



The impact of exposure time on biophysical parameters of the wound environment and patient comfort during dressing changes: a descriptive study.

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Letter of Authenticity

I certify that this thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the Department library, being available for loan and photocopying.

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Abstract

Wound healing is a complex milieu that affects millions of people around the world every day. Practice based concerns have been described anecdotally by nurses in acute care facilities where wounds requiring an assessment by health care professionals have been left without their primary dressings for a considerable length of time. A number of studies have demonstrated that the temperature, transepidermal water loss (TEWL) and pH of a wound's microenvironment influence wound healing; however, there is limited research on the effect of the dressing changes on these parameters as well as the risk of contamination of the wound through prolonged exposure.

The impact of prolonged exposure throughout delays in a dressing change on these biophysical wound bed parameters and the possible contamination of the wound during the wound dressing procedure; and the affect delays have on patient pain, comfort and activities of daily living, were investigated through a descriptive correlational study.

Demographics and participant questionnaire data were analysed using descriptive statistics and frequency distributions. Patterns of distribution of the wound temperature, TEWL and pH data were reviewed before being further analysed along with the bacterial and patient questionnaire data using Generalised Estimating Equations regression models. A GEE linear regression model was used for normally distributed data; and GEE logistic regression models for data which were not normally distributed, using the Statistical Analysis System (SAS) 9.3.

The results identified that the participants' wounds were hypothermic as well as alkaline at dressing removal and throughout the period of exposure. The mean wound temperature increased throughout the total duration of the down time which was contrary to expectation,

although despite this all wounds remained hypothermic. The pH became more alkaline with the chance of having a pH of >8.5 , 12% higher than having a pH of <8.5 .

There was no relationship between the size of the wound and any of the wound bed parameters; however, there was a relationship between the type of wound, the temperature and pH. No associations could be made in regards to the participant's body temperature and wound temperature.

In addition to the investigation into the wound bed parameters, agar plates placed in proximity to the exposed wounds grew pathogens which could potentially contaminate the wound.

The third issue investigated was the affect wound dressing changes on the participant's pain, comfort and activities of daily living, an important aspect of the holistic approach to patient care. Participants were noted to be unable to perform some activities of daily living; including hygiene, toileting, nutrition and positioning during the wound down time. Analgesia was offered haphazardly despite the majority of patients having a pain score pre dressing removal that would indicate analgesia was required and an associated increase in their pain score during the dressing procedure.

The impact of delayed wound dressing changes on the patient's activities of daily living and pain are important in the delivery of patient centred care; however the major findings of the study relate to the poor state of the wounds immediately following removal of the dressing. Hypothermic, alkaline wound beds are not conducive to healing and warrant further investigation.

Glossary of terms

Acidic - A value between 0 and 7 (the logarithmic concentration of hydrogen ions in a substance).^{1,2}

Acticoat™ - An antimicrobial silver impregnated dressing.³

Acute wound – A wound that follow the wound healing response and are ‘healed’ within a specific time frame.^{4,5}

Agar - Gelatinous material used in Petri dishes for the growth of bacteria and fungi.⁶

Alkaline - pH between 7 and 14 (the logarithmic concentration of hydrogen ions in a substance).^{1,2}

Ambient temperature (AT) – Environmental temperature surrounding an object.⁷

Anastomosis - Surgical connection between two structures.⁸

Aspergillus Fumigatus - Opportunistic fungus.^{9,10}

Aural temperature - Measurement of the infrared heat generated by both the eardrum and its surrounding tissue.^{11,12}

Basal metabolic rate (BMR) - Rate at which the body uses energy to perform essential activities.¹³

Binary - Used in statistics where variables can only take on two possible values.¹⁴

Body mass index (BMI) - An estimate of body fat.⁷

Body temperature - Part of a homeostatic mechanism that maintains the body at optimum operating temperature.¹⁵

Brown adipose tissue (BAT) - Tissue is made up of many small lipid droplets and a wealth of mitochondria that is used to burn energy, Adipose tissue sits between the outer layer of the skin and the inner layer of muscle.¹⁶

Chronic wound – A wound with delayed healing as the wound does not progress through the acute wound healing phases in a timely manner.^{4,5}

Cidex® ortho-phthalaldehyde (OPA) - A chemical disinfectant.¹⁷

Circadian rhythm - Regulates the body's biological functions and roughly follows a 24-hour cycle.¹⁸⁻²¹

Collagen - A protein that provides the skin with strength.²²

Colonisation - The presence of bacteria in the wound.²³

Colony forming unit (CFU) - A measure of the number of colonies of bacteria present in a sample, with a colony being a group of the same organism growing.²⁴

Combine dressing – highly absorbent secondary dressing.

