waned and aeration loss deteriorated in both groups during the postoperative period, respectively (Figure 1).

Figure 1



Discussion and Conclusion

Even though the mean postoperative oxygenation indices were higher in FCV versus PCV [3], this finding cannot be explained by an improvement of postoperative lung aeration due to FCV. Thus, other causes of postoperative lung dysfunction might have an impact. By the time of abstract presentation, the study will be completed and further EIT-parameters as well as confirmatory statistical analyses will be presented.

References

1 Borgmann, S et al. Crit Care Med 2018;22:245, 2 Weber, J et al. BMC Anesthesiol 2020;20:24,
3 Becker, S et al. Eur J Anaesthesiol 2021; 38(e-S 59):127

07AP01
Cardiac, Thoracic and Vascular Anaesthesiology

>> https://esaic2022.abstractserver.com/program/#/details/presentations/971

Gender differences in applied tidal volume with compliance titrated flow-controlled ventilation during cardiac surgery – a subgroup analysis of a randomized clinical trial

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Background and Goal of the Study

Flow-controlled ventilation (FCV) provides a continuous gas flow and coupled with direct tracheal pressure measurement precise determination of dynamic compliance is feasible. Accordingly, not only positive end-expiratory pressure (PEEP), but also peak pressure can be titrated to achieve the highest dynamic compliance. This personalized ventilation approach leads to an automatic adaption of the applied tidal volume to the functionally available lung tissue within individual lung mechanic limits, which may differ between female and male patients and represents the rationale for this sub-group analysis.

Materials and Methods

A sub-group analysis of 24 patients randomized to receive flow-controlled ventilation in cardiac surgery without ventilation during the cardiopulmonary bypass period was performed. Ventilation was established with compliance titrated PEEP and peak pressure settings and flow adjusted to maintain normocapnia at an I:E ratio of 1:1. Linear mixed-effects model was used in order to investigate sex related differences in respiratory parameters.

Results and Discussion

Whereas in women (n=6) and men (n=18) PEEP and peak pressure settings were similar after compliance guided titration, the resulting tidal volume was significantly lower in female patients (8.6 vs 9.9, 95% CI -2.3 to -0.2 ml/kg PBW; p=0.029) compared to male individuals. Concomitantly, female patients had a significantly lower compliance (49.3 vs 70.3, 95% CI -33.1 to -8.8 ml/cmH2O; p=0.003) compared to men. Gas exchange parameters were comparable in either gender. Our results indicate that the functional lung volume in women are lower compared to men, even after adjustment to published formulas of predicted body weight (PBW). This finding is even more notable, as previous trials have shown that in clinical routine female patients receive higher tidal volumes than male individuals [1].

Conclusion

Female patients were found to receive lower tidal volumes after compliance guided pressure settings with FCV compared to men during cardiac surgery. This finding may indicate that the functionally available lung volume in women is lower and thus using PBW does not adequately comply with sex related differences. This supports the use of a personalized ventilation strategy with FCV.

References

1 Nijbroek SG, Hol L, Swart P, et al. Sex difference and intra-operative tidal volume: Insights from the LAS VEGAS study. Eur J Anaesthesiol. 2021;38:1034-1041.

09AP02
Intensive Care medicine

>> https://esaic2022.abstractserver.com/program/#/details/presentations/964

Flow controlled ventilation as a novel useful strategy in weaning from extracorporeal membrane oxygenation therapy in critical course of COVID-19 in parturient – case presentation

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Background

Mortality of Covid-19 patients supported with veno-venous extracorporeal membrane oxygenation (ECMO) reaches 38% [1]. As the duration of ECMO is associated with increased mortality and (hematologic) complications, weaning is crucial. Effective yet protective ventilatory strategies are urgently needed [1]. Flow Controlled Ventilation (FCV) may facilitate ECMO weaning by decreasing the mechanical energy transferred to and dissipated in the patient's lungs due to the active and fully controlled expiration [2].

