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# Management of Decubitus Ulcer using Gentamycin Sulphate Iontophoresis - A Case Study

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### ABSTRACT

Most infective organisms have developed resistance against antibiotics. There is need to find other means to deliver antibiotics locally. There appears to be limited studies on the use of gentamicin sulphate iontophoresis in wound management. The participant in this study was a subject diagnosed with mild head injury secondary to motor vehicle accident who later developed a unilateral pressure sore on the left gluteal region. The subject received 15-minutes of gentamicin sulphate iontophoresis (Interrupted Direct Current) three times a week for five weeks. The case report showed that there was a 65.7% reduction in wound surface area of the decubitus ulcer at the end of five weeks. Also, bacterial growth reduced from very heavy growth to scanty growth at the end of the 5<sup>th</sup> week. This report suggested that gentamicin sulphate ointment iontophoresis as adjunct with traditional saline-wet-to-moist (WM) wound dressing had an effect in healing the decubitus ulcer of the participant used in this study.

### INTRODUCTION

Pressure sores in our hospitals today are very rampant among bedridden patients. They occur in approximately 9% of hospitalized patients usually during the first 2 weeks of hospitalization and in approximately one fourth of nursing home residents. The yearly risk of pressure ulceration in patients with neurological impairment is 5 to 8%, with a lifetime risk of approximately 85% and mortality rate of 8%.<sup>1</sup> Prolonged pressure over bony prominences, coupled with the loss of sensation, voluntary movement, and vasomotor control, prevents adequate circulation to the skin.<sup>2</sup>

Wound infection is the deposition and multiplication of bacteria in tissues with an associated host.<sup>3</sup> Most cases are hospital acquired; they are often associated with extended lengths of stay. Olafimihan reported that of all the wounds of patients in a Nigerian teaching hospital, *Staphylococcus aureus* and *Klebsiella* species were the commonest infective organisms.<sup>4</sup> However, chronic pressure ulcers are most likely to have *Staphylococcus aureus*, *Streptococcus*, or *Pseudomonas aeruginosa* as a

significant invading organism that produces potentially destructive and virulent tissue destroying factors.<sup>5</sup> Open wounds become colonized by hospital pathogens and subsequently become infected.

Chronic, open, non-healing wounds pose a continual challenge in medicine,<sup>6</sup> and resistance to management with antibiotics has become problematic in recent years, particularly with rise of epidemic strains of *S. aureus*.<sup>7</sup> The transdermal delivery of gentamicin is considered unfeasible because it has low permeability through the dermis.<sup>8</sup> Systemic administration of antibiotics is more likely to promote resistance because more organisms in the host are being exposed to the antibiotic. Normal wound dressing alone may not be enough to heal the wounds and this may necessitate adjunctive therapies.<sup>5</sup> There appear to be limited studies on the use of gentamicin sulphate iontophoresis in wound management, and the only known study was used to treat wound at the ear cartilage.<sup>9</sup> Ear cartilage heals slowly and has limited vascularity, and this precludes use of systemic antibiotics. There is a need to further explore ways of delivering antibiotics. Furthermore, the therapeutic application of electric current for wound healing does not seem to have been widely embraced.<sup>10</sup>

## CASE STUDY

### Subject

The participant in this study was a 27-year-old male student who consented to participate in the study. He was diagnosed with mild head injury secondary to motor vehicle accident and later developed a unilateral pressure sore on the left gluteal region. He was an inpatient at the Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) Ile-ife, Osun state at the time of the study. The result of the Fasting Blood Sugar revealed that he was non-diabetic. His social history showed that he was a non-smoker and does not take alcohol. Physical examination showed that he did not have risk factors for cardiovascular disease and he also tested negative for HIV test.

### Presentation

Two weeks after admission, the skin broke down due to unrelieved pressure. The wound surface area was 9.20cm<sup>2</sup> (3.80cm x 2.42cm) and assessment after the 4<sup>th</sup> week showed that it had increased to 14.80cm<sup>2</sup> (5.72cm x 2.59) despite traditional saline-wet-to-moist wound dressing.<sup>2</sup> The wound depth was, however, not ascertained. The wound was at stage 2.

### Examination

The wound was debrided when it was observed that there was partial necrosis of the wound tissues. The Pressure Sore Status Tool was used to assess type and amount of exudates produced, epithelialization, wound appearance, wound edge, and peripheral oedema.<sup>11</sup> The surface area of the decubitus ulcer was determined by planimetric method.<sup>12</sup> The surface area of the ulcer is thus computed as: Wound surface area (cm<sup>2</sup>) = Number of squares within the tracing X 0.0625cm<sup>2</sup>.<sup>13</sup>

Swabs taken from the decubitus ulcers were cultured. *Staphylococcus aureus*, *Klebsiella* species and *Proteus vulgaris* were isolated from the culture, and both *Staphylococcus aureus* and *Klebsiella* species were found to be sensitive to gentamicin sulphate while *proteus vulgaris* was insensitive to it. A medical laboratory scientist who was blinded to the purpose of the study assessed the growth of bacteria.

