Patient-Centered Concerns: Pain

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I — Infection and Inflammation

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Table 1: Diagnostic Imaging Tests for Osteomyelitis

Type of Test	Comments
Radiographs	• Often falsely negative • Delayed positive: May take 10 to 21 days
Bone Scan	• Positive result often earlier than X-ray • May have false positive
WBC Scan	• May not distinguish charcot from osteomyelitis
MRI	• Can accurately distinguish osteomyelitis from Charcot foot • Diagnostic test of choice when clinical signs are equivocal

Table 4: Systemic Antimicrobial Therapies
Legend: E=Excellent M=Moderate I=Intermediate V=Variable P=Poor

Agents	Gram +ve Staph/Strep	Gram –ve Pseudomonas/enteric	Anaerobes
Cephalexin	E/E	I/I	I
Cefuroxime	G/E	I/I	I
Amoxicillin/Clavulin	E/E	I/V	G
Cloxacillin	E/M	I/I	I
Clindamycin	E/E	I/I	E
Ciprofoxacin	E/E	I/I	P
Cortimoxazole	M/M	I/E	I
Metronidazole	M/M	I/I	E

Table 5: Active Ingredients

Class & Agent	Action	Effect in healing	Effect on bacteria	Comments
Alcohols Ethyl Alcohol Isopropyl Alcohol	Dehydrates proteins and dissolves lipids	Cytotoxic May cause dryness and irritation on intact skin	Bactericidal and viricidal On intact skin: Not for use on open wounds	Used as a disinfectant on intact skin. Stings and burns if used on open skin
Biguanides Chlorhexidine up to2% (also available in a gauze and foam dressings)	Acts by damaging the cell membranes	Relatively safe. Little effect on wound healing Toxicity – small effect on tissue	Highly bactericidal against Gram-positive and Gram–negative organisms	Highly effective as hand washing agent and for surgical scrub Binds to stratum corneum and has residual effort
Halogen compounds Sodium hypochlorite (e.g Hygeol, Eusol, Dakin'ss)	Lyses cell walls	Acts as a chemical debrider and should be discontinued with healing tissue (high tissue toxicity)	Dakin's solution and Eusol (buffered preparation) can select out Gram-negative microorganisms	High pH causes irritation to skin
1% Iodine (povidone) (e.g Betadine) (slow release dressings)	Oxidizes cell constituents, especially sulfoxyl protein groups (SH); iodinates proteins and inactivates them	Povidone iodine Cytotoxicity depends on dilution. Potential toxicity in vivo related to concentration and exposure	Prevents and controls bacterial growth in wounds Resistance has not been reported Broad spectrum of activity, although decreased in the presence of pus or exudates	Toxicity is of concern with prolonged use or application over large areas Potential for thyroid toxicity
Organic acid *Acetic (0.25-1%)*	Lowers surface pH	Cytotoxicity in vitro; in vivo is concentration-dependent	Effective against *Pseudomonas*. May be useful for other Gram-negative rods and *Staphylococcus aureus*	Often burns and stings on application
Peroxides *3% Hydrogen peroxide*	May induce cell death by oxidative damage	Can harm healthy granulation tissue and may form air emboli if packed in deep sinuses	Very little to absent antimicrobial activity	Acts more like a chemical debriding agent by dissolving blood clots and softening slough. Safety concerns- deep wounds due to reports of air embolisms
Tinctures *Gentian violet*	Very weak antiseptic	Carcinogen and cytotoxic. May cause erosions, ulcers or areas of necrosis especially on mucous membranes	Kills Gram-positive organisms and some yeasts such as Candida, more effective at higher pH but can select out overgrowth of Gram-negative organisms	High irritancy potential and occasional allergies
Mercurochrome	A very weak antiseptic with action inhibited in the presence of organic debris	Epidermal cell toxicity	Not enough data available	Contact allergen and irritant; systemic toxicity and rare death through topical application, possible aplastic anemia
Cetrimide (quaternary ammonium)	Disrupts membranes, may inactivate some proteins	High toxicity to tissues	Gram-positive and -negative organisms	Good detergent but very irritating to open wounds