Case Report

A 24-year-old parturient without comorbidities was admitted to hospital for initiation of V-V ECMO due to critical course of COVID-19. Mechanical ventilation was started on the day of caesarean section (32nd gestational week) and ECMO two days later (Resp score 5; ECMO flow 3,5 l/min, sweep gas at 4 l/min). Initially, we applied ultraprotective ventilation, PEEP titration, neuromuscular blockade, and proning. Norepinephrine was used and SOFA score was 9. Due to heparin and thrombocytopenia, the patient had a bleeding disorder and required multiple transfusions of blood products. During daily ECMO weaning trials using pressure released volume-controlled ventilation mode (FiO_2 0,6) and PEEP titration, normocapnia and sufficient oxygenation were not achieved. On the 9th day of ECMO therapy, FCV was initiated (FiO_2 0,6; Inspiration Flow 14 L/min; I:E ratio 1:1,1; Peak 28 mbar; EEP 9 mbar). PaO_2/FiO_2 increased from 96 to 154 and pCO_2 decreased from 63 to 44 mmHg. At 12th day ECMO therapy could be terminated under FCV. Static compliance of the lungs increased from 13 ml/cm H_2O to 28 ml/cm H_2O. Two weeks after ECMO termination conventional ventilation is still being applied in the ICU.

Discussion

We present the first case using FCV as an effective method to improve ventilation parameters in patients undergoing ECMO therapy. In this patient FCV significantly improved oxygenation while reducing hypercapnia and shortened ECMO therapy.

References

1 Ramanathan K, et al. Extracorporeal membrane oxygenation for COVID-19: a systematic review and meta-analysis. Crit Care. 2021 Jun 14;25(1):211

2 Barnes T et al. Minimisation of dissipated energy in the airways during mechanical ventilation by using constant inspiratory and expiratory flows - Flow-controlled ventilation (FCV). Med Hypotheses. 2018 Dec;121:167-176

Learning points

FCV may improve weaning from ECMO and shorten ECMO duration.
Presented finding requires confirmation in clinical studies.

11AP03
Respiratory and Airway Management (3)

>> https://esaic2022.abstractserver.com/program/#/details/presentations/1110

Mechanical power and ventilatory efficiency during flow-controlled ventilation in severe COVID-19 ARDS

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Background and Goal of the Study

The prevention of ventilator-induced lung injury (VILI) is the mainstay of the management of mechanical ventilation in patients with ARDS. Mechanical power, which represents the total inflation energy transferred from the mechanical ventilator to the lungs, including flow and respiratory rate, is associated with VILI and mortality in patients with ARDS. Flow-controlled ventilation (FCV) is a ventilation mode that provides low, constant flow throughout both inspiration and expiration without pauses implemented by the Evone® ventilator (Ventinova Medical, Eindhoven, The Netherlands). By avoiding high peak flows and reducing respiratory rate, FCV may lead to the minimization of applied and dissipated energy in order to attenuate VILI in ARDS patients.

Materials and Methods

FCV was used when the arterial partial pressure of oxygen to inspired oxygen fraction ratio was lower than 150 mmHg during conventional volume-controlled ventilation, despite neuromuscular blockade and prone positioning longer than 12 hours, in 7 patients admitted to the ICU because of severe ARDS secondary to coronavirus disease-19. We registered the changes in ventilatory settings, respiratory mechanics (including driving pressure and mechanical power), and gas exchanges during the transition from conventional volume-controlled mechanical ventilation (CMV) to FCV and back.

Results and Discussion

During FCV, the decreased inspiratory flow was associated with an overall decreased respiratory rate and minute ventilation, in comparison with CMV. During FCV, despite similar driving pressure and compliance, the mechanical power was overall lower, as compared with CMV. Moreover, we observed an overall lower ventilatory ratio during FCV.

Conclusion

Our findings suggest that FCV may reduce mechanical power and increase ventilatory efficiency in patients who remain severely hypoxemic after the optimization of CMV.

