Vascular Access – A Surgical Wound
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Disclosure
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Objectives
Explain the process for healing a surgical wound.
Describe the optimal environment for wound healing.
Discuss the effects of dressing disruption on wound healing.
Clinically Proven

Dressing disruption is a major risk factor for catheter-related infections
Jean-François Timsit, MD, PhD et al., Critical Care Medicine (June 2012); 40 (6): 1707-1714

Abstract

Objective: Major catheter-related infection includes catheter-related bloodstream infections and clinical sepsis without bloodstream infection resolving after catheter removal with a positive quantitative tip culture. Insertion site dressings are a major means to reduce catheter infections by the extraluminal route. However, the importance of dressing disruptions in the occurrence of major catheter-related infection has never been studied in a large cohort of patients.

67%

Of the 11,035 dressing changes, 7,247 (or 67%) were performed before the planned date.

That means that 2 out of every 3 dressings FAILED.

So What is Happening?

• Exposure to pathogens – sure!
• But is there more to the story?

Sterile Insertion, Scrub the Hub, Sterile Dressing Change... But What About the Wound?

Delaying or even preventing healing of the wound, we may be setting the patient up for infection.
Wound Care Specialists Might Have a Clue for Vascular Access Specialists

Vascular Access Site

A vascular access site has the indwelling catheter with direct access to circulating blood and often sutures in a host that is most likely compromised at the time of insertion.

Is a Vascular Access Site a Surgical Wound?

This is a full thickness wound, made with a cutting instrument under sterile conditions with control of size, location and nature of the wound.
Human Skin

Human skin is human skin and heals the same, whether it has been injured with or without intention.

Process of Healing

Injury → Inflammation → Proliferation → MATURATION

Phases

The phases are widely overlapped and healing can often progress forwards and back through the various phases.
**Injury**

What is happening?
- Damaged vessels constrict to slow blood flow
- Platelets aggregate to stop bleeding
- Leukocytes migrate into tissue to initiate inflammatory response

**Inflammation**

What is it?
The inflammatory phase is a time of hemostasis and inflammation. This phase usually begins about one hour post injury and lasts up to about 4 days.
Neutrophils Inactivate Bacteria with Oxidative Bursts

Macrophages Eat Debris, Release Angiogenic Substances to Stimulate Growth, and Orchestrate the Immune Response

Inflammation

How do we assess, and what do we find?
What we see upon assessment at this time is a bit of swelling, perhaps some redness and warmth, and maybe a little pain.
Proliferation

What is it?
The Proliferative Stage is the process of tissue reconstruction. It begins 3-4 days after injury and persists through day 7 if all proceeds without interruption.

What is happening?
- Fibroblasts proliferate in the wound and secrete glycoproteins and collagen
- Epidermal cells migrate from the wound edge
- Granulation tissue is formed from macrophages, fibroblasts and new capillaries

What do we find on assessment?
Redness has subsided, the wound region is soft and non-tender, temperature should be consistent with the rest of the body, not excessively warm to touch.
Maturation

What is it?
Remodeling of collagen. The Maturation Stage is the final part of the wound healing process. It begins 3-4 days after injury and can persist a year or longer.

What is happening?
- Fibroblasts secrete collagen type I to strengthen wound
- Wound remodeling occurs as fibers reorganize
- Wound contracts increasing tissue integrity
- Epidermal cells grow over connective tissue to close wound
Maturation

What do we find on assessment?
This wound will be stable, non-tender; the area around the wound will be consistent with the normal skin temperature, color, and texture, without drainage.

Magical Day 7

The FIRST dressing change should happen here - on DAY 7.

The Optimal Environment

In order for the wound to proceed through this well defined, predictable, and complex process in the expected time frame, the wound benefits from the optimal environment.

The Optimal Environment:

Maintain Temperature

and provide for

Moist Wound Healing
Moist Wound Healing

The optimal environment for skin repair is Moist Wound Healing. Moist healing was born in 1962 when George D. Winter discovered that epithelialization would proceed twice as fast in a moist environment than under a scab.

Moist Wound Healing

There are two principles in moist wound healing:

- No disinfectants over the wound
- Keep the wound in a moist environment

Why No Disinfectants Over the Wound?

Routine, prolonged use of iodine, peroxide, chlorhexidine, alcohol, and acetic acid are non-selective in their activity and will kill healthy cells as well as bacteria.
Why No Disinfectants Over the Wound?

- In wound care, it is considered preferable to avoid the use of these products unless there is wound infection. A study by Lineweaver et al concluded that cytotoxic agents impede wound healing.
- Several studies demonstrated that povidone-iodine was detrimental to the healing process and resulted in an increased infection rate.
- In vascular access, we have to consider the device and perhaps sutures at the wound site. We have to consider a risk/benefit approach.

Lineweaver et al. Topical Antimicrobial Toxicity, Arch Surg 120(3) 267 1985

Keep the Wound in a Moist Environment

Epithelialization is drastically slowed in the presence of scab tissue that forces epithelial cells to burrow rather than freely migrate over granulation tissue.
Maceration can lead to enlargement of the wound, increased susceptibility to mechanical forces, and infection.

Weeping/Oozing (Moisture Balance) Requires the Right Amount of Absorbency/Wicking to Maintain a Healing Moisture Balance
The Importance of Temperature

Cells and enzymes function optimally at normal body temperature.

A temperature drop of just 2 degrees C is sufficient to affect the biological healing process.

Cooling Causes Vasoconstriction, Reducing Blood Supply. Healing Cells and Bacteria then Compete for Available Resources.

Why Does the Temperature Drop?

