Wound Care in Children

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Final thoughts

• Accidents will happen many wounds of various sizes, complexities, surrounded by the less than ideal circumstances will challenge you

• How you approach the child will make a long lasting impression... hopefully good

• Your biggest enemies will be wound infection, retained foreign body and unacceptable scar
ED approach to the child

• The child may be fearful, the parent may be anxious
• Look quickly form a distance before examining the wound
• Incorporate Child Life as soon as possible to allay anxieties and gain trust, then begin a focused and careful history
Important historical aspects

- Mechanism
- Timing
- Tetanus status
- NPO status
- Environment
- Allergies
- Medical problems that may affect procedure: autism, ADHD
- Medical problems that may impair healing: Diabetes, immunocompromised, steroids, bleeding disorder
Timing

• No finite cutoff from the literature
• Largest study found cutoff of 6 hours
• ACEP policy of 1999 recommends 12 hour window
• Wedmore study of 2005 found the optimal time was 6-10 hours but extended to 12 hours for face and scalp
Examination

• Best to perform last
• Neurovascular status: check pulses and ask child to move the distal extremity; this can be aided with po medications and anesthetic
• Be creative in working with the child
• This part of the exam can help the physician in determining need for procedural sedation
Consultation Guidelines

• Deep wounds to hand or foot
• Full thickness lacerations of eyelid/lip/ear
• Lacerations involving nerves, arteries, bones/joints
• Penetrating wounds of unknown depth
• Severely contaminated wounds requiring drainage
• Wounds with strong concern for cosmesis
Laceration repair

• Primary closure more appropriate than delayed closure in children
• Before sedation consider CHILD LIFE
• Sedation: choices are simple to complex
• Attempt needleless if possible: intranasal fentanyl and midazolam or po midazolam with topical LET
Laceration with deeper sedation

- NPO STATUS OF 4-6 HRS
- Need for IV, use J tip
- Team approach with dedicated sedation RN, MD anesthesia privileges to administer sedation independent of operator
- Choices: Ketamine, propofol
- Provides good control of patient, may allay anxiety of parent
Anesthetic

• LET is good choice for simple lacerations
• Intradermal: Lidocaine with or without epi
• Epi provides better hemostasis but slightly greater risk of wound infection over plain
• Buffering plain lidocaine with Na bicarb and injected slowly and on inside of wound edge offers to least painful method
### Maximum doses/volume of anesthetics

<table>
<thead>
<tr>
<th>Anesthetic</th>
<th>Dose</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% lido with epi</td>
<td>7.0 mg/kg</td>
<td>0.70 ml/kg</td>
</tr>
<tr>
<td>1% lido without epi</td>
<td>4.5 mg/kg</td>
<td>0.45 ml/kg</td>
</tr>
<tr>
<td>LET gel (4% lidocaine)</td>
<td>-----</td>
<td>0.18 ml/kg</td>
</tr>
</tbody>
</table>
Cleansing/irrigation

• Betadine, alcohols, chlorhexidine are of near equal value
• Avoid betadine greater than 1%
• Normal saline vs tap water ...no difference (Cochrane 2008) general rule: 100ml/cm length
• Hydrogen peroxide is a poor choice due to tissue toxicity
• 35ml/65ml syringe with 19 g needle was effective at >25 psi
Closure method

- Efficient, easy and will minimize pain and scarring
- Wound tension, location, and depth
- Cost and time predicted that child will remain still
Tissue Adhesives

• Saves time (ave of 5.7 min)
• Saves cost ($50)
• Wound healing and scar formation equal to standard method
• Octylcyanoacrylate is more flexible with higher bursting strength than other adhesives
• Very good for facial lacerations especially those that cross “Langer lines”
Tissue adhesives

- Not to be used in or close to hair
- Special caution close to eyes...Use trendelenberg above eyes and reverse below eyes
- Keep wound clear of topical antibiotics and saturation with liquids
- DO NOT USE ON ANY BITES!
Facial Lacerations in Children

• Increasing use of absorbables especially fast absorbing plain gut
• Monocryl is also a good choice but harder to work with
• Use the finest suture you are comfortable with (5-0/6-0)
• Nylon, fast absorbing gut, and derma bond had equal outcomes one year later
Suturing techniques

