Effects of Pulsed RF Energy Compared to Standard Electrocautery on Transvenous Lead Materials

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Abstract

Introduction: Standard electrocautery can cause thermal injury to the insulation of transvenous pacing and defibrillation leads. There is a novel surgical cutting blade that uses pulsed radiofrequency (RF) to generate a plasma-mediated discharge along the exposed rim of an insulated blade, creating an effective cutting edge while minimizing collateral thermal damage. The purpose of this study was to determine the effects of electrocautery using the pulsed RF blade on transvenous lead insulation materials.

Methods: A preparation of chicken breasts at 37°C was used with transvenous leads tunneled superficially. Energy was delivered using a standard cautery blade and the pulsed RF blade (PEAK PlasmaBlade™) at outputs of 20 and 30W for 3 seconds. Parallel and perpendicular blade orientations were used on ten leads with outermost insulations of silicone rubber, polyurethane (PU55D), or silicone-polyurethane copolymer. Damage to each lead was classified after visual and microscopic analysis as no damage, minimal damage, significant damage without full breach and significant with full breach of insulation.

Results: We hypothesized that using insulated planar electrodes to deliver pulsed electric waveforms of very short duration (<100 µs) from the exposed edges (12 µm wide) would result in less thermal injury to silicone, polyurethane and copolymer insulated leads. Standard electrocautery can cause thermal injury to the insulation of transvenous pacing and defibrillation leads. Thermal injury increases the incidence of lead failure. Consistent with prior findings, polyurethane and copolymer materials are highly susceptible to thermal damage during standard cautery. In this study Pulsed RF blade technology caused less thermal injury to all lead insulation materials compared to standard electrocautery. This new technology may be useful during device upgrades and pulse generator replacements.

Conclusions: Minimizes collateral thermal damage.

Hypothesis

We hypothesized that using insulated planar electrodes to deliver pulsed electric waveforms of very short duration (<100 µs) from the exposed edges (12 µm wide) would result in less thermal injury to silicone, polyurethane and copolymer insulated leads. We previously demonstrated:1

- Polyurethane (PU55D) insulated leads are extremely vulnerable to thermal damage from standard cautery.
- Silicone insulated leads are resistant to thermal damage but can be damaged mechanically by the blade if cautery is delivered perpendicularly to the lead.
- There is a novel surgical cutting blade that uses pulsed radiofrequency (RF) to generate a plasma-mediated discharge along the exposed rim of an insulated blade.
- Minimizes collateral thermal damage.
- Creates an effective cutting edge.

Methods

A preparation of chicken breasts at 37°C was used with transvenous leads tunneled superficially. Energy was delivered using a standard cautery blade and the pulsed RF blade (PEAK PlasmaBlade™) at outputs of 20 and 30W for 3 seconds. Parallel and perpendicular blade orientations were used on ten leads with outermost insulations of silicone rubber, polyurethane (PU55D), or silicone-polyurethane copolymer. Damage to each lead was classified after visual and microscopic analysis as no damage, minimal damage, significant damage without full breach and significant with full breach of insulation.

Results

- Standard electrocautery can cause thermal injury to the insulation of transvenous pacing and defibrillation leads.
- Thermal injury increases the incidence of lead failure.
- Lim et al. previously demonstrated:1
  - Polyurethane (PU55D) insulated leads are extremely vulnerable to thermal damage from standard cautery.
  - Silicone insulated leads are resistant to thermal damage but can be damaged mechanically by the blade if cautery is delivered perpendicularly to the lead.
  - There is a novel surgical cutting blade that uses pulsed radiofrequency (RF) to generate a plasma-mediated discharge along the exposed rim of an insulated blade.
  - Minimizes collateral thermal damage.
  - Creates an effective cutting edge.

Conclusions

Consistent with prior findings, polyurethane and copolymer materials are highly susceptible to thermal damage during standard cautery. In this study, pulsed RF blade technology caused less thermal injury to all lead insulation materials compared to standard electrocautery. This new technology may be useful during device upgrades and pulse generator replacements.

References


Disclosures: Paul Davison – Vice President of Research and Development at Peak Surgical, Inc.