Table 6: Silver Preparations Used in Wound Management

Ionized silver levels: 0 none + low ++ moderate +++ high

Preparation	Delivery Mechanism	Product Name	Benefits	Comments
Silver salts				
Silver nitrate	0.5% solutions in burn wounds	• Silver nitrate solution	• Easy to use • High cytotoxicity	• Staining • May lead to electrolyte imbalance (sodium and chloride) • Short half-life (requires frequent changes that maybe painful)
Silver sulfadiazine (SSD)	1% silver and sulphonamide in carrier cream	• Flamazine • Silvadene, SSD Cream (+) Contradictory values on silver release rate in literature.	• Easily available • Wide clinical acceptance though controlled studies using SSD are rare	• Cytotoxic (in vitro) • Tends to leave heavy deposits of foreign matter (termed a pseudoeschar) on the wound surface • Pain associated with removal of pseudoeschar.
	Polyester gauze dressing impregnated with hydrocolloid particles and SSD	• Urgotul SSD (0)	• Easy to apply • Promote moist wound healing	• Less effective antimicrobial agent in vitro
Silver amorphous hydrogel	Silver chloride	• SilvaSorb Gel (+)	• Low cytotoxicity, broad spectrum antimicrobial that delivers time-released silver for 3 days	• May need secondary dressing.
Silver sodium chloride polyacrylate sheets	Silver chloride	• SilvaSorb Sheet • SilvaSorb Perforated • SilvaSorb Cavity (+)	• Low cytotoxicity, broad spectrum antimicrobial that delivers time-released silver	• Absorbs well, but slowly.
Silver mesh	8mg/g Silver sulphate mesh gauze	• Tegaderm Ag mesh (+)	• Porous structure allows exchange of fluid/active substance between the wound surface and covering dressings (e.g. foams, alginates)	• Tendency to adhere to wounds • Can be used with ibuprofen foam for pain relief and both antimicrobial and anti-inflammatory effects
	Petrolatum mesh with silver	• Physiotulle (++) • Triact Ag (+)	• Low adherence to wound to promote patient comfort	• Oil bases may decrease availability of ionized silver
Silver-calcium-sodium phosphates	Co-extruded in polymer matrix (film) for superficial wounds with limited exudate	• Arglaes Film • Arglaes Island • Arglaes powder (Ag/calcium alginates)(+)	• Residual antimicrobial activity lasts up to 7 days	• Limited absorption of fluid for film version (better for alginate island). • Good absorption from island version with calcium alginate pad. • Powder useful with negative pressure wound therapy/ostomies
Silver chloride site disc	Polyacrylate silver chloride	• SilvaSorb Site (+)	• Lower profile protection for external devices	• Not self adhesive, needs a secondary adhesive

Table 6: Silver Preparations Used in Wound Management

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Preparation	Delivery Mechanism	Product Name	Benefits	Comments
Silver Salts				
Silver salt/calcium alginate	High M (manuronic acid) alginate bonded through a metallic silver plated nylon mesh core	• Silverlon calcium alginate (++)	• The metallic silver mesh core provides up to 7 days of antimicrobial protection.	• The durable mesh core ensures the high tensile strength, that can be cut
	1.1 mg.cm2 silver and calcium alginate	• Silvercel (++)	• Manages wound exudate while promotes autolytic debridement	• Completely bioresobable.
	gel-like foam matrix backed with non-woven polyester fiber	• Calgitrol Ag (foam) (+) • Calgitrol Ag Plus (calcium alginate gel) (++)	• Matrix absorbs exudate and allows the timed release of collagen and maltodextrin	
	combination of silver, alginate and maltodextrin	• Algidex Ag	• Available in thin sheet, paste or with integrated foam backing	
Silver and collagen dressings	55% type I bovine collagen 44% ORC /collagen matrix and 1% silver ORC salt	• Prisma (+)	• Biodegradable • Absorbs destructive bacteria and proteases into the dressing	• Low levels of silver with two other anti-inflammatory mechanisms
	Hydrated collagen-based silver ion-releasing	• Covaclear Ag (+)	• Provide moisture to healable wounds • The dressing is transparent and allows clinicians to monitor high risk wounds without having to remove the dressing	• All dressings need to be used once package is opened to avoid drying of the product
Silver calcium alginate/carboxy-methyl-cellulose dressing		• Maxorb Extra Ag (sheet or rope) (+)	• Low cytotoxicity delivers silver for 4 days • Vertical wicking/ one piece removal	• Oil bases may decrease availability of ionized silver
Silver-calcium-sodium phosphates	Co-extruded in polymer matrix (film) for superficial wounds with limited exudate	• Arglaes Film • Arglaes Island • Arglaes powder (Ag/calcium alginates)(+)	• Residual antimicrobial activity lasts up to 7 days	• Limited absorption of fluid for film version (better for alginate island). • Good absorption from island version with calcium alginate pad. • Powder useful with negative pressure wound therapy/ostomies
Silver-sodium carboxy-methylcellulose dressing	Dressing containing 1.2% ionic silver released via ion exchange	• Aquacel AG (+)	• Provides fluid lock to prevent excess wound fluid from macerating surrounding skin • Good vertical wicking.	• Provides fluid lock until dressing saturated