• Little tension: simple interrupted are most common
• High tension: vertical mattress best for eversion of wound edges
• Combinations of both in same wound
• Running or continuous should be avoided as any mistake will cause the entire wound to be reclosed. If infected the entire material must be opened
• Running subcuticular is good for special circumstances e.g. parallel to lines in cooperative older patient
Laceration repair techniques

A. SIMPLE INTERRUPTED
B. RUNNING BASEBALL STITCH
C. RUNNING SUBCUTICULAR
## Suture guidelines in Pediatric wounds

<table>
<thead>
<tr>
<th>Location</th>
<th>Deep (vicryl)</th>
<th>Superficial (nylon)</th>
<th>Removal time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalp</td>
<td>4-0</td>
<td>4-0 or staples</td>
<td>5-7 days</td>
</tr>
<tr>
<td>Face</td>
<td>5-0</td>
<td>6-0</td>
<td>3-5 days</td>
</tr>
<tr>
<td>Eyebrow</td>
<td>5-0</td>
<td>5-0/6-0</td>
<td>4-5 days</td>
</tr>
<tr>
<td>Lip</td>
<td>5-0</td>
<td>6-0</td>
<td>4-5 days</td>
</tr>
<tr>
<td>Trunk/extremity</td>
<td>3-0/4-0</td>
<td>4-0/5-0</td>
<td>6-8 days</td>
</tr>
<tr>
<td>Hands/feet</td>
<td>4-0/5-0</td>
<td>4-0/5-0</td>
<td>7-10 days</td>
</tr>
</tbody>
</table>
ABSORBABLES
Bite wounds

• Dogs: 85-90% infection rate :5-10%
• Cats :5-10% highest infection rate at 50%
• Humans: 2-3% 18% rate of infection
• Rodents:2-3%
• Issue is infection
Bite wounds

• DO NOT CLOSE:
  Over 8 hours
  Puncture bites
  CAT or HUMAN
  Hand or foot
  Immunocompromised host
  Those already infected

DO NOT USE DERMABOND
IRREGULAR WITH FLAP
FINE SUTURES
CORNER STITCH WITH BURIED HORIZONTAL
STRENGTHEN WITH STERI STRIP
Special technique
“the corner stitch”

Half buried mattress
Added strength
Steristrips with crossing of parallel pattern
HAND
CLEAN BUT DON’T CLOSE
GOOD BULKY DRESSING SIMILAR TO BURN DRESSING
ABRASION FROM FALL OFF BIKE

GOOD SOURCE OF STREP OR STAPH
CLEAN WELL AND APPLY TOPICAL ANTIBIOTIC
SIMPLE LACERATION WITH EXTENSIVE INFECTION AT 48 HRS

STRUCK BY GOLF CLUB 48 HRS PRIOR TO LACERATION REPAIR AT OUTSIDE HOSPITAL

IMAGING WITH FACIAL CT INDICATED TO EVALUATE FOR FACIAL FXS AND DEEP INFECTION

ADMIT FOR IV ABX AND CULTURES
# HELP! CHILD LIFE

## Distraction Techniques

<table>
<thead>
<tr>
<th>age</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant</td>
<td>Pacifier, bubbles, toys</td>
</tr>
<tr>
<td>Toddler</td>
<td>Bubbles, songs, pop-up books, kaleidoscope, toys</td>
</tr>
<tr>
<td>School age</td>
<td>Videos, video games, search for objects in pictures, stories, joking, nonprocedural conversation</td>
</tr>
<tr>
<td>Adolescents</td>
<td>Headphone music, video games, nonprocedural conversation, focusing on objects</td>
</tr>
</tbody>
</table>

Quiet room with lights dimmed
Sedation goals

• Minimize child’s emotional /physical discomfort and maximize amnesia of painful procedure

• Allow physician to adequately control patients behavior providing for safe and effective procedure
sedation

- Need is assessed on initial level of child’s anxiety as well as parents
- Complexity and time demand to complete
- Age and potential cooperation of patient
- Npo status: “ideal”: 2hrs clear, 4hrs breast milk, 6hrs formula and solids
### Preparation for PSA, SOAP-ME mnemonic

