

Fig. 24 See text for description

caregiver answered to a questionnaire about socio-demographic characteristics (age, sex, marital status) and the work conditions (intensive care unit conditions, number of hours of work per day, the number of on-call duty hours at the hospital). The Malasch Burn Inventory score was used to assess the burnout syndrome in our sample.

**Results** One hundred questionnaires were distributed in the departments of EMICU, surgery and pediatrics. Only 79 were collected, registered and then analyzed.

The participation rate was about 79 %. We found that 58 % of all caregivers working in EMICU had a burnout syndrome and 26 % of them were seriously affected. Forty-two percent of the affected caregivers had a high level of emotional distress, 43 % had a high level of depersonalization, and 39 % had a low level of professional fulfillment.

The mean average age of our sample was 33 years with a standard deviation of 9. We have a female predominance with a sex ratio of 0.46. Fifty-six percent of the caregivers enrolled in the study were married.

From all the persons who answered to the questionnaire, 47 % chose their department of work. More than half of our population (72 %) works in the hospital from < 10 years. The average number of hours of work per week was 41 h. Twenty-seven percent of all caregivers had to work at least two on-call duties per week.

Analytical study showed that among the socio-demographic characteristics, the female sex was significantly associated with the lowest score of professional fulfillment ( $p = 0.03$ ). Seventy-two percent of caregivers affected by burnout were male with 40 % who were seriously affected. Sixty-one percent of our affected population was married with a severe score in 22.7 % of cases.

General surgery department had the highest level of emotional distress and depersonalization (73 and 64 %) followed by our EMICU department (56 and 60 %), while the level of professional fulfillment was the lowest in pediatric department (14.3 %) followed by our EMICU department (23.5 %).

**Conclusion** As expected, the prevalence of burnout syndrome is particularly high in our Tunisian emergency and intensive care unit. We found also that it was correlated with socio-demographic characteristics. Our department had one of the highest levels of burnout syndrome in the hospital. We are trying to identify the causes of this high level. Preventive and interventional measures against burnout syndrome should be started. This work is the first step of a multicenter Tunisian study.

**Competing interests** None.

## P26

### Resistance of endotracheal tubes measured after extubation in ICU patients

Alina Stoian<sup>1</sup>, Loredana Baboi<sup>1</sup>, Florent Gobert<sup>1</sup>, Hodane Yonis<sup>1</sup>, Romain Tapponier<sup>1</sup>, Jean-Christophe Richard<sup>1</sup>, Claude Guérin<sup>1</sup>

<sup>1</sup>Réanimation médicale, Hôpital de la Croix-Rousse, Lyon, France

**Correspondence:** Claude Guérin - claude.guerin@chu-lyon.fr

Annals of Intensive Care 2016, 6(Suppl 1):P26

**Introduction** Increase in resistance of endotracheal tube (RETT) during mechanical ventilation in ICU should reflect reduction in internal

diameter due to accumulation of secretions. The aim of this study was to measure RETT after extubation in ICU patients. Our hypothesis was that RETT increased with the length of use of invasive mechanical ventilation.

**Patients and methods** The study was performed over patients intubated for at least 1 day in our ICU. Once the patient was extubated, the tube was immediately stored in a plastic bag at room temperature and kept in a safe place until bench assessment. This was performed maximal 24 h after extubation as follows. The endotracheal tube was attached to a filter (Hygrobac), and both were set to ASL 5000 active servo lung (IngMar Medical). The lung model was set in passive condition in order to deliver two consecutive breaths at constant flow from 2 to -2 L/s. The filter was tested first, and then, the filter and the endotracheal tube were run. The relationship of pressure ( $P$ ) to flow was fitted to the following equation  $P = K1 \text{ flow} + K2 \text{ flow}^2$ , where  $K1$  and  $K2$  are constants.  $P$  pertaining to endotracheal tube was obtained by subtracting  $P$  from filter to  $P$  from filter and endotracheal tube. Dividing  $P$  by flow led to  $\text{RETT} = K1 + K2 \text{ flow}$ . RETT at 1 L/s (cm H<sub>2</sub>O) was equal to  $K1 + K2$ . The relationships of  $K1$ ,  $K2$  or RETT to length of intubation was analysed by linear mixed model where tube brand and size were factors with random effects.

**Results** We included 52 patients (34 male) of median (first-third quartiles) age 68 (61-78) years. The median duration of intubation was 5.5 (2-9) days (min 1-max 19 days). Endotracheal tubes were from Mallinckrodt ( $n = 45$ ), TaperGuard ( $n = 4$ ) or Rush ( $n = 3$ ) brands and internal diameter 7.0 ( $n = 10$ ), 7.5 ( $n = 39$ ), 8.0 ( $n = 3$ ) mm. The relationships of  $K1$ ,  $K2$  or RETT to length of intubation were not significant taking into account both brand and size of endotracheal tubes (Fig. 25).

**Conclusion** Increase in resistance of endotracheal tube used in the ICU is not related to the length of tracheal intubation.

