

## Effect of using Heated Humidifier versus Heat Moisture Exchangers on Tracheobronchial Secretion and Body Temperature among Mechanically Ventilated Patients

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### **Abstract**

**Background:** When a patient receives mechanical ventilation (MV) support through an artificial airway, the physiological functions of upper airway for conditioning the inspired air will have impaired. To avoid the consequences associated with lack of humidification in mechanically ventilated patients, a variety of humidifiers are used. Nurses should be aware, which is the most suitable type for her patients. **Objective:** Assess the effect of heated humidifier (HH) and heat moisture exchanger (HMEs) on tracheobronchial secretion viscosity and body temperature among mechanically ventilated patients. **Settings:** This study was carried out in general ICUs at the Damanshour Medical National institute. **Subjects:** A convenience sample of 60 adult mechanically ventilated patients from starting day of invasive MV were included in the current study. **Tools:** One tool was used for data collection. It consists of five parts. **Results:** Findings of the present study show that the HH group had a higher frequency (63.3%) of thin tracheal secretion viscosity in comparison to the HME (53.3%). As regard patients' temperature, there was no significant difference between the two groups at the two times of measurements ( $P=0.817, 0.110$ ). **Conclusion:** The HH has more positive effect on patients' tracheal secretion than the HME. **Recommendations:** Conduct protocols to improve the practice regarding HH use for patients with invasive MV.

**Keywords:** Mechanical ventilation, Humidifiers, Heated humidifier, Heat moisture exchanger.

### **Introduction**

Mechanical ventilator (MV) is an artificial, external device, which was designed to replace, and later to assist, the inspiratory muscles. The primary function of MV is to promote alveolar ventilation and carbon dioxide (CO<sub>2</sub>) elimination, they are also used for correcting impaired oxygenation which may be a difficult task (Poor, 2018). The upper airway plays a major important role in the physical defense of the lung by filtering, humidifying, and warming inspired gases before they reach the trachea, preventing dehydration of airway secretions

and prevent airway obstruction. The nose performs most of this conditioning because it is rich with vascular system that contain a numerous and very thin veins. The inspired air is warmed up to the body temperature with 100% relative humidity (RH) when entering the gas-exchanging parts of the lungs. During the exhalation processes the expired gas returns the heat back to the upper airway (McNulty & Eyre, 2015)

Insertion of an artificial air way as endotracheal tube (ETT) is a critical device to attach the patients with MV. This device bypasses the upper way and loss their function for humidifying, and warming

inspired gases, addition to MV suppresses these mechanisms, more surface of the airway is required to meet the heat and humidity requirement of the lung, and the point at which the inspired air become fully saturated shift down to the lower airway that normally located five cm below the carina and called isothermic saturation boundary. Finally, the inspired air from MV reach the gas exchange part of the lung without humidifying, and warming (Billington & Lockett, 2019)

The provision of heating and humidity for inspired air during artificial ventilation with MV is a standard of care worldwide. Current humidification devices can be divided into active heated humidifiers (HH) and passive heated devices such as, heat moisture exchangers (HMEs) (Wong, Shakir, Farboud et al.,2016).

Active heated humidifiers, act by passing the inspired gases through a heated water reservoir within a closed-circuit system, examples of this device include bubble and Passover humidifiers. (Abin, Shiri - Qidari, Hanifi, et al.,2018). passive heated devices act by capture the heat and humidity of exhaled air and release it at the next inspiration. The most common example of passive humidifiers is the HMEs, which are placed on MV circuit between the patient and the Y connector of the inspiratory and expiratory limbs. They can be hydrophobic, hygroscopic or combined HMEs, all of them with or without filter that decrease the incidence of viral and bacterial infection from the inspired air (Mcnulty & Eyre, 2015).

When providing humidification with HH for patients with invasive mechanical ventilator (IMV) the device should provide gas temperature between 34°C and 41°C with a relative humidity (RH) of 100%,and for patients who are humidified with passive HMEs the gas temperature should be 34°C and 100% relative humidity, to prevent the drying out of secretions in the artificial airway .It's important to measure the

temperature and humidity of delivered air for patients on IMV to achieve the over mentioned criteria (Ashry&Modrykamien,2014).