Conduction - Heat transferred through touching another object i.e. an electric blanket.²⁵⁻²⁷

Consultant - Medical officer who has undertaken specialist training following completion of their residency year.²⁸

Contamination - Introduction of microbes (to the wound) that may lead to possible invasion by potential pathogens.²³

Convection - Heat transferred through the movement of air or water over the skin such as having a bath or sitting in an air conditioned room.²⁵⁻²⁷

Cytokines – Protein that initiates vasodilation of the blood vessels surrounding a wound.^{4,29}

Deep vein thrombosis (DVT) – Blood clot that forms in the veins of the leg and may impact on wound healing due to vascular integrity.³⁰

Dermacheck - Software used with the Multi skin Centre MC750.³¹

Down time - The time between dressing removal and dressing reapplication.

Endogenous – When something originates from within the body.⁴

Epithelialisation - Involves the formation of new epidermal cells by mitosis and cell migration.^{32,33}

Erythema - Redness of the skin.³⁴

Evaporation - The outward heat transfer through water loss such as via perspiration.²⁵⁻²⁷

Exogenous – Something that originates from outside of the body.⁴

Exposure - The time between dressing removal and dressing reapplication.

Fibroblast - Cells which promote tissue growth through production of collagen.²²

Fluke[®] 971 - A temperature and humidity meter.³⁵

General Estimating Equations (GEE) - An analysis model utilised for analysing repeated measures data for both within and between participants.¹⁴

Glass electrode - A pH measuring probe connected to an electronic meter to measure and display the pH reading.³⁶

Granulocytes – White blood cells also known as polymorphonuclear leukocytes that help fight infection.²²

Graphic pain scale (GRS) – A visual analogue pain scale where descriptors are placed at intervals along the length of the line.³⁷

Histamine - A protein that initiates vasodilation of the blood vessels surrounding a wound.^{4,29}

Histiocytes – Cells which promote tissue growth through production of collagen.²²

Humidity - The amount of water vapour present in the air.³⁸

Hydrocolloid dressing – A flat occlusive adhesive dressing.³⁹

Hydrofibre dressing – A highly absorbent wound dressing that converts to a gel.⁴⁰

Hydrogel dressing - A 70-90% water based dressing product.³⁹

Hypothermic wound - Where the temperature drops below the required temperature for normal wound healing - 36°C.⁴¹

Infection - The presence of at least *one* of the following: 1. Purulent drainage, with or without laboratory confirmation, from the wound; 2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the wound; 3. At least one of the following signs or

symptoms of infection: increased pain or tenderness, localized swelling, redness, or heat from the wound.³⁴

Keratin - A protein within keratinocytes, cells mainly filled with a protein called keratin that resists changes in temperature, pH and enzymatic digestion.²²

Lactate - The product formed when lactic acid disassociates in water and has been known to accelerate collagen deposition.

Langerhans cells - Found in the stratum germinativum which is important in the immune function of the skin as they recognise foreign invaders.²²

Leukocytes - Inflammatory cells that defend the body against infections.²⁹

Logarithmic scale – A scale that describes outcome variables which are not normally distributed nor have a normally distributed logarithmic function. I.e. a pH of 4 is ten times different to a pH of 5; however, this is tenfold to 6. A pH of 4 is 100 times different to a pH of 6.^{1,2}

Macrophages - Inflammatory cells that defend the body against infections.²⁹

Mast cells – A leukocyte found in the skin that participates in the early recognition of pathogens.⁴²

MC750 - The platform which the pH and TEWL probes used to feed the data into the software program Derma Check.⁴³

Microorganisms – Include bacteria, fungus or virus that are unable to be seen without the aid of a microscope that may be pathogenic or non-pathogenic.⁴⁴

Mitotic activity – The degree of cell division and commencement of re epithelialisation.⁴⁵

Mixed non-pathogens - Numerous types of skin flora found on the skins surface.⁴⁶

Monocytes - Inflammatory cells that defend the body against infections.²⁹

Myofibroblasts – Fibroblasts cell that assist in the wound healing process by aiding tissue repair.⁴⁷

Neutrophils - Inflammatory cells that defend the body against infections.²⁹

Non-pressure ulcer – An ulcer that presents from a non-pressure related aetiology.