**Competing interests** None.

## P27

### Length of endotracheal tube, humidification system and airway resistance: an experimental bench study

Frédéric Duprez<sup>1</sup>, Arnaud Bruyneel<sup>2</sup>, Thierry Bonus<sup>1</sup>, Grégory Cuvelier<sup>3</sup>, Sharam Machayekhi<sup>1</sup>, Sandra Olieuz<sup>1</sup>, Alexandre Legrand<sup>4</sup>

<sup>1</sup>ICU, C.H. Epicura, Hornu, Belgium; <sup>2</sup>Nursing school, Condorcet, Mons, Belgium; <sup>3</sup>Laboratoire de l'effort et du mouvement, Condorcet, Tournai, Belgium; <sup>4</sup>Physiologie et pharmacologie, Université de Mons - Campus Plaine de Nimy, Mons, Belgium

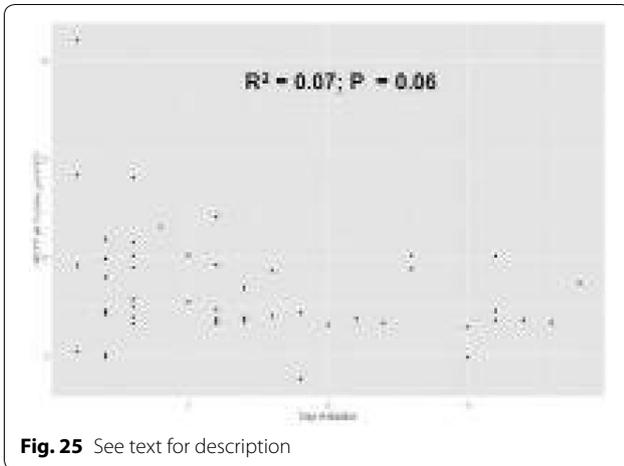
**Correspondence:** Frédéric Duprez - dtamedical@hotmail.com

Annals of Intensive Care 2016, 6(Suppl 1):P27

**Introduction** After intubation, the resistance of the inspiratory line is usually increased. This rise in airway resistance is associated with the presence of the endotracheal tube, a heat and moisture exchanger (HME) and/or any another tubing in the breathing circuit. During assisted ventilation or in spontaneously breathing patient, these high resistances will increase the work of breathing and negatively impact the chance of weaning. To limit this elevation in resistance, the endotracheal tube is sometime shortened and a heated humidifier used instead of a HME. The aim of this study was to evaluate the actual effect of these strategies on the airway resistance.

**Materials and methods** A two-compartment model of adult lung (DTL: TTL 1600 Dual Test Lung, Michigan Instrument) was connected to a Dragër Evita 4<sup>®</sup> Ventilator. The ventilator was set in volume-controlled mode ( $V_T$ : 0.5 L; respiratory frequency: 20 bpm; inspiratory flow: 70 L/min). To simulate normal and obstructive clinical conditions, two different resistances were placed at the entry of the airline connected to DTL by using Pneuflo<sup>®</sup> (parabolic resistor, Michigan Instrument; mean  $\pm$  SD:  $2.5 \pm 0.06$  and  $17.04 \pm 0.03$  cmH<sub>2</sub>O/L s<sup>-1</sup>). Compliance of the artificial lung was set to 70 ml/cmH<sub>2</sub>O.

The airline was compounded of an endotracheal tube and a humidification system. Three different inside diameters (ID) (Portex<sup>®</sup> endotracheal tube of 7, 8 and 9 mm) and two humidification systems (HME (Gibbeck Humid Vent<sup>®</sup> Adult) or Fisher and Paykel MR850 Heated Humidifier<sup>®</sup>) were evaluated before and after shortening of the tube at 10 cm length. The change in pressure was measured by an analog



iWorx station/digital IWx/214. Resistance value was calculated from the following equation:

$$\text{Inspiratory Resistance} = (\text{Peak pressure} - \text{Plateau pressure}) / \text{Inspiratory flow}$$

Statistical test (Student's test) was performed. Values are presented as mean  $\pm$  standard deviation.

#### Results

**Conclusion** The use of heated humidifier instead of HME and shortening of endotracheal tube (10 cm of length) allow significant decrease in airway resistance. Both strategies may be helpful for the weaning of obstructive patients. However, the shortening of the tube (relative impact) has a decreasing impact when the tube diameter is growing and even for smaller tube the impact of humidifier is more important (Table 10).