Disruption of respiratory epithelial integrity, increase tracheobronchial secretion dryness, increase risk of airway obstruction and increase the body heat loss during IMV related to an administration of cold and dry medical gases by IMV( Gaffney& Dalton,2018).Conversely, if the heating and humidity of inspired gas are too high, the viscosity of the mucus reduces, mucus volume increases leading to increase the risk of respiratory infection, and the risk of atelectasis through a condensation of water droplets throughout the airways. Significant body heat gain may also result, with thermal injury to airway mucosa. So, it's important to measure the temperature and humidity of inspired air for the patients who are on IMV near to airway to avoid the over mentioned complications (Filippini, Serpelloni, Quaranta et al.,2019).

Application of HH for IMV is effective in preventing a reduction in blood pressure and body temperature. Body temperatures of patients who received humidified heated ventilated gases were higher than those of patients who did not receive humidified heated ventilated gases at 0.5°C. Excessive respiratory heat loss may lower body temperature, and artificial humidification of dry inspired gases by HMEs seems to reduce the drop in body temperature by means of their ability to conserve heat and moisture during expiration (Billington&Lockett ,2019). Critical care nurse plays a major important role during the selection and implementation of humidification devices by monitoring the tracheobronchial secretion viscosity, and patient's body temperature to maintain hemodynamic stability (Dawson, 2016).

### ***Aims of the Study***

This study aims to Assess the effect of using heated humidifier versus heat moister exchangers on tracheobronchial secretion

viscosity and body temperature among mechanically ventilated patients.

### ***Research hypotheses***

1. Patients who are subjected to heated humidifier have less viscous tracheobronchial secretion and lower frequency of air way obstruction than patients who are subjected to heat moister exchangers.
2. Patients who are subjected to the heated humidifier have higher body temperature than patients who are subjected to heat moister exchangers.

### ***Materials and Method***

#### ***Materials:***

#### ***Research design:***

Quasi experimental research design will be used in this study.

#### ***Settings:***

This study conducted at the general ICUs of Damanhur Medical National institute, which is classified to general ICU I(15bed) and the general ICU II (13bed).

#### ***Subjects:***

A convenience sample of 60 adult mechanically ventilated patients from starting day of invasive mechanical ventilation (IMV) admitted to the previously mentioned settings were included in the current study. The patients were assigned into two chronological equal study groups.

**Group A:** the study group A consisted of 30 patients who were subjected to HH in the units based on American Association of Respiratory Care (AARC) guidelines.

**Group B:** the study group B consisted of 30 patients who were subjected to HMEs in the units based on AARC guidelines.

#### ***Exclusion criteria:***

- Patients who have bloody tracheobronchial secretions.

- Patient with severe hypothermia in which body temperature were less than 32°C.

#### ***Tools:***

One tool was used to collect data of the study, which was Consisted of five parts, four parts of this tool was developed by the researcher after extensive review of related literature (Montgomery, Camporota, Orhan et al., 2015; Grossbach, Chlan & Tracy., 2011). The second part of this tool was adopted from Gross & Park, 2012. The tool was including:

**Part one: "Patients' characteristics":** It included patients' demographic data such as age and sex, patients' clinical data such as current diagnosis, past medical and surgical history.

**Part two: "Tracheobronchial secretion assessment":** This part was adopted from (Gross & Park, 2012). That involved three types of secretion viscosity thin, moderate and thick.

**Part three: "Airway obstruction assessment ":** It included patients' data such as partial pressure of arterial oxygen (PaO<sub>2</sub>), partial pressure of arterial carbon dioxide (PaCO<sub>2</sub>), arterial oxygen saturation (SaO<sub>2</sub>), use of accessory muscles of breathing; air entry, breath sounds, and number of endotracheal tubes changed. Ventilator data such as peak airway pressure (P peak), minute volume, Y shape temperature and humidity.

**Part four:" Physiological response to humidification assessment ":** It included heart rate, blood pressure, respiratory rate and rectal temperature.

#### ***Method:***

- An approval from the ethical committee, Faculty of Nursing was obtained.
- An official permission was obtained from the Faculty of Nursing Alexandria University to the administrative authorities of the Damanhur Medical National institute to conduct the study.