Nosocomial infection – An infection contracted whilst an inpatient of a hospital.⁴⁸

nu-beca® - A multi-function infrared thermometer.⁴⁹

Open wound – A wound that is healing by secondary intention.⁵⁰

Oxygen tension – The percentage of oxygen molecules present in the local blood supply.⁵¹

Parietal mass – A tumour located in the parietal lobe of the brain.

Partial thickness - The depth of a wound that has not penetrated through to the dermal layer.⁵²

Petri dishes – The container used to hold agar.

Phagocytosis - The engulfing of a pathogen by a phagocyte.⁴⁴

Planimetry – The measurement whereby the wound edges are traced to determine the wound size.⁵³

Plasma cells – The white blood cells that secrete antibodies that aid healing.⁵⁴

Polymorphonuclear leukocytes (PMN) - White blood cells that help fight infection.²²

Polymyalgia rheumatic – An arthritic disorder.⁵⁵

Post auricular – The region located behind the ear.

Pressure ulcer – An ulcer that develops due to a reduction in blood flow following prolonged pressure to the skin and underlying tissues which can cause the tissues to die.^{56,57}

Primary dressing - The dressing applied directly to the wound bed to assist with wound healing.

Primary intention – Wound healing where approximation of the wound edges is able to be achieved using sutures.⁵⁸

Radiation - The heat transfer through infrared rays with no contact such as from the sun.²⁵⁻²⁷

Registrar - A specialist medical trainee following completion of both internship and resident medical officer training.²⁸

Relative humidity (RH) - The actual ratio of water vapour in the air at a given temperature and expressed as a percentage. Air with a RH of 50% contains half of the water it can contain at that temperature.³⁸

Resident medical officer (RMO) – A medical officer who is undertaking additional training following completion of the intern year.²⁸

Secondary intention – Wound healing in which an open wound heals over a period of time with the utilisation of dressings.⁵⁸

Semi-critical site – The level of disinfection required for an instrument used on intact mucous membranes or non- intact skin.⁵⁹

Skin temperature - The temperature of the skin.¹⁵

Strike through – Wound exudate that has been unable to be retained by the dressing and is visible as a patch of wetness on the outside of the dressing.

Temporal – The side of the head next to the eyes.⁶⁰

Temporary dressing – An alternative cover placed over an open wound for a short period of time.⁶¹

Tertiary intention – Wound healing whereby dressings are initially utilised and once a wound is clean and viable it is then closed with sutures or grafting.⁵⁸

Thermoregulation – The homeostatic control of a person's body temperature.⁶²

T-lymphocytes - Inflammatory cells that defend the body against infections.²⁹

Transepidermal water loss (TEWL) – Used to measure the amount of moisture evaporating from the epidermis, also used in the conduct of wound research.⁶³

Traumatic wound – When tissue damage has been caused by some form of trauma.⁶⁴

Tulle Gras™ – A cotton dressing that has been saturated with soft paraffin to reduce the risk of adherence to the wound bed.⁶⁵

Vacuum assisted closure (VAC) - A negative pressure wound therapy that aids in the drawing of fluid from the wound bed in wounds healing by secondary intention to promote formulation of granulation tissue, removal of infectious wastes and drawing the wound edges together.⁶⁶

Verbal rating scale (VRS) – A pain scale where descriptors are placed at intervals along the length of the line.³⁷

Visitrak™ – A standardised wound measurement system using planimetry.⁶⁷

Visitrak Digital – A portable tablet that provides an accurate area measurement by converting a line tracing into a true area measurement.⁶⁸

Visitrak Grid - The tracing film used with the Visitrak Digital.⁶⁹

Visual Analogue Scale (VAS) – A pain scale described as a straight line at which the end anchors are labelled as the extreme boundaries of the phenomena being studied i.e. no pain and extreme pain.³⁷

White adipose tissue (WAT) - Adipose tissue which comprises 20-25% of the body weight in humans, with white adipose tissue storing energy in the form of fat.¹⁶

Wound - Where the function of the skin is impaired, following damage subsequent to an injury or underlying disease process.^{70,71}

Wound assessment – The process of examining key wound parameters to be reviewed on a regular basis.⁷²

Wound breakdown – A wound that dehisces or bursts open.

Wound microenvironment – The condition of the wound environment and cellular interfaces indicative of wound healing.⁷³

Zinc dressing – A topical application of Zinc within a bandage to assist with superficial wounds that require occlusion.⁶⁵