Cetacaine Spray as an Ex Vivo "Plastic-on-Plastic" Lubricant for Airway Management Procedures

A New Use for Dipropylene Glycol?

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In addition to being an aerosolized topical local anesthetic, Cetacaine Spray has the physical property of being an excellent medical lubricant for airway management and related procedures. This is a result of the constituent ingredient dipropylene glycol (DPG). However, because of the presence of benzocaine, this medication can cause methemoglobinemia if absorbed excessively. The authors speculate that aerosolized DPG may be useful as medical lubricant, independent of the local anesthetics contained within Cetacaine Spray. Further research into this potential application of DPG may be indicated.

During the practice of routine hospital-based airway management, anesthesiologists and pulmonologists are frequently involved in situations where mechanical movement of "plastic-on-plastic" occurs. These arise during such circumstances as fiberoptic intubations, tracheal tube exchanges, the use of an intubating laryngeal mask airway (iLMA), bronchoscopy, and double-lumen tracheal tube placement.[1,2]

Thus, excessive friction can result in significant difficulties when deploying a tracheal tube from the surface of a fiberscope. Similarly, the use of an iLMA may be hampered by excessive friction, particularly when advancing a tracheal tube through its shaft.

Furthermore, when an iLMA is used as a fiberoptic-compatible oral airway, excessive friction can occur on 2 surfaces simultaneously, both internally and externally to the tracheal tube. Specifically, mechanical movement may be hindered between the fiberscope and the inner surface of the tracheal tube as well as between the outer surface of the tracheal tube and the iLMA.

Consequently, these procedures are greatly facilitated with the utilization of a plastic-on-plastic lubricant.

The authors have found the use of Cetacaine Spray, as a lubricant, advantageous. It produces an extremely smooth "friction-free" motion of plastic-on-plastic materials. In addition, this medication is readily available and is also frequently utilized, as a topical local anesthetic, during "awake" airway management procedures. Furthermore, as shown in Figures 1 and 2, it is supplied in a pressurized container and is subsequently aerosolized. This facilitates its deployment, particularly within hollow plastic shafts.

This lubricating effect is due to the presence of dipropylene glycol (DPG), which is a pharmacologically inactive ingredient within Cetacaine Spray.[3-5] It should be noted that the DPG has the chemical formula of $C_6H_{14}O_3$ and is illustrated in Figure 3. Furthermore, the isomers of this chemical are also utilized in the commercial preparation of DPG. Specifically, DPG functions as a "plasticizer," which reduces the viscosity of the entire mixture. The composition of Cetacaine Spray is listed in the Table.[6] By weight, DPG is its greatest component. Moreover, DPG is commercially prepared from soybean oil.[3] Topically, it is considered biologically safe and is frequently utilized in the formulation of cosmetics, perfumes, soap, skin care, and shaving products.[5]

Compared with other water-soluble substances that are used as lubricants in these situations, such as lidocaine gel or Surgilube, Cetacaine Spray appears to have a much lower viscosity and subsequently has a consistency that resembles a liquid rather than a gel. Thus, when applied topically to plastic, the DPG component produces an extremely "slippery" low-friction surface.

However, because of the propensity for Cetacaine to result in methemoglobinemia, this off-label use should be done ex vivo (outside the body) to reduce this potential

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FIGURE 1. Cetacaine Spray being used as a lubricant with an intubating laryngeal mask airway.

adverse effect. It should be noted that methemoglobinemia occurs from oxidation of the iron molecule, within hemoglobin, from its normal Fe^{2+} state to an Fe^{3+} state. It is this oxidized Fe^{3+} state that causes hemoglobin to lose its ability to bind oxygen. Moreover, it is the benzocaine component of Cetacaine that is specifically responsible for this adverse effect.[7] Cetacaine is commercially available in either a spray or gel form, and both formulations contain benzocaine. Likewise, other topical local anesthetics also contain benzocaine.