- The study tool tested for content validity by 5 experts in the field of the study. The necessary modifications were done accordingly.
- Data were collected by the researcher during approximately four months starting from July 2020 to October 2020.
- The patients were assigned into two equal control groups:
  - Group (A) who subjected to pass over HH without wire in the units based on AARC guidelines.
    1. The researcher selected MV circuit that designed for HH and have a water trap, and MV circuit tested for leaks immediately before use.
    2. The researcher insured that the MV circuit drained the water downward the HH and not toward the artificial airway or the ventilator. Water traps was placed correctly to receive the drained water and, evacuated frequently when become filled. The HH chamber filled with distilled water by closed system, at the required level that determined on it.
    3. Initial checkup was done after the system setup. Condensation of water in the device or in the ETT was checked after five minutes of the HH working. The humidifier was adjusted to keep the temperature in Y shape within (34°C: 41°C), and relative humidity 100%, then checked the temperature and humidity in Y shape daily for seven days with hygrometer probe that was disinfected by alcohol swap between each patient.
  - Group (B) who subjected to HMEs with antibacterial filter in the units based on AARC guidelines.
    1. The researcher placed HMEs in MV circuit before the Y shape not before the ventilator machine. Condensation of water in the HMEs or in the ETT was checked within five minutes after the placement.
    2. Routinely changed the HMEs every 48-96hrs or if excessive condensation and secretion present on it, or according manufacture recommendation. Except in patients with chronic obstructive pulmonary disease the HMEs was routinely changed every 48 hours in patients. The HMEs was removed before nebulizer session, and returned after the session end.
    3. Temperature and humidity in Y shape was checked daily for seven days with hygrometer probe that was disinfected by alcohol swap between each patient

### **Ethical considerations:**

An informed written consent was obtained from each study subject after explanation of the study purpose. Anonymity and privacy of the study subjects, confidentiality of the collected data, and the subject's right to withdraw at any time were maintained.

### **Statistical Analysis**

Data was analyzed using PC with statistical package for social science (SPSS) version 26. The level of significance was  $\leq 0.05$ .

### **Results**

**Table (1)** illustrates distribution of the studied groups according patient characteristics. more than half of the HH group were male 56.7% as compared to 63.3% of the HMEs group. Concerning age, most of the study samples of HH group, and HMEs group (63.3%, 56.7%) were ranged between  $50 \geq 60$  years old. There was no statistically significant difference between the two groups regarding sex and age ( $p=0.59$  and  $0.24$  respectively) As regard current diagnosis, more than half of the HH group were respiratory disorders (53.3%) as compared to 60 % of the HMEs with nervous disorders, with no statistically significant difference between the two groups regarding current diagnosis ( $p=0.64$ ).

**Table (2)** shows comparison between the two studied groups according to tracheobronchial secretion viscosity. The majority of study sample in HH group had thin secretion viscosity that represents (63.3%) followed by moderate secretion viscosity that represents (26.7%). As compared to more than half of study sample in HMEs group had moderate secretion viscosity that represents (53.3%) followed by thin secretion viscosity that represents (30%). There was statistically significant difference between the two studied groups regarding tracheobronchial secretion viscosity ( $p=0.005$ ).

**Table (3)** illustrates comparison between the two studied groups according to respiratory parameters and frequency of endotracheal tube changed. In relation to Pao<sub>2</sub>, the mean  $\pm$  SD of Pao<sub>2</sub> in HH group was  $150.06 \pm 33.20$  as compared to  $139.95 \pm 42.08$  of the HMEs group. Regarding Paco<sub>2</sub>, the mean  $\pm$  SD of Paco<sub>2</sub> in HH group was  $35.19 \pm 7.68$  as compared to  $35.50 \pm 6.60$  of the HMEs group. Concerning Sao<sub>2</sub>, the mean  $\pm$  SD of Sao<sub>2</sub> in HH group was  $96.18 \pm 3.48$  as compared to  $95.67 \pm 2.88$  of the HMEs group. Finally regarding frequency of endotracheal tube changed the HH group was recorded less frequency of endotracheal tube changed (10%) compared with (26.7%) in HMEs group. There was no a statistically significant difference between the two groups regarding Pao<sub>2</sub>, Paco<sub>2</sub>, and Sao<sub>2</sub> ( $p= 0.306, 0.866, 0.539$  and  $0.095$  respectively).