Ventilatory settings, respiratory mechanics, and gas exchanges

	C1	F	C2	C1	F	C2	C1	F	C2	C1	F	C2	C1	F	C2	C1	F	C2	C1	F	C2
Patient	Respiratory rate (breaths/min)			Minute ventilation (L/min)			Driving pressure (cmH_2O)			Inspiratory flow (L/min)			Mechanical power (J/min)			PaO_2/FiO_2 (mmHg)			Ventilatory ratio		
1	28	17	21	11.76	7.07	8.82	12	12	12	25.87	15.00	26.46	25	10	17	103	112	133	2.1	1.3	2.0
2	28	18	28	12.90	7.92	12.32	12	11	10	25.80	15.00	24.64	24	11	25	130	107	80	3.6	1.3	3.7
3	27	16	24	12.96	8.00	11.52	13	13	13	25.92	15.00	23.04	27	14	24	118	125	103	2.6	1.5	2.6
4	25	16	25	12.5	8.32	12.50	10	11	12	27.50	15.00	27.50	26	15	25	140	190	152	2.5	1.4	2.6
5	26	20	25	11.18	7.40	10.75	12	11	11	27.95	14.00	21.50	21	11	20	134	142	150	2.3	1.4	2.4
6	22	11	22	9.46	5.50	9.46	11	14	12	18.92	11.00	18.92	19	10	19	127	142	153	1.9	1.0	1.6
7	22	14	21	9.24	5.60	8.61	14	14	14	18.50	11.00	17.22	20	11	18	133	202	157	1.3	1.1	1.6

For each variable, three values are reported: the last value before the transition to FVC (column C1), the values at the end of the FCV cycle, after about 240 minutes of FCV (column F), and the last values recorded for the patient, 120-180 minutes after the transition back to CMV (column C2) system.

07AP05
Cardiac, Thoracic and Vascular Anaesthesiology (5)

>> https://esaic2022.abstractserver.com/program/#/details/presentations/1276

Flow-controlled ventilation versus pressure-controlled ventilation in thoracic surgery requiring one-lung ventilation – a randomized, controlled, single-center trial

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Background and Goal of the Study

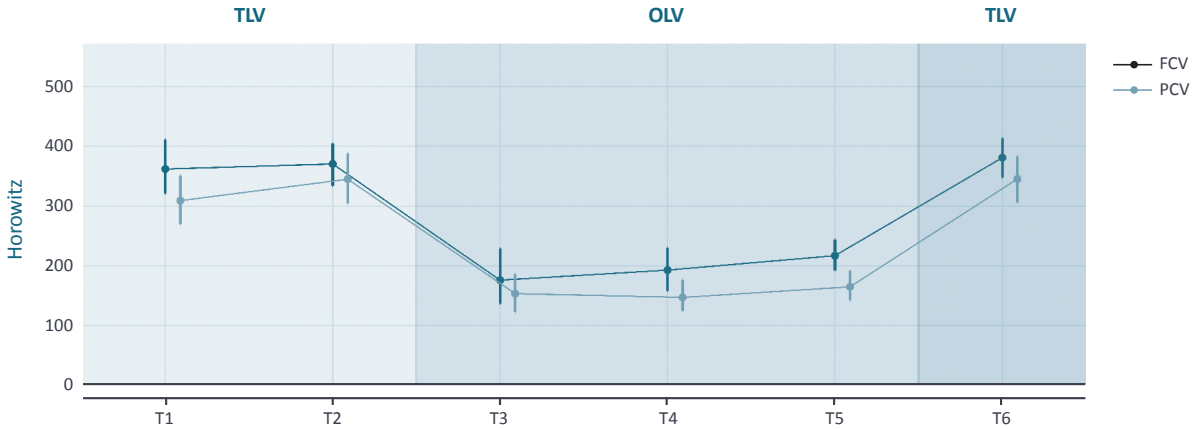
Flow-controlled ventilation (FCV) establishes a continuous gas flow during the whole ventilation cycle. Coupled with direct intra-tracheal pressure measurement precise determination of dynamic compliance is feasible and ventilator settings can be adjusted accordingly to achieve the highest dynamic compliance as a personalized approach. Aim of this randomized trial was to investigate the effect of compliance-guided FCV in terms of gas exchange compared to current standard pressure-controlled ventilation (PCV) during one-lung ventilation (OLV).