When the dressing is removed, temperature drops because:

• The dressing is removed
• Evaporation cooling of moisture under the dressing
• The wound is scrubbed with room temperature solution
• Evaporation cooling occurs while the site dries
The Importance of Temperature

The healing process can remain in suspended animation for a long time:
3 hours and 48 minutes minimum in disruption of healing… can be up to 8 hours

FOR ONE DRESSING DISRUPTION!


According to McGuiness et. al.

“The cumulative damage achieved by this episodic cooling has yet to be established. Three to four hours multiplied by a number of frequent dressing changes may result in a substantial delay in healing.”

Scrubbing Mechanically Removes the Healing Matrix

Friction wears away newly formed epithelium or granulation tissue and may return the wound to the inflammatory phase.
How Dressing Disruption Alters the Optimal Environment

- Disinfection with cytotoxic agents kill off the proliferating cells
- Exposes the wound to pathogens who then compete for limited resources
- Cools the wound which halts chemical processes
- Scrubbing mechanically disturbs the healing matrix
- Additional chemicals are introduced to the wound site for the dressing change

Why do we “Carpet Bomb” our Surgical Site? We Add Products to Resolve Problems from Other Products:

1. Start with a CHG scrub to insert the device.
2. Apply a skin prep (of some varied formulation).
3. Clean any stray blood or debris from the device and/or site with alcohol.
4. Place an antimicrobial disc or an impregnated dressing.
5. Add a benzoin or tackifying agent to the wound area.
6. Apply an adhesive dressing.
7. Removal with an adhesive remover.

The Wound Moves Backward on the Healing Continuum
So Back to the Timsit Study: What is Happening?

1. The wound is exposed to pathogens when the dressing disrupts
2. Removal of the dressing cools the wound, interrupting healing for 3 to 8 hours
   • Scrubbing with antiseptic cools the surface
   • Evaporation further cools the surface
   • Cooling causes vasoconstriction and decreased oxygen available to fight infection
3. Scrubbing disrupts the newly forming matrix and proliferating tissues
4. Cytotoxic scrub may kill off healing tissues

The wound moves backward on the healing continuum.

CR-BSI Risks Increased with Each Dressing Change

A durable dressing that will last for 7 days is critical in prevention of CRBSI and protecting these surgical sites through the healing process.

You can Prevent the Four Wound Stressors

1. Chemical
2. Mechanical
3. Moisture Imbalance
4. Temperature
Look for a dressing that is able to:

- **Remain adherent for 7 days to protect the wound from pathogens and allow for healing to progress uninterrupted**
- **Provide securement to allow the matrix to stabilize and the wound to contract**
- **Manage moisture to prevent maceration and/or dessication**
- **Promote moist wound healing, minimizing or eliminating cytotoxins on the wound**

Conclusion

A vascular access exit site is a surgical wound. It is helpful to keep this in mind as we care for these sites. A durable dressing that will last for 7 days is critical in prevention of CRBSI and protecting these surgical sites through the healing process.

References

- Cutting, K. Factors influencing wound healing. *Nursing Standard* September 7, vol II #50 pp33-3
- McGuinness, W., Velle, E. Harrison, D. Influence of dressing changes on wound temperature. *Journal of Wound Care Vol 13, No 9,* October 2004
References

- Valentina Dini, MD, PhD; Pietro Salvo, PhD; Agata Janowska, MD; Fabio Di Francesco, PhD; Alessandro Bartoni; and Marco Romanielli, MD, PhD. Correlation Between Wound Temperature Obtained With an Infrared Camera and Clinical Wound Bed Score in Venous Leg Ulcers. Wounds 2015;27(10):274-278.
- National Alliance of Wound Care blog accessed 2/2017

Bacteria Resistant to CHG

The suggestion is not that we now have bacteria resistant to CHG. What we DO know is there are two pathogens that have shown the ability to become resistant.

History has given us pause to respect this and proceed cautiously in regard to antimicrobial use. In both of these instances, bacteria showed the ability to mutate in the presence of CHG. HOWEVER, in both cases the concentration of CHG was a subtherapeutic concentration.

It is imperative that CHG agents be used according to the manufacturer's instructions – with a full 30 second scrub for ChloraPrep®, a full 2 minute scrub with PDI, both allowed a complete dry time for central line care.

And Looking Toward the Future – A Call for Antimicrobial Stewardship

Currently, we are not suffering with CHG resistant pathogens, however, two microbes have proven the ability to become resistant to CHG.

- Klebsiella pneumonia
- E. faecium
- E. faecalis

Resistant bugs – "Mechanisms of increased resistance to chlorhexidine and cross-resistance to colistin following exposure of Klebsiella pneumonia clinical isolates to chlorhexidine published in the Antimicrobial Agents and Chemotherapy journal showed how researchers induced resistance to chlorhexidine (CHG) in Klebsiella pneumonia, and identified cross-resistance to the antibiotic, colistin—marking the first time that any bacteria was shown to exhibit resistance to CHG.”

"What are possible clinical impacts of VRE exposures to sub-MIC chlorhexidine? Based on our results, E. faecium and E. faecalis isolates harboring Vancomycin A-type resistance genes will synthesize modified cell walls in response to sub-bactericidal levels of chlorhexidine."

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A total of 1,229 CVC dressings were observed from 590 CVCs.

- One dressing had a median (IQR) duration of 68.5 h (range, 32–105 h)
- Compared to a median duration of 43.5, 46.0 and 40.5 h for the other dressings (P < 0.001).
- SHIELD® stayed on average 59% longer than Tegaderm® IV Advanced
- The comparison dressings were Sorbaview®, Opsite™ IV3000, 3M Tegaderm® and 3M Tegaderm IV Advance®