**Table (4):** illustrates comparison between the two studied groups according to ventilator data. The mean  $\pm$  SD of P peak in HH group was  $23.03 \pm 4.15$  as compared to  $26.10 \pm 4.02$  of the HMEs group. Regarding minute volume, the mean  $\pm$  SD of minute volume in HH group was  $10.79 \pm 1.77$  as compared to  $10.61 \pm 3.18$  of the HMEs group. Concerning respiratory rate, the mean value  $\pm$  SD of respiratory rate in HH group was  $21.75 \pm 3.32$  as compared to  $24.26 \pm 3.53$  of the HMEs group. The mean  $\pm$  SD of Y shape humidity in HH group was  $100 \pm 0$  compared to  $69.96 \pm 0.21$  in HMEs, finally the mean  $\pm$  SD of Y shape temperature in HH group was  $36.81 \pm$

$0.83$  compared to  $34.00 \pm 0.46$ . There was a statistically significant difference between the two groups regarding P peak, Respiratory rate, Y shape humidity, And Y shape temperature ( $p= 0.005, 0.006, <0.001$  and  $<0.001$  respectively). There was no statistically significant difference between the two groups regarding minute volume ( $p= 0.788$ ).

**Table (5):** illustrates comparison between the two studied groups according to physiological responses. The mean  $\pm$  SD of heart rate in HH group was  $98.82 \pm 12.25$  as compared to  $100.27 \pm 17.07$  of the HMEs. The mean  $\pm$  SD of rectal temperature 1st time before the intervention in HH group was  $37.54 \pm 0.42$  as compared to  $37.51 \pm 0.39$  of the HMEs group. The mean  $\pm$  SD of rectal temperature 2nd time within one hour after the intervention in HH group was  $37.68 \pm 0.40$  as compared to  $37.51 \pm 0.39$  of the HMEs group. The mean  $\pm$  SD of systolic blood pressure in HH group was  $115.91 \pm 14.32$  as compared to  $120.30 \pm 11.47$ . Finally, the mean  $\pm$  SD of diastolic blood pressure in HH group was  $74.00 \pm 9.61$  as compared to  $76.71 \pm 6.81$  of the HMEs group. There were no statically significant differences between the two groups regarding heart rate, first, second rectal temperature, systolic and diastolic blood pressure ( $p=0.707, 0.817, 0.110, 0.195, \text{ and } 0.212$  respectively).

## Discussion

The results of this study showed that the patients with HH were associated with less secretion viscosity than the patients with HMEs. The current study finding is in agreement with (Misset, et al., (2021) who conducted retrospective study to investigate the effect of HMEs vs HH during long-term mechanical ventilation. They found that tracheal secretions became thicker between the first to fifth day in the HME group than in the HH group. Heated humidifier is superior to any other device for preventing the secretions in the airway from drying out and

are universally used with ICU ventilators (Ashry& Modrykamien,2014). This may be related to that the HH devices were achieved the AARC criteria's as regarding temperature and humidity of delivered air by MV, but in HMEs devices the preset temperature by AARC was achieved, and humidity did not achieve (Restrepo et al., 2012).

**As regard respiratory parameters during the use of humidifiers**, the current study findings revealed there was no statistically significant differences in mean PaO<sub>2</sub> in the two-study group. This may be related to increase work of breathing and respiratory rate in HMEs patients to maintain the same level of PaO<sub>2</sub> as in HH patients. inline of current study Schreiber et al., (2019) who conducted comparative study between HH, HMEs and active HMEs during IMV found that no significant difference in PaO<sub>2</sub> between HH and HMEs groups.

**Regarding partial pressure of arterial carbon dioxide (PaCO<sub>2</sub>)**, the result of current study found there was no statistically significant difference in mean PaCO<sub>2</sub> between the two-study group. This may be rated to increase in total work of breathing (WOB) to maintain the same level of PaCO<sub>2</sub> in HMEs group. The current study finding is in agreement with Gillies et al., (2017) who conduct study about HMEs versus HHs for mechanically ventilated adults and children that found no statistically significant differences between the two-study group,

On the other hand, these results were in disharmony with the study done Cheung., (2013) who conducted a study on the use of humidification system among mechanically ventilated patients to reduce the work of breathing, found that significant increase in paco<sub>2</sub> in HMEs group related to artificial dead space and extra workload to respiratory work that added when using HMEs.

**Regarding frequency of endotracheal tubes changed**, the results of the current study revealed that there was less artificial airway obstruction in HH group compared with HMEs group with no

statistically significant difference, this result may be related to insufficient airway humidification by HMEs compared with HH that increase chance for drying out tracheobronchial secretion and required timely intervention for endo-tracheal tube (ETT)obstruction. The current study finding is in agreement with the study done vargas et al., (2017), he was found no significant difference in artificial airway occlusion between passive HMEs and HHs and no effect of HHs with and without heated wire compared to HMEs.