The amount of exudate produced by the decubitus ulcers (both experimental and control limbs) were also assessed by the Pressure Sore Status Tool.<sup>11</sup> The assessment of the amount of exudate produced by the pressure sore on the Pressure Sore Status Tool is based on a Likert scale of 5:

1. None
2. Scant
3. Small
4. Moderate
5. Large<sup>9</sup>

The epithelialization of the decubitus ulcers (both experimental and control limbs) was assessed by the Pressure Sore Status Tool.<sup>11</sup> The assessment of the epithelialization was based on a Likert scale of 5. The main researcher, although not blinded, graded the epithelialization.

1. 100% wound covered and surface intact.
2. 75% to less than 100% of wound covered or epithelial tissues extends greater than 0.5 cm into wound bed.
3. 50% to less than 75% of the wounds covered with epithelial tissues.
4. 25% to less than 50% of wound covered
5. Less than 25% of wound covered.

## Treatment

The periphery of the ulcer was cleaned with methylated spirit. Moistened, sterilized gauze was wrapped around the electrodes of the Electrical stimulator (Medi-link model 70A, Serial no 99160). The wound was off-loaded by encouraging the subject to side-lye in order to avoid being subjected to further pressure. There was also regular turning while on the bed. Moreover, the gentamicin sulphate ointment was applied on the active electrode of the Interrupted Direct Current (IDC). The intensity of the IDC used for the iontophoresis was maintained at the sensory threshold of the patient (current intensity of 2.72mA). Each gram of ointment contains 1.7 mg of gentamicin sulfate, equivalent to 1 mg of gentamicin base. An equivalent of 3ml of the ointment was used. The subject received 15-minutes of iontophoresis three times per week for 5-weeks.<sup>14</sup> Swab samples were taken before and after the procedure of iontophoresis. These samples were immediately sent to the laboratory for the analysis of bacterial growth. The participant received the traditional saline-wet-to-moist (WM) wound dressing as adjunct treatment throughout the course of gentamicin sulphate iontophoresis. Further follow-up could not be done after 5-weeks as the participant discharged himself against medical advice.

## RESULTS

The initial wound surface area was 14.81cm<sup>2</sup>, while the final surface area was 5.10cm<sup>2</sup>, a 65.7% reduction in wound surface area. The purulent exudates at the initial stage of the study, resolved at the end of the 5<sup>th</sup> week. Also, the wound became clean and there was almost complete formation of epithelial cells (Table 1, below).

Similarly, bacterial growth, which was very heavy at the start of treatment, became scanty at the end of the 5<sup>th</sup> week. The well-defined edge of the wound became indistinct, while there was a reduction in the amount of associated oedema at the end of the 5<sup>th</sup> week (Table 1, below).

**Table 1: Characteristics of the wound**

Characteristics	1st week	5th week	% decrease
Surface Area (cm <sup>2</sup> )	14.81	5.10	65.7
Type of exudate	Purulent	No exudate	-
Amount of exudates	Moderate	None	-
Epithelialization	75%	< 100 %	-
Appearance	Moderately clean	Clean	-
Edge	Well-defined	Indistinct	-
Peripheral Oedema	Pitting oedema >4cm	Minimal swelling	-
Bacteria growth	Very heavy growth	Scanty growth	-

## DISCUSSION

Gentamycin is widely used in the treatment of severe infections and it is active against many strains of Gram-negative bacteria and *Staphylococcus aureus*. In ointment form, gentamicin is absorbed slowly and systemic absorption may occur after application to large areas of denuded skin.<sup>15</sup> The mechanism of iontophoresis is based on the physical phenomenon that "like charges repel and opposite charges attract."<sup>16</sup> Gentamicin sulphate ions are forced across the skin because of its low permeability through the dermis by simple electronic repulsion of similar charges.

There is evidence that proliferation and migration of epithelial and connective tissue cells involved in wound repair can be increased by an electric field.<sup>17,18</sup> The decrease in bacterial growth to a scanty level and decrease in surface area might be attributed to the effect of gentamicin sulphate ointment. High-voltage pulsed galvanic stimulation (HVPGS) has also been reported to induce human fibroblasts in culture to increase their rates of DNA and protein synthesis.<sup>19</sup>

This case report has limitations as there was no control wound. Future studies should increase the sample size, have a wound to serve as control, and also consider other factors such as difference in nutrition, skin permeability and presence of other disorders.

The treatment of pressure ulcers requires prolonged surgical and nursing care, which may take up to 120 days.<sup>20</sup> Luther reported that electrical stimulation could help speed up wound healing by increasing capillary density and perfusion, improving wound oxygenation, and encouraging granulation and fibroblast activity.<sup>21</sup> Fernandez-Chimeno et al. also reported that electrical current has an antibacterial effect thereby aiding healing at all stages.<sup>22</sup> Several other reports have shown promotion of wound healing using physical agents such as Ultraviolet radiation and electrical stimulation as adjunct therapies.<sup>12,14,23</sup>

## CONCLUSION

Gentamicin sulphate iontophoresis might have a positive effect in the healing of the decubitus ulcer in the subject who participated in this study.

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