<table>
<thead>
<tr>
<th>S (suction)</th>
<th>Size appropriate catheters and working</th>
</tr>
</thead>
<tbody>
<tr>
<td>O (oxygen)</td>
<td>Adequate supply and functioning flow meters</td>
</tr>
<tr>
<td>A (airway)</td>
<td>Size appropriate airway equipment, checked and functioning</td>
</tr>
<tr>
<td>P (Pharmacy)</td>
<td>Emergent meds including antagonists</td>
</tr>
<tr>
<td>M (monitoring and meds)</td>
<td>Functioning pulse oximeter, bp, ekg, etCO2, stethoscope</td>
</tr>
<tr>
<td>E (equipment)</td>
<td>Special equipment as needed on the patient and procedure</td>
</tr>
<tr>
<td>Sedative/hypnotic*</td>
<td>Dose/route</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Etomidate</td>
<td>IV: 0.1-0.3mg/kg</td>
</tr>
<tr>
<td>Midazolam</td>
<td>IV(0.5-5y):0.05-0.1mg/kg</td>
</tr>
<tr>
<td></td>
<td>IV(6-12y):0.025-0.05mg/kg</td>
</tr>
<tr>
<td></td>
<td>IM: 0.1-0.15mg/kg</td>
</tr>
<tr>
<td></td>
<td>PO:0.5mg/kg</td>
</tr>
<tr>
<td></td>
<td>Intranasal:0.2-0.5mg/kg</td>
</tr>
<tr>
<td>Pentobarbital</td>
<td>IV:1-6MG/KG,titrate doses at 1-2mg/kg q3-min</td>
</tr>
<tr>
<td>Propofol</td>
<td>IV:1mg/kg titrate 0.5mg/kg dose</td>
</tr>
<tr>
<td>ANALGESICS</td>
<td>Dose /route</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>IV: 1ug/kg up to 50ug q 3-5 min</td>
</tr>
<tr>
<td></td>
<td>IN: 2ug/kg</td>
</tr>
<tr>
<td>Morphine</td>
<td>IV: 0.05-0.15MG/KG TO 3 MG/dose q3-5min</td>
</tr>
<tr>
<td>DISSOCIATIVE</td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td>IV: 1-1.5MG/KG Q 10 MIN</td>
</tr>
<tr>
<td></td>
<td>IM: 4-5mg/kg repeat 2-4mg/kg after 10 min</td>
</tr>
<tr>
<td>INHALATIONAL</td>
<td></td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>Preset mixture with min of 30 %</td>
</tr>
</tbody>
</table>
## Antagonistic meds

<table>
<thead>
<tr>
<th>Naloxone</th>
<th>IV/IM: 0.1-0.4mg, max 2mg/dose, q3min, max 10-20mg</th>
<th>IV: 2</th>
<th>IV: 20-40</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flumazenil</td>
<td>IV: 0.02mg/kg/dose, q1min, up to 1mg</td>
<td>1-2</td>
<td>30-60</td>
<td>Long term benzo use caution in children with seizure disorder</td>
</tr>
</tbody>
</table>

“FIGHT BITE”

CAREFUL EXAM FOR
TENOSYNOVITIS, FRACTURE, AND
JOINT INVOLVEMENT
HAND SURGEON OR ORTHO CONSULT

USUALLY PRESENT 2-3 DAYS AFTER
INJURY AND APPEAR VERY
SUPERFICIAL BUT REQUIRE
AGGRESSIVE TREATMENT WITH IV ABX
AND/OR SURGERY
OUCH!
TORN NAIL OFF NAILBED
LET APPLIED
PO NARCOTIC
NAIL TRIMMED WITH IRIS SCISSORS
AND BULKY DRESSING APPLIED OVER
NONADHERING DRESSING
XRAY TO R/O FX
FB/LAC

Xray or ultrasound to determine depth, size; usually more complicated than appears

Will need careful planning with use of good anesthetic, and use of moderate sedation
FB

REMOVED WITH KETAMINE SEDATION
WITH US BEFORE AND AFTER TO
ENSURE COMPLETE REMOVAL
PART OF A PORCELAIN DOLL THROWN
AT THE CHILD BY HIS BROTHER
TYPICAL CHIN LAC