**Competing interests** None.

#### Reference

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#### P28

##### Diagnosis contribution and safety of bronchoalveolar lavage in intensive care unit

Fatma Feki<sup>1</sup>, Amira Jamoussi<sup>1</sup>, Takoua Merhebene<sup>1</sup>, Emna Braham<sup>2</sup>, Asma Ghariani<sup>3</sup>, Faouzi El Mezni<sup>2</sup>, Leila Slim<sup>3</sup>, Jalila Ben Khelil<sup>1</sup>, Mohamed Besbes<sup>1</sup>

<sup>1</sup>Respiratory icu, Hospital Abderrahmen Mami De Pneumo-Phtisiologie, Ariana, Tunisia; <sup>2</sup>Pathology, Hospital Abderrahmen Mami De Pneumo-Phtisiologie, Ariana, Tunisia; <sup>3</sup>Microbiology, Hospital Abderrahmen Mami De Pneumo-Phtisiologie, Ariana, Tunisia

**Correspondence:** Amira Jamoussi - dr.amira.jamoussi@gmail.com  
*Annals of Intensive Care* 2016, **6**(Suppl 1):P28

**Introduction** Bronchoalveolar lavage (BAL) is a diagnostic tool that explores the deep lung; it can provide useful histological and microbiological information. However, endobronchial injection of important volumes of saline serum may cause hypoxemia. This risk is particularly important to consider in ICU patients. The aim of this study was to determine the diagnostic value and to identify incidents attributable to BAL in intensive care unit.

**Patients and methods** This was a retrospective study conducted from January 2011 to December 2014 at the respiratory ICU of the Abderrahmen Mami Hospital in Ariana (Tunisia). Were included all patients who underwent BAL in intensive care unit. We recorded demographic,

**Table 10** See text for description

Resistance value (cm H2O/L.sec-1) and variation in %			
Normal initial Resistance		High initial Resistance	
HME	Heated humidifier	HME	Heated humidifier
4,88 (+/- 0,04)	2,5 (+/- 0,06)	19,73 (+/- 0,03)	17,04(+/-0,03)
(**) -95%		(**) -15,8 %	
Tube 7	Tube 7 cut down	Tube 7	Tube 7 cut down
13,36 (+/-0,06)	11,74 (+/- 0,03)	26,19 (+/-0,04)	25,13(+/-0,02)
(**) -13,8%		(**) -4,2%	
Tube 8	Tube 8 cut down	Tube 8	Tube 8 cut down
8,36(+/-0,05)	7,27(+/-0,01)	22,99(+/- 0,02)	22,2(+/-0,01)
(**) -15%		(**) -3,6%	
Tube 9	Tube 9 cut down	Tube 9	Tube 9 cut down
4,39(+/-0,05)	3,98 (+/-0,10)	18,79 (+/-0,04)	18,42(+/-0,02)
(*) -10,3%		(*) -2%	
		** p<0,001	
		* p<0,01	

clinical and paraclinical characteristics of patients, results and incidents of BAL.

**Results** During the 4 years of the study, 100 BALs were performed in 100 patients (55 men and 45 women) with a mean of age of 44 years [15 years—87 ans].

Respiratory history was present in 22 patients and systemic disease in 31 patients, and 42 patients were smokers.

The main cause of admission was acute respiratory failure (97 patients).

On chest X ray, alveolar and/or interstitial damage was found in 93 patients; 78 were bilateral.

BAL was performed under invasive ventilation in 20 patients, under NIV in 20, on oxygen in 54 and for six patients in ambient air.

BAL was contributory to diagnosis in 77 patients: 28 cases of intra-alveolar hemorrhage, 26 cases of bacterial pneumonia (ten community-acquired pneumonia and 16 nosocomial), eight cases of pulmonary pneumocystosis, six cases of active pulmonary tuberculosis, six cases of malignant pulmonary infiltrate, two cases of eosinophilic pneumonia and one case of histiocytosis X.

The major occurring incident was severe hypoxemia in four patients among which three had required endotracheal intubation. In the 96 remaining patients, BAL was safe and harmless.

**Conclusion** In ICU, BAL is a good and safe tool; it contributes to diagnosis in 77 % of cases. However, the risk of worsening breathing after BAL should be evaluated, especially in critically ill patients.

**Competing interests** None.

#### P29

##### Impact of fiberoptic bronchoscopy performed under noninvasive ventilation on the outcome of critically ill patients: a cohort study over 11 years

Antoine Marchalot<sup>1</sup>, Christophe Girault<sup>2</sup>, Gaetan Beduneau<sup>2</sup>, Dorothée Carpentier<sup>2</sup>, Steven Grange<sup>2</sup>, Emmanuel Besnier<sup>3</sup>, Gioia Gastaldi<sup>2</sup>, Julien Abily<sup>2</sup>, Marion Beuzelin<sup>2</sup>, Fabienne Tamion<sup>4</sup>

<sup>1</sup>Seine-Maritime, CHU Charles Nicolle Rouen, Rouen, France; <sup>2</sup>Réanimation Médicale, Centre Hospitalier Universitaire Rouen, Rouen, France; <sup>3</sup>Pôle Réanimations Anesthésie SAMU, Hospital Center University Rouen, Rouen, France; <sup>4</sup>Réanimation médicale, Hospital Center University Rouen, Rouen, France

**Correspondence:** Antoine Marchalot - amarchalot@gmail.com  
*Annals of Intensive Care* 2016, **6**(Suppl 1):P29

**Introduction** Fiberoptic bronchoscopy (FOB) is frequently performed in intensive care unit (ICU) for diagnostic and/or therapeutic procedures. The main complication of FOB is hypoxemia, which can lead