**As regard mechanical ventilator data during the use of the study humidifiers**, the current study findings revealed that the mean p peak of the HH group is less than the mean p peak of the HMEs group. This may be attributed to the extra resistance that added by the HMEs to the circuit due to the presence of the internal membrane (Gillies et al.,2017). The current study finding is in agreement with Esquinas, 2012) who reported a significant increase in airway resistance during use of HMEs with or without antibacterial filter, and an increase in total work of breathing to maintain the same level of PaCO<sub>2</sub>. In contrast of current study Morán et al., (2011) who conducted a comparative study about the effects of HH, and HMEs systems on endotracheal tube resistance. They did not find statistical differences between the two devices in ETT airflow resistance.

**Regarding minute volume**, the results of this study show that was no clinically significant difference between the mean minute volume of HH group compared with the mean minute volume of HMEs group. This may be related to an increase in respiratory rate to compensate for the decrease in tidal volume produced by the HMEs device's that increased dead space and airway resistance. On the other hand, these results were in disharmony with the study done by Lucato et al., (2017) They conducted a study to measure ventilatory changes during the use of HMEs in mechanically ventilated patients with pressure support. They

adjusted the ventilation parameters to compensate for possible changes. They found that the use of HMEs increased the respiratory rate and reduced the tidal and minute volumes compared with the use of the HH.

**Regarding the respiratory rate,** the results of current study showed that the mean respiratory rate of the HH group was less than the mean respiratory rate of the HMEs group. This may be attributed to less airway obstruction in HH group compared with HMEs group. The current study finding is in agreement with Lucato et al., (2017) they conducted a study to measure ventilatory changes during the use of HMEs They found less air way obstruction and less respiratory rate in HH group compared with HMEs group. On the other hand, these results were in disharmony with the study done by Yin et al., (2020) who conducted a study for evaluation of three common airway humidification methods for patients with severe traumatic brain injury. They found no difference between the HH group and HMEs regarding the respiratory rate. HH group compared with HMEs group.

**Regarding Y shape temperature and humidity,** the results of current study showed that the HH devices achieved the AARC criteria's as regarding temperature and humidity of delivered air by MV, but in HMEs devices the preset temperature by AARC was achieved but humidity did not achieve. Inline of current study Roux et al., (2015) conducted a study to evaluate the efficiency of HH in delivering warm and humidify inspired air. They found that the use of HH delivered warm and humidify inspired air with low and high air flow by MV.

The current study finding is in agreement with Restrepo et al., (2012) they found that only 37% of HMEs have been meet the standard criteria was applied by the AARC guidelines, that may lead to an increase in tracheal tube occlusion, a serious adverse event that may occur in mechanically ventilated patients and requires timely intervention. On the other hand, these results

were in disharmony with the study done by Filippini et al., (2019) who used HMEs in mechanically ventilated patients, they found that temperature and humidity of ventilated gases were maintained within the expected range and remained stable over the entire observation period.

**Regarding body temperature,** the results of current study showed that the mean second rectal temperature in HH group was higher than the mean second rectal temperature in HMEs with no clinically significant differences. In contrast with current study Gillies et al., (2017), demonstrates that body temperature was significantly decreased by approximately 0.5 °C when an HME was used and compared to patients on HH.

**Regarding noninvasive blood pressure,** the results of current study showed that no clinically significant difference between the mean blood pressure in HH group compared with mean blood pressure in HMEs group. Inline of current study Shin et al., (2019) conducted a study to measure the effect of using HH on physiological factors in elderly patients with MV. They found that there was no clinically significant difference as regards to systolic and diastolic blood pressure between the two groups with or without active humidification.

### **Conclusion**

The majority of the studied patients with HH recorded less airway obstruction compared with near one third of HMEs group recorded airway obstruction and required immediately intervention to change the endotracheal tube.

### **Recommendations**

*In line with the findings of the study, the following recommendations are made:*

- Emphasis on presence of HH with suitable water level
- Provide proper function of HH tool in nursing record as a daily duty of the

nursing routine care for tracheal intubated patients.

- Replication of the current study on large sample, patients with tracheostomy tube (TT), longer duration of data collection and different settings for generalization of the result.