Furthermore, assessment for the signs and symptoms of methemoglobinemia should always be made when using this medication. These include cyanosis, chocolate colored blood, and central nervous system changes. Also, values for oxygen saturation (Spo_2) may tend to be at approximately 85%.[8] During extreme circumstances, additional symptoms of methemoglobinemia may arise that could include myocardial ischemia and coma. Infrequently, methemoglobinemia may occur from other medications such as nitroglycerine, nitroprusside, lidocaine, and silver nitrate. Complete lists of drugs that have this adverse effect are available. Rare genetic disorders may also produce methemoglobinemia.[9,10]

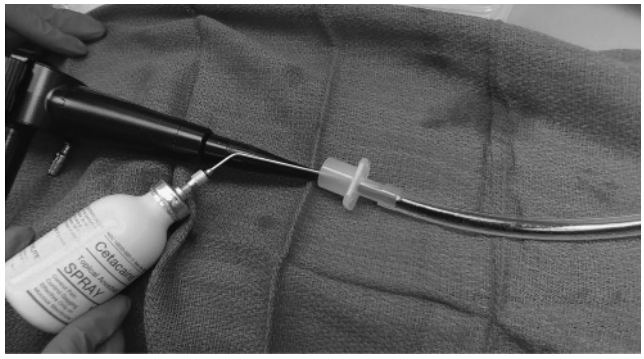

FIGURE 2. Cetacaine Spray can also be utilized as a lubricant for fiberoptic and bronchoscopic procedures.

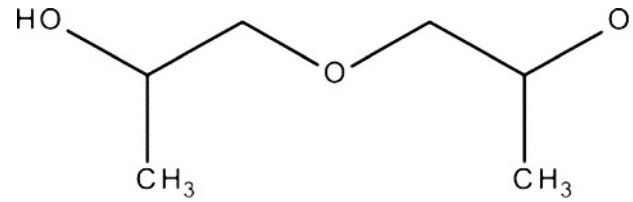

FIGURE 3. Chemical structure of dipropylene glycol. Additional isomers of this structure may be included as a commercially available mixture. It is this substance that is responsible for the lubricating nature of Cetacaine Spray.

In addition, co-oximetry may be necessary to confirm this diagnosis.[10] Methylene blue should also be readily accessible, as it reduces the Fe^{3+} state of methemoglobin back to its normal Fe^{2+} state.[11] The respective oxidation and reduction reactions of benzocaine and methylene blue are summarized in Figure 4.

Care must be taken to ensure that no excessive Cetacaine Spray exists on those parts that might come in contact with oral, nasal, pharyngeal, or mucous membranes.

Only a thin "light film" of Cetacaine Spray is indicated, as this medication can be readily spread over the sliding surfaces of these devices using a sterile gauze. Moreover, a fiberscope can be advanced as well as rotated, over the tracheal tube, to produce an even distribution of this substance prior to intubation. This can be done, in a similar manner, with an iLMA.

It should be noted that Cetacaine is commercially available only in the United States and Canada, whereas benzocaine is obtainable, as an aerosolized spray, internationally. Thus, given the potential for methemoglobinemia from Cetacaine, the authors speculate that DPG "by itself" may be a useful medical lubricant. Therefore, DPG could be supplied in a pressurized container and aerosolized in a manner similar to Cetacaine Spray. Further research regarding its safety, efficacy, and financial cost would be necessary to assess DPG for this potential use.

TABLE. Chemical Composition of Cetacaine Spray

Agent	Weight, %	Function
Dipropylene glycol (DPG)	70-85	Lubricant and viscosity reduction
Benzocaine	10-20	Ester local anesthetic
Butamben	1-5	Ester local anesthetic
Tetracaine	1-5	Ester local anesthetic
Saccharine	1-5	Flavoring agent
Benzalkonium chloride	0.5-2%	Antimicrobial

By weight, DPG is its major component.

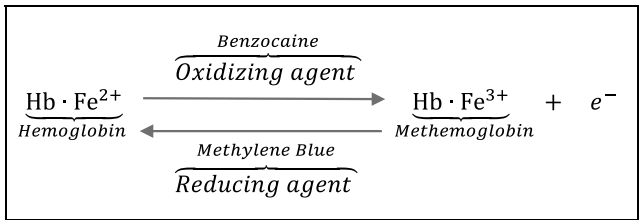

FIGURE 4. An oxidation reaction is responsible for benzocaine converting the iron moiety, within normal hemoglobin, into methemoglobin, whereas a reduction reaction, occurring from the use of methylene blue, reverses this potentially life-threatening condition. Benzocaine is one of the active ingredients in Cetacaine and other topical local anesthetics.

Additional medical applications, for DPG, could possibly include its use as a lubricant during hospital-based gastrointestinal, gynecologic, and urologic procedures.

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