Materials and Methods

Overall 46 patients were randomized to receive FCV or PCV for the duration of general anaesthesia. FCV was established with compliance titrated end-expiratory pressure (PEEP) and peak pressure, flow adjusted to achieve normocapnia during total lung ventilation (TLV) and mild permissive hypercapnia during OLV. In the control group PCV was established with compliance titrated PEEP, peak pressure set to achieve a tidal volume of 6-8 ml/kg predicted body weight (PBW) during TLV and 4-6 ml/kg PBW during OLV, respiratory rate set to maintain normocapnia during TLV and mild permissive hypercapnia during OLV. The primary outcome parameter was defined as oxygenation (paO_2/FiO_2) at 30 minutes after OLV initiation.

Results and Discussion

43 patients were included into final analysis and the primary outcome parameter paO_2/FiO_2 was significantly higher in the FCV group (n=21) compared to control (n=22) (187 vs 136, MD 39 (95% CI 1 to 75); p=0.047) after 30 minutes of OLV (Timepoint T4). Additionally, the required respiratory minute volume (MV) to obtain similar $paCO_2$ levels was significantly lower in FCV (3.0 vs 4.5, MD -1.3 (95% CI -1.9 to -0.8) l/min; p<0.001), which indicates improved CO_2-removal.



Conclusion

In this randomized trial flow-controlled ventilation was found to be superior to current standard pressure-controlled ventilation after 30 minutes of OLV in terms of oxygenation and CO_2-removal.

07AP05
Cardiac, Thoracic and Vascular Anaesthesiology (5)

>> https://esaic2022.abstractserver.com/program/#/details/presentations/1320

Flow-controlled ventilation improved gas exchange during one-lung ventilation: a randomised experimental cross over study

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Background and Goal of the Study

Flow-controlled ventilation (FCV) is a new ventilation modality characterized by constant inspiratory and expiratory flow. While the beneficial effects of FCV on respiratory mechanics and gas exchange have been demonstrated, the feasibility of this modality in special conditions, such as one-lung ventilation is yet to be explored. We aimed at comparing the effects of FCV to pressure-regulated volume control ventilation (PRVC) on lung aeration, gas exchange and haemodynamics during one-lung ventilation (OLV).

Materials and Methods

Ten pigs (body weight: 45±0.5 kg) were anaesthetized and randomly assigned to be ventilated with FCV (Fraction of inspired oxygen (FiO_2): 0.5, Flow: 15 l/min, Fr: 30-35/min, peak inspiratory pressure (PIP) set to target a tidal volume of 7 ml/kg for whole lung and 5 ml/kg for one-lung ventilation, positive end-expiratory pressure (PEEP): 5 cmH_2O) or PRVC (FiO_2: 0.5, Fr: 30-35/min, Tidal volume: 7 ml/kg for whole lung and 5 ml/kg for one-lung ventilation, PEEP: 5 cmH_2O). Electrical impedance tomography (EIT), arterial partial pressure of oxygen (PaO_2), carbon dioxide ($PaCO_2$), central venous oxygen saturation (SvO_2), mean arterial pressure and cardiac output were determined at baseline and one hour after either FCV or PRVC applied during OLV obtained with an endotracheal blocker. The sequence was repeated in a cross-over design and a new set of data was collected.

Results and Discussion

OLV has led to a decrease in PaO_2 under both FCV and PRVC ($p<0.05$) while an increase of $PaCO_2$ was only noted under PRVC ($p<0.001$) compared to whole lung ventilation. EIT demonstrated significant ventilation redistribution by the increased aeration of dependent and non-dependent regions during OLV with both modalities ($p<0.05$ for all) in a similar manner, while PIP was significantly lower under FCV ($p<0.001$). Ventilating one lung with FCV led to better gas exchange with higher PaO_2 and SvO_2 and lower $PaCO_2$ than with PRVC (170.6±15.8 vs 154.1±13.4 mmHg, 78.7± 5.0% vs 73.1±4.2% and 43.5±6.3 vs 52.6±11.7 mmHg, respectively $p<0.05$). Haemodynamic parameters remained constant with both ventilation modalities and under OLV.

Conclusion

Improved lung aeration and gas exchange was evidenced in FCV during one-lung ventilation at lower airway pressure than with PRVC. Our findings suggest that this new modality can be considered as a protective ventilation modality during one-lung ventilation.