NOTE LOSS OF PIGMENTATION
APPROXIMATE EDGES WITH CENTER
STITCH FIRST
REMOVAL OF SUTURES

NOTE DEPIGMENTATION AND GOOD USE OF PROLENE (BLUE) SUTURES
SCAB CAN BE PREVENTED WITH KEEPING WOUND SOMEWHAT MOIST WITH MOISTERIZING CREAMS OR OINTMENTS i.e. ANTIBIOTIC OINTMENT, ALOE VERA
SIMPLE CLOSURE
NON ABSORBABLE BUT ASKED TO RETURN IN 48 HRS FOR WOUND CHECK

ANTIBIOTICS CONTROVERSIAL
DOG BITES

PUNCTURE

LARGE TEARING OF TISSUE

X RAYS INDICATED ON DEEP CRUSHING DOG BITES
SNAKE BITE

FOREARM WITH SUSPECTED PARTIAL ENVENOMATION
SNAKE BITE

RATTLESNAKE
SNAKE BITE

BASIC WOUND CARE
MARK BORDER AND REMEASURE OR
MARK SEQUENTALY
TETANUS STATUS
PAIN CONTROL
CROFAB BEGINNING AT 6 VIALS IV

NOTE DIFFERENCE IN HAND SIZE
DEEP GAPING WOUND
CONTROL BLEEDING
VIGOROUS IRRIGATION
DEEP ABSORBABLE SUTURES TO CLOSE DEAD SPACE AND IMPROVE TENSILE STRENGTH
UNDERMINING OF SUBCUTANEOUS TISSUE WILL ALLOW MOVEMENT AND DECREASE TENSION
GAPING WOUND

USE OF VERTICAL MATTRESS SUTURE TECHNIQUE WILL EVERT WOUND EDGES AND DECREASE TENSION
GAPING WOUND
INFECTION PRONE
TETANUS PRONE
DOOR SLAM INJURIES

PARTIAL AMPUTATION TO FULL AMPUTATION
NAIL BED INJURY
POSSIBLE FRACTURE
FINGER INJURY

PAIN CONTROL FIRST!
PO OPIOID
DIGITAL BLOCK
RE-COVER WITH LOOSE DRESSING ON THE WAY TO XRAY AT LEAST 20 MIN POST PAIN CONTROL

MOST WILL REQUIRE IV SEDATION

Then:
Prep with betadine
Copious irrigation
Remove nail and save
Apply temporary tourniquet proximimaly
Close nail bed lac with one or two 6-0 fast absorbing gut
Close lacs on both sides of finger with fast absorbing gut
Place nail back into sulcus under germinal matrix, remove tourniquet, affix nail with steristrips/mastisol and splint
Start keflex if fracture and reinspect in 48 hrs
Slam injury

Ugly mess

Nail bed lac/fx phalanx
Nail secured in germinal matrix as physiological dressing
Large deep and long

Pain control
Xray
Explore for tendon nerve or vascular injury

Note good flexion of hand/fingers
Deep wound

Tendon identified
Closure dependant of many factors that may result in hand surgeon referral (good luck!)
Tendon injury

Shiny area is one end of extensor tendon
Tendon injury in contaminated wound

14 yo playing in “junk yard” fell off a car onto glass jar
Tetanus record shows he had recent booster

NOTE: flexed index and middle finger
Extensor injury is apparent as well as dirty grease contamination

Pain control
x-ray
Ceftazamine started asap
Wound cleaned and irrigated, explored and skin closed in ED
Discharged on keflex to be seen in hand clinic for definitive repair the next morning
Closure prior to dressing

Antibiotic ointment
Nonadhering dressing
Loose gauze layers
Bulky gauze roll (kerlix)
Return in 48 hrs for wound check and dressing removal
Over the joint laceration

May need xray
Strengthen wound with 4-0 nylon and possibly vertical mattress
Consider splint /sling
“Nonslip dressing”
Lower extremities
Humerus
Tear 4 strips of tape
Cover wound with antibiotic ointment
Then rolled over by one half 4x4
Then 4 corner mastisol away from wound
Two quick wraps then every other wrap is secured with the tape strips over the tacky mastisol

Otherwise the dressing will fall loose to patients ankle when walking out the door!
“non slip dressing “

Final appearance...comfortable and functional
Dog bite to the face

Typical due to height of child approximates the mouth of the dog.

