Title: AN EVALUATION OF FIVE METALLIC TAPES FOR PROTECTION OF ENDOTRACHEAL TUBES DURING CO2 LASER SURGERY

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Introduction. A survey of the complications of laser laryngoscopic surgery has shown that endotracheal explosions were the most frequent complication. To prevent this catastrophe, the wrapping of combustible endotracheal tubes with metal tape has been recommended. However, it has been suggested that some tapes may not afford adequate protection. We sought to evaluate the protection offered by five commercially available metal tapes.

Methods. Size 8 polyvinylchloride endotracheal tubes (Wallinckrodt hi-lo [R]) were wrapped with a continuous strip of 1/2" self adhesive foil tape. The wrapping was started at the distal (cuffed) end and was applied in an overlapping fashion. The tapes used were: 3M (St. Paul, MN) #425, #430, #433, Radio Shack (Tandy Corp., Ft. Worth, TX) #44-1155 and copper foil tape (Venture Tape Corp., Rockland, MA). Five liters of 100% oxygen per minute were made to flow through the tubes. A Laser Sonic's model LS880 CO2 laser and Zeiss operating microscope employing a 400 mm lens and a 0.68 mm beam diameter were used. The beam was directed onto the foil wrapped tubes at the point of overlapping of the tape. Seventy watts of power in the continuous mode of laser operation was used. The time necessary until the occurrence of smoke, flames or perforation or "blow torch" ignition were noted. Finally, a segment of tape was wrapped adhesive side outward and the same procedure undertaken.

Results. 3M #425, #433 and copper tape were unaffected by 25 seconds of laser impact. Penetration and blow torch fire of the tube occurred in 7 and 14 seconds respectively with the Radio Shack and 3M #1430 tapes (see figure 1).

The adhesive backing of the 3M #433 and Radio Shack tapes were ignited and the tape perforated within 0.1 second of the laser's impact. Flaming occurred at 1 second without penetration of the 3M #1430 and copper tape. 3M #425 tape could be made to smoke at 2 seconds however no flaming occurred and there was no perforation.

Discussion. The use of the CO2 laser in close proximity to the airway puts the surgeon and anesthesiologist in competition and places combustible endotracheal tubes at great risk for a fire which may convert the tube into a blow-torch. This might cause significant airway burns and leave the patient without a patent airway. The use of metallic tape to protect these tubes has been suggested however the type of tape used is often not specified or an ineffective type advocated.

Our result showed that 3M #1430 and Radio Shack #44-1155 tapes offer inadequate protection of flammable endotracheal tubes and should not be used for this purpose. 3M #433 tape has a flameable backing and also should not be used. Copper foil and 3M #425 tapes provided excellent protection of the endotracheal tubes and are thus recommended for use during CO2 laser surgery in proximity to the airway. The possibility of changes in the composition of these tapes dictates that whenever a new batch of tape is used, its incendiary characteristics should be reconfirmed.

In the evaluation of metallic tape it is important that the laser beam be directed at the edge of the tape since some tapes such as the Radio Shack #44-1155 have an inner plastic layer which is highly flammable but would not be detected by the laser's impact on the center of the tape.

None of the tapes studied are manufactured for medical applications nor has such use been sanctioned by the Food and Drug Administration to our knowledge. Thus the manufacturer cannot be held liable for any complications. The use of metallic tape provides protection only from the direct impact of the laser beam. Indirect combustion due to sparks or heat from combustion is still possible.

References.

Figure 1. Endotracheal tube fire in a PVC tube wrapped with Radio Shack #44-1155 tape after contact with a CO2 laser.