

## Condensed water in the dryline water trap system of capnography as a potential source of infection: a case report



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### ABSTRACT

Capnometry is the measurement of carbon dioxide (CO<sub>2</sub>) in a sample of gas. Capnography is continuous monitoring of the concentration or partial pressure of CO<sub>2</sub> in respiratory gases. Here, we are reporting two cases of bacterial isolation from the water trap being used in the intensive care unit (ICU) and in one case was admitted to COVID ICU whose sample from the collected water trap was sterile. In all three of these patients a side stream capnography monitoring was being used. On close inspection of water trap chamber of capnograph we saw some collection of condensed water in all the three chambers. We sent the samples of all three patients for culture sensitivity out of which two was positive and one was sterile later on. The ICU- acquired infections are becoming a challenging health concern especially when caused by multi drug resistant pathogens and in current COVID 19 pandemic risks to health care worker are even more and it always warrants a close observation. In our case contamination of breathing systems may occurred because of compliance failure possibly due to improper inspection and functional testing of the sampling tube and exhaust tube which may lead to the reversal of the direction of flow through the sampling tube in a diverting respiratory gas monitor (RGM).

**KEY WORDS:** Capnography. drywater trap system, condensed water, COVID-19, infections, respirator.

## INTRODUCTION

Capnometry is the measurement of carbon dioxide (CO<sub>2</sub>) in a sample of gas. Capnography is continuous monitoring of the concentration or partial pressure of CO<sub>2</sub> in respiratory gases. Dryline Water Trap System (Mindray Patient Monitor, Beneview T8, Hamburg, GmbH, Germany) is a complete water trap subsystem. Manufacturer recommends it as a semi-disposable device for use up to one month.

## CASE

Here, we are reporting two cases of bacterial isolation from the water trap being used in the intensive care unit (ICU) and in one case was admitted to covid ICU whose sample from the collected water trap was sterile. A proper written informed consent was obtained from all of these three patients' relatives.

### Patient A

A 38 years old female with features of adult respiratory distress syndrome (ARDS) was on volume controlled mode of mechanical ventilation (FiO<sub>2</sub> = 60%; TV = 380 ml; PEEP = 8 cm H<sub>2</sub>O; RR = 16 rate per minute; I:E = 1:1.5; Trigger = 2 L/min) for last 3 days. She was on empirical antibiotics of intravenous piperacillin-tazobactam and clindamycin.

### Patient B

A 45 years old tracheostomised male with right-sided temporo-parietal hemorrhagic contusion following a road traffic accident was admitted to our ICU. Patient was on pressure support mode of mechanical ventilation (FiO<sub>2</sub> = 50%; PS = 12 cm H<sub>2</sub>O; PEEP = 6 cm H<sub>2</sub>O, RR = 12 rate per minute; I:E = 1:2; Trigger = 2 L/min) for 14 days and was on antibiotic coverage of intravenous meropenem and clindamycin.

### Patient C

A 32 years old male presented with high grade of fever 102°F , respiratory distress, Spo<sub>2</sub> 89% on room air and he has positive travel history, so he was admitted to covid intensive care unit as suspected COVID-19 case. We applied continuous positive airway pressure (CPAP) and nasopharyngeal and oropharyngeal sample was sent for covid testing. In this case we applied a full-face mask with good seal

to minimize particle dispersion. We used, dual limb circuitry with a filter on the expiratory limb on our ventilator. The ventilatory settings used was:  $FiO_2 = 55\%$ ;  $PS = 10 \text{ cm H}_2O$ ;  $PEEP = 5 \text{ cm H}_2O$ ,  $I:E = 1:2$ ;  $Trigger = 2 \text{ L/min}$ ). We also used the lowest effective pressures between 5 to 10 cm H<sub>2</sub>O using this CPAP mode of ventilation to minimise the aerosol generation. He was managed conservatively.

In all three of these patients a side stream capnography monitoring was being used. On close inspection of the water trap chamber of capnograph we saw some collection of condensed water in all the three chambers as shown in Figure 1. We sent the samples of all three patients for culture sensitivity to confirm whether the water present inside the trap is a contaminant or not. The samples were sent to department of microbiology and then the sample was plated on blood agar and MacConkey agar and incubated at 37 °C aerobically for 24 hours. The Colonies derived from Case sample A was non hemolytic on blood agar plate and lactose non-fermenter on MacConkey agar while the Case sample B gives non hemolytic mucoid colonies on blood agar plate and lactose fermenting pink colonies on MacConkey agar. The Case Sample C has shown no growth and it was sterile on blood and MacConkey agar, and other two colonies was further evaluated using Gram Stain and several other biochemical tests. Based on the Gram stain properties and biochemical reactions the non-fermenter, non-hemolytic colonies were identified as *Acinetaobacter baumannii* strain (Case sample A) and the mucoid colonies were identified as *Klebseilla pneumoniae* (Case sample B).



**Figure 1.** Dryline water trap system filled with condensed water.

## DISCUSSION

ICU- acquired infections are becoming a challenging health concern especially when caused by multi drug resistant pathogens and in current COVID 19 pandemic risks to health care worker are even more and it always warrants a close observation. Some of the commonly contaminated items reported in literature are ECG leads, blood pressure cuffs, ventilator buttons, circuits, suction system switches and medical charts [1]. As per literature search this is the first case of obtaining culture and sensitivity of condensed water present inside the dryline trap water system which showed positive result for bacterial growth for first two cases and sterile culture for third case. No previous such reports has been published in literature which suggested that the condensed water present inside the water trap is either sterile or contaminants or with positive bacterial growth. These bacterial growths either represent contamination or infected lung flora and it may be a potential source of contamination. In our case we have used HME + BV (Heat moisture exchange + bacterial viral) filters in all three cases during capnography monitoring, we also ruled out the possibility of any surface or air contamination. In side-stream systems the temperature of the sampled gases decreases toward room temperature during its transit from the patient connection to the monitor [2]. Water vapour is invariably present in the sampled expired air which gets condensed due to lower room temperature. A water trap is used to remove any water if present in particulate form before it enters the analysis cell [3]. As water trap has a shelf life of around 1 month and if it is recommended to be used in multiple patients, it can be a potential source of cross infection. There are various available evidences which indicates that COVID-19 virus is transmitted during close contact through respiratory droplets (such as coughing) and by fomites [4]. The case C after one day the test of RT-PCR was COVID-19 negative. We know that the end-tidal CO<sub>2</sub> line water trap is likely to fill relatively quickly and will need decanting. This water may be virally contaminated [5]. Internal contamination is not an issue as the sampled air is HEPA filtered and dried prior to entering the gas bench.

In our case contamination of breathing systems may occurred because of the compliance failure possibly due to improper inspection and functional testing of the sampling tube and exhaust tube which may lead to the reversal of the direction of flow through the sampling tube in a diverting respiratory gas monitor (RGM). The second reason for breathing system contamination may be due to non-functioning of breathing system filter as it is not a component of RGM with high-integrity characteristics. There is an unacceptable

risk of cross-infection with exhaust tube under normal condition and single fault condition as the RGM are designed in such a way that sample gas is not returned to the breathing system. If its compliance is properly checked by inspection and functional testing [6].

## CONCLUSION

So, it is recommended that daily inspection, functional testing and routine check for all breathing system filter should be made mandatory and never ignore any condensed water collection in the dry trap system as they may behave as a potential source of cross contamination and infection. As these are not suitable for mechanical re-processing or sterilization, but we can reuse this dry trap system at the time of crisis by cleaning with moist wipes using 70% solution of isopropyl alcohol during current COVID-19 pandemic.

## Disclosure statement

The authors did not report any potential conflict of interest.

## REFERENCES

- [1] Russotto V, Cortegiani A, Raineri SM, Giarratano A. Bacterial contamination of inanimate surfaces and equipment in the intensive care unit. *J Intensive Care*. 2015; 3: 54.  
doi: <https://doi.org/10.1186/s40560-015-0120-5>
- [2] Severinghaus JW. Water Vapor Calibration Errors in Some Capnometers Respiratory Conventions Misunderstood by Manufacturers?. *Anesthesiology*, 1989; 70(6): 996-998.  
doi: <https://doi.org/10.1097/0000542-198906000-00019>
- [3] Butani M. Capnography. *Indian J. Anaesth*. 2002 ;46 (4) : 269-278
- [4] Liu J, Liao X, Qian S, Yuan J, Wang F, Liu Y, et al.. Community transmission of severe acute respiratory syndrome coronavirus 2, Shenzhen, China, 2020. *Emerg Infect Dis*. 2020; 26(6): 1320-1323.  
doi: <https://doi.org/10.3201/eid2606.200239>
- [5] Robinson AJ, London W, Kotan L, Downing W. A modification to the Maquet Flow-i anaesthesia machine for ICU ventilation. *medRxiv*, 2020.  
doi: <https://doi.org/10.1101/2020.04.06.20054882>
- [6] ISO 80601-2-55:2018, Medical electrical equipment - Part 2-55: Particular requirements for the basic safety and essential performance of respiratory gas monitors.  
[WWW]: <https://www.iso.org/standard/67241.html>  
(accessed 1 August 2020)