Now return 48 hrs later while on augmentin

Nice suturing by OMF, but too many and too tight!
Remember the need for approximation but with somewhat loose and minimal number of sutures.

This wound needed iv ketamine with removal of enough sutures to drain culture, pack and place on Clindamycin
# Tetanus Prophylaxis

<table>
<thead>
<tr>
<th>Clean minor wounds</th>
<th>All other wounds*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give DTaP(&lt;7y)</td>
<td>Give TIG</td>
</tr>
<tr>
<td>Td(7-9Y)</td>
<td>Give Td/Tdap/DTaP</td>
</tr>
<tr>
<td>Tdap(&gt;10y)</td>
<td>Give TIG</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vaccines unknown/&lt;3</th>
<th>Yes</th>
<th>No (infants &lt;6wks ,YES)</th>
<th>Yes</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccines &gt;3</td>
<td>Only if &gt;10 yrs</td>
<td>No</td>
<td>Only if&gt;5ys</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*all other include wounds contaminated with dirt, feces, soil, or saliva; puncture wounds, avulsions, GSW, crush, burns, or frostbite
Common wound infections and recommended treatment

<table>
<thead>
<tr>
<th>Type</th>
<th>Pathogen</th>
<th>Antibiotic</th>
<th>dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacerations abrasions</td>
<td>Staph/Strep</td>
<td>Cephalexin or Dicloxacillin or</td>
<td>25-50/kg/day q6h 50mg/kg/day q8h 30-50mg/kg/day q6h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Erythromycin</td>
<td></td>
</tr>
<tr>
<td>Puncture wounds</td>
<td>Staph/Strep Pseudomonas</td>
<td>As above Ceftazidime iv Cipro</td>
<td>As above 100-150/kg/day q8h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>po</td>
<td></td>
</tr>
<tr>
<td>Human bites</td>
<td>Staph/Strep/anaerobes</td>
<td>Amox-clav or Clinda and Bactrim</td>
<td>30-50mg/kg/d q12h 10mg/kg/d,q 8h 10mg/kg/d q 12h</td>
</tr>
<tr>
<td>Animal bites</td>
<td>Staph/Strep, Pasteurella, Eikenella</td>
<td>Same as for human bites</td>
<td>Same as for human bites</td>
</tr>
</tbody>
</table>
Special suture techniques

- Half buried mattress: flap or corner stitch
- Vertical mattress: eversion of edges and need for strength
- Running subcuticular: low tension in skin lines with good cosmeseis but with older child, will need to follow and remove sutures yourself
# Rabies treatment

<table>
<thead>
<tr>
<th>Animal</th>
<th>Relative risk</th>
<th>Usual treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PETS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rodent</td>
<td>Very low</td>
<td>none</td>
</tr>
<tr>
<td>Rabbit</td>
<td>Very low</td>
<td>None</td>
</tr>
<tr>
<td>Cat, dog, ferret</td>
<td>Low</td>
<td>None, quarantine x 10 days</td>
</tr>
<tr>
<td><strong>FARM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock</td>
<td>Low</td>
<td>Non, quarantine x 10 days</td>
</tr>
<tr>
<td><strong>STRAY/WILD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rodent</td>
<td>Very low</td>
<td>None, pub health consult</td>
</tr>
<tr>
<td>Rabbit</td>
<td>Very low</td>
<td>None, pub health consult</td>
</tr>
<tr>
<td>Cat, dog, ferret</td>
<td>Medium</td>
<td>Public health consult</td>
</tr>
<tr>
<td>Raccoons, skunks, foxes, coyotes</td>
<td>High</td>
<td>Begin rabies treatment</td>
</tr>
<tr>
<td>Bats</td>
<td>Very high</td>
<td>Begin treatment</td>
</tr>
</tbody>
</table>
CDC Recommendations for use of HRIG and Vaccine in Rabies post exposure