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EFFECT OF HIGH VOLTAGE PULSED CURRENT AND ALTERNATING CURRENT ON HISTAMINE INDUCED FITC DEXTRAN LEAKAGE FROM HAMSTER CHEEK POUCH MICROCIRCULATION.

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PURPOSE: Our goal was to determine effect of cathodal high voltage pulsed current (HVPC), anodal HVPC and alternating current (AC) on macromolecular leakage from microvessels. RELEVANCE: Clinicians commonly apply electrical stimulation (ES) in an attempt to control posttraumatic edema formation. Effectiveness of ES, however, has just recently begun to be scientifically examined. Recent work performed here at the University at Buffalo demonstrated that cathodal high voltage pulsed current (HVPC) reduced edema formation after acute injuries in hind limbs of frogs and rats. However, only two studies of mechanism of action of such HVPC presently exist. Since leakage of plasma proteins from postcapillary venules is the primary cause of edema formation, inhibition of such leakage via ES may inhibit edema formation. SUBJECTS: 52 Syrian golden hamsters were used in this series of 7 complementary studies. METHODS AND MATERIALS: Hamsters were anesthetized, injected with fluorescein isothiocyanate dextran (FITCdx) and cheek pouches prepared for observation of microvessels via intravital fluorescence microscopy. Number of leakage sites and total area of leakage of this fluorescent tracer molecule were determined, via computer digital image processing, at 3, 4 and 5 minutes after initiation of intervention. Number of leakage sites of FITCdx produced solely by application of histamine served as control measures to which subsequent data regarding treatment interventions were compared. Effect of simultaneous application of histamine and each of the following forms and intensities of ES on leakage was determined: continuous, 120 pps, cathodal HVPC at 90%, 50%, or 10% of visible motor threshold (VMT) intensity; continuous, 120 pps, anodal HVPC at 90% or 50% VMT intensity, and AC (2500 Hz carrier frequency modulated to 50 pps) at 90% VMT intensity. Count data were expressed as number of leakage sites/field of view. Total area measures are expressed as the sum of individual areas of leak sites included in count measure. ANALYSES: Data for number of leakage sites and total area of leakage were analyzed separately by 7 X 3 ANOVA (group X time).with repeated measures. Differences were accepted as significant at $p < 0.05$. Tests for simple main effect determined sources of these significant differences. RESULTS: Total area of leakage and number of leak sites were significantly less in pouches treated with cathodal HVPC at 90% and 50% VMT and anodal HVPC at 90% VMT than control pouches or pouches treated with other types and intensities of ES. Significant differences between these groups were noted at 4 and 5 minutes after initiation of intervention. However, no significant differences were noted between pouches treated with cathodal HVPC at 90% and 50% VMT and anodal HVPC at 90% VMT. CONCLUSIONS: These studies revealed that selection of appropriate current parameters such as polarity, intensity, wave form (HVPC vs AC) may be critical in the effectiveness of our patient treatment. HVPC, below motor threshold, may affect edema formation by inhibiting microvessel permeability. Inhibition of macromolecular leakage was possible with cathodal HVPC at lower intensity than was necessary to achieve a similar inhibition using anodal HVPC. AC was not effective in modulating leakage even at 90% VMT intensity. Thus, it appears that there may be a dose response or threshold intensity necessary for significant treatment effect. Though we must use caution in generalizing these results to humans, this information may provide clinicians with a beginning for scientifically based guidelines for application of ES to achieve the clinical goal of edema control.

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