Warm Air Convection Heating Blankets May Increase the Absorption of Transdermal Nitroglycerin

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WARM air convection heating blankets are commonly used to maintain normothermia in patients undergoing surgery and anesthesia. This communication reports a case where the application of a warm air convection heating blanket directly over transdermal nitroglycerin ointment may have caused accelerated absorption and an augmented effect.

Case Report

A 77-yr-old, 72-kg woman was scheduled for a right hemicolectomy for colon carcinoma. Her medical history was remarkable for chronic stable angina, previous myocardial infarction, hypertension, and S/P hysterectomy. Echocardiogram revealed inferior akinesis and estimated ejection fraction of 40%. Her chronic medications included diltiazem and sublingual nitroglycerin as occasion requires. Her preoperative hemoglobin was 11.7 g/dl.

The evening before surgery, a pulmonary artery catheter was inserted, and her pulmonary artery pressures were 25-28/9-12 mmHg. Her cardiologist ordered 2 inches nitroglycerin ointment applied 2 h before surgery. After an uneventful induction with etomidate, fentanyl, cisatracurium, and isoflurane, the patient was maintained with isoflurane, fentanyl, and cisatracurium. Arterial and pulmonary artery pressures after induction were approximately 120/70 and 25/10, respectively. Approximately 5-10 min after induction, an upper body forced air warming blanket, which covered the nitroglycerin ointment that had been applied to the patient's chest, was turned on at 110 ± 5°F. Within 20-30 min, the patient's pulmonary artery pressure decreased to 18/7-8, and the systolic arterial pressure decreased to 90-100 mmHg despite fluid therapy. Surgical blood loss during this period was less than 50 cc. The patient was treated with intermittent 40-μg phenylephrine boluses, and the nitroglycerin ointment was removed. Approximately 20-30 min after the removal of the nitroglycerin ointment, the patient's arterial and pulmonary artery pressures increased and stabilized. The patient then was started on a 17 μg/min intravenous nitroglycerin infusion. The remainder of the patient's perioperative course was unremarkable.

Discussion

 Forced air warming is commonly used in operating rooms, and its popularity may continue to grow because of recent reports indicating that maintaining intraoperative normothermia can reduce the incidence of adverse events.1-3 Such increased use will increase the opportunities for warming blankets to be used on patients with transdermal medications.

This case suggests that application of a forced air warming blanket over nitroglycerin ointment may accelerate the absorption of nitroglycerin. Although systemic and pulmonary arterial blood pressures had been stable for the 2 h after the application of nitroglycerin and was not markedly changed after induction, a fall in systemic and pulmonary arterial blood pressure was noted shortly after the warming unit was turned on. There were no surgical events nor intravenous medication administrations that could account for these observations. With the warming blanket left on, the nitroglycerin ointment was removed, and 20-30 min later, all noted changes had resolved. This is consistent with the known duration of the preparation.1

There are many medications that can be administered transdermally (e.g., nitroglycerin ointment, nitroglycerin patch, fentanyl, clonidine, scopolamine, nicotine, estradiol, testosterone, salicylic acid). Presumably, heat could influence either drug delivery to the skin or transport through it.

Rose et al.4 reported a patient who suffered a fentanyl overdose when a heating pad came in contact with a fentanyl patch. The manufacturer provides a precautionary statement that serum concentrations of fentanyl may increase by approximately one third in patients with a body temperature of 40°C (102°F) because of accelerated release of fentanyl from the drug reservoir (a mechanism not applicable to nitroglycerin ointment,

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but potentially applicable to nitroglycerin patches) and increased skin permeability. The fentanyl patch manufacturer also warns against exposing the patch application site to direct external heat sources. Of interest, Rung et al. concluded that skin temperature in the range of 52–38°C has no effect on transdermal fentanyl therapy.

A dermatology textbook states “Increased skin temperature, like increased water content of skin, clearly results in an increase in absorption through the skin.” A literature search, however, revealed only one article concerning how heating affects the absorption of nitroglycerin. Heating skin to 100°C for 5 min appreciably damaged hairless mouse skin barrier function.

It is also possible that the application of the warming blanket resulted in increasing the area of skin directly in contact with the nitroglycerin ointment because of either the melting or spreading of the ointment. However, the relationship of the rate and extent of absorption varying with the square measure of the skin over which a dose is spread has not been adequately studied.

In conclusion, the possibility exists that application of a warm air heating blanket, especially if set at a high temperature, over nitroglycerin ointment (and perhaps other transdermal medications) may accelerate the absorption of medication, thereby effectively increasing the dose rate. Depending on the medication, the effects of an augmented infusion rate may either be evident during or masked by the anesthetic. Based on this report and that noted previously, until there are data to support or refute this hypothesis for each specific medication and delivery system, it may be prudent to avoid placing a warming blanket directly over transdermal medications. To prevent or manage such a problem, one can:

1) Discontinue the transdermal medication(s) and administer the medication(s) via an alternative route. (The transdermal medications should be removed sufficiently in advance to prevent accelerated absorption from medication remaining within a skin depot)
2) Apply the transdermal medication(s) to a location that will not be warmed by the heating blanket; or
3) Insulate the transdermal medication(s) from the warming blanket.

References