**Table (1): Comparison between the two studied groups according to Patient characteristics**

Patient characteristics	HH (n = 30)		HMEs (n = 30)		$\chi^2$	p
	No.	%	No.	%		
<b>Sex</b>						
Male	17	56.7	19	63.3	0.27	0.59
Female	13	43.3	11	36.7		
<b>Age (years)</b>					4.41	MC p=0.24
18 – 30	6	20	2	6.7		
31– 40	3	10	5	16.7		
41 – 50	2	6.7	6	20		
51 ≥ 60	19	63.3	17	56.7		
<b>current diagnosis</b>						
Respiratory disorders	16	53.3	13	43.3	0.60	0.64
Renal disorders	3	10	3	10	0.00	
Cardiovascular disorders	7	23.3	5	16.7	0.41	
Endocrine disorders	2	6.7	5	16.7	1.45	
Nervous disorders	13	43.3	18	60	1.67	
Immune disorders	1	3.3	0	0	1.017	
Gastrointestinal disorders	3	10	6	20	1.17	
<b>Medical history</b>	5	16.7	3	10	0.57	
Respiratory disorders	3	10	5	16.7	0.57	
Renal disorders	7	23.3	8	26.7	0.09	
Cardiovascular disorders	5	16.7	7	23.3	0.41	
Endocrine disorders	4	13.3	7	23.3	1.002	
Nervous disorders	0	0	2	6.7	2.07	
Immune disorders	5	16.7	5	16.7	0	

$\chi^2$ : Chi square test    MC: Monte Carlo    p: p value for comparing between the studied groups

**Table (2): Comparison between the two studied groups according to secretion viscosity**

Secretion viscosity	HH (N = 30)		HMEs (N= 30)		$\chi^2$	P
	No.	%	No.	%		
No secretion	3	10	1	3.3	10.795*	0.005*
Thin	19	63.3	9	30		
Moderate	8	26.7	16	53.3		
Thick	0	0	4	13.3		

\*: Statistically significant at  $p \leq 0$

$\chi^2$ : Chi square test

**Table (3): Comparison between the two studied groups according to respiratory parameters and frequency of endotracheal tube changed during the use of the study humidifiers.**

Respiratory parameters	HH (N = 30)		HMEs (N= 30)		Test of sig	P
	Mean	SD	Mean	SD		
Pao <sub>2</sub>	150.06	33.20	139.95	42.08	t=1.033	0.306
Paco <sub>2</sub>	35.19	7.68	35.50	6.60	t=0.170	0.866
Sao <sub>2</sub>	96.18	3.48	95.67	2.88	t=0.618	0.539
Frequency of ETT changed	No.	%	No.	%	$\chi^2$	P
No	27	90	22	73.3	2.783	0.095
yes	3	10	8	26.7		

t: Student t-test

p: p value for comparing between the studied groups

 $\chi^2$ : Chi square test**Table (4): Comparison between the two studied groups according to ventilator data during the use of the study humidifiers**

Ventilator data	HH (N = 30)		HMEs (N= 30)		Test of sig.	P
	Mean	SD	Mean	SD		
P peak	23.03	4.15	26.10	4.02	t= 2.912*	0.005*
Minute volume (L/min)	10.79	1.77	10.61	3.18	t= 0.271	0.788
Respiratory rate	21.75	3.32	24.26	3.53	2.842*	0.006*
Y shape humidity	100	0	69.96	0.21	788.500*	<0.001*
Y shape temperature	36.81	0.83	34.00	0.46	16.240*	<0.001*

X<sup>2</sup> Chi Square Test

\* Statistically significant at P ≤0.05

**Table (5): Comparison between the two studied groups according to physiological response during the use of the study humidifiers**

Physiological response	HH (N = 30)		HMEs (N = 30)		Test of sig	P
	Mean	SD	Mean	SD		
Heart rate	98.82	12.25	100.27	17.07	t=0.378	0.707
Rectal temperature 1 <sup>st</sup> time	37.54	0.42	37.51	0.39	t=0.232	0.817
Rectal temperature 2 <sup>nd</sup> time.	37.68	0.40	37.51	0.39	t=1.625	0.110
Blood pressure (Systolic)	115.91	14.32	120.30	11.47	t=1.310	0.195
Blood pressure (Diastolic)	74.00	9.61	76.71	6.81	t=1.262	0.212

1st time: time before the intervention

2nd time: within one hour after the intervention

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