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Preparation	Delivery Mechanism	Product Name	Benefits	Comments
Silver Salts				
Silver salt-containing foam	Polyurethane foam with silver sodium hydrogen zirconium phosphate	• Contreet Foam (++)	• Provides bacterial balance in a foam dressing • Second-generation foam allows partial fluid lock • High absorption	• Less maceration than simple foams with one cell size
	Polyurethane foam with F-68 surfactant, glycerol and starch copolymer	• PolyMem Silver (+)	• Low cytotoxicity in vitro	• Lower silver release than other foams
	polyurethane foam pad containing silver sulphate and activated carbon	• Mepilex Ag (+++)	• Soft silicone wound contact layer for less trauma	• Foam can be cut without any carbon leaked into the wound
	Silver foam sponge	• Optifoam Ag (+)	• Adhesive and nonadhesive	• Good conformability
Silver salt combined with hydrocolloid	Chronic wounds with increased bacterial burden	• Contreet HC (+)	• Provides odor control under hydrocolloid dressing	• Minimal fluid absorption
Metallic Silver				
Silver charcoal	Silver incorporated into charcoal for odour control	• Actisorb (0)	• Silver kills organisms trapped on the charcoal • Deodorizing properties, as odor molecules bind to charcoal • Traps endotoxins	• Product cannot be cut, as charcoal particles will leak out.
Nylon cloth/fibric	Metallic silver plated nylon	• Silverlon Wound Packing Strips • Silverlon island wound dressings • Silverlon wound pad dressings • Silverlon negative-pressure dressing • Silver Derm (++)	• Provides fluid lock to prevent excess wound fluid from macerating surrounding skin • Good vertical wicking.	• Provides fluid lock until dressing saturated

Table 6: Silver Preparations Used in Wound Management

Ionized silver levels: 0 none + low ++ moderate +++ high

Preparation	Delivery Mechanism	Product Name	Benefits	Comments
Ionized/ Nanocrystalline Silver				
Fabric with ionic silver		• Interdry Ag	• Able to wick moisture away from skin surface	• Thick exudate may clog the wicking mechanisms
Silver-coated fabric – 3 layers	One rayon polyester inner core between 2 layers of silver-coated mesh	• Acticoat burn (+++)	• Equivalent to silver nitrate in burns with less frequent dressing changes • Anti-inflammatory	• May need to add moisture (water not saline) or pre-soak dressing • Staining of the wound may cause burning and stinging on application (may pre-soak longer)
Silver-coated calcium alginate	Two rayon polyester core layers between 3 layers of silver coated polyethylene mesh	• Acticoat 7 (+++)	• Sustained release of bactericidal concentrations of silver over 7 days • Useful for weekly application under compression therapy in venous ulcers	• May provide higher initial release of silver compared to other dressings in this class
Silver-coated foam	Silver + calcium alginate wafer	• Acticoat absorbent (+++)	• Provides rapid and high fluid absorption and hemostasis.	• Potential of staining of surrounding keratin. • Dried-up dressing can be mistaken as necrotic tissue
Silver salt combined with hydrocolloid	Highly exudative wounds	• Acticoat moisture control (+++)	• Highly absorbent • Visible strikethrough to indicate needs for dressing change	• Potential of staining of surrounding keratin.

Table 7: SILVER Guidelines

S	Signs of increased bacterial burden	Assess and differentiate superficial from deep wound infection using NERDS and STONEES signs
I	Ionized silver	Only ionized silver exert antimicrobial effect. Requires an aqueous (exudative) environment to activate silver
L	Log reduction over time	Quick kill time
V	Vehicle for moisture balance	Select dressing materials to match moisture level
E	Effects on viable cell	Watch for toxic effect on viable cells
R	Resistance	Resistance is rare; requires three mutations to develop resistance to silver

M — Moisture Balance

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