Quantification of Drying Effect of Water Soluble Versus Petrolatum Products on Nasal Mucosa

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ABSTRACT

Outcome Objectives:
1) Determine water loss of various nasal emollients exposed to air and their ability to humidify air
2) Compare water loss from sheep nasal mucosa that has been coated with various nasal emollients

Methods:
Ongoing laboratory studies were performed in an academic setting beginning in October 2012. A setup consisting of two specimen chambers, a flow meter, an air source, and two humidity/temperature sensors was used to test the ability of various nasal emollients to humidify air. Water loss from the agents was calculated based on weight and humidity. Experiments were also performed using sheep nasal mucosa coated with a semi-permeable membrane. Water loss was similarly determined for the mucosa. To determine exactly how much water evaporated from tissue versus emollient, a chamber containing water covered by a semi-permeable membrane was created. ANOVA was used to determine a difference in mean water loss compared to initial weight. A T-test was used to compare for differences between water-soluble and petroleum emollients. A literature review on complications of petroleum products was performed.

Results:
Water-based nasal emollients lost more water than petroleum-based products. Nasal mucosa coated with water-based products rather than petroleum also lost more water. Water loss correlated with humidity and weight loss (Pearson’s correlation coefficient= 0.9356). A pilot study using the water chamber and semi-permeable membrane confirmed the findings.

Conclusion:
Petroleum-based nasal emollients are superior to water-based emollients in terms of less dehydration of underlying mucosa. There are however rare complications associated with the use of petroleum products.

METHODS AND MATERIALS

Specimen chambers were set up in a circuit with air flow from a pressurized tank as shown in Figure 1. The proximal chamber contained a temperature and humidity sensor that continuously measured air entering the circuit. A flow meter was set up in-line to measure flow rate, which was set at 2.5 L/min for all experiments. The distal chamber is where the specimen was placed and also contained a temperature and humidity sensor that was measured continuously. Sensors were calibrated for atmospheric pressure and pressure of the pressurized air. Data were continuously recorded using Twin Star Acquisition and Storage Software (Twin Star Medical). A silicone well was used to create the specimen, nasal emollient, tissue or both. Only the top surface of the specimen was exposed to airflow, as it sat in the well. The tissue and emollient were placed at a surface area of 1.5 cm x 1.5 cm for all experiments. All emollients were tested with the same starting mass. Water-soluble products were EZ lubricating jelly, Ayr gel, and NeillMed sodium hyaluronate spray gel. Oil and petroleum-based emollients were NozOil, Panaris, Aquaphor and Vaseline. Recently sacrificed sheep were used to harvest nasal turbinate mucosa for the experiments. The corners of the mucosa were tucked to the well for consistent surface area. Weights of the emollients and tissue were recorded before and after exposure to airflow for 30 min. Water loss was also calculated by humidity measurements. Pearson’s correlation coefficient was used on both methods.

To determine water loss separately from the emollient and underlying water, a chamber was created shown in Figure 2. This consisted of Tyvek (semi-permeable membrane) overlying a chamber containing water. The membrane was coated with the emollient and tested as described above.

RESULTS

Measurements of water loss determined by weight and humidity via software were highly correlated (Pearson’s correlation coefficient= 0.9356). As expected, water-soluble emollients (Ayr saline gel, EZ lubricating jelly and hyaluronate spray gel) had significant water loss compared to petroleum and oil-based emollients (p= 8.82E-15) (Figure 3.) Figure 4 shows the same data from one trial showing water loss over time.

Figure 5 (left) mean % weight loss of emollients performed in triplicate over time. Figure 4 (right) shows weight loss (%) versus time for each emollient.

Figure 6 shows the experiments to separately determine water loss from the emollient and underlying mucosa using a chamber of water and semi-permeable membrane. The negative control (bare membrane) appeared to lose the greatest amount of water followed by membranes coated with water-soluble emollients and least from petroleum and oil-based emollients. Percent weight loss (water loss) from emollients was as follows: hyaluronate (45.2%), EZ jelly (38.4%), Ayr gel (41.1%), Vaseline (4.5%), Aquaphor (8.4%), NozOil (7.5%), Panaris (4.5%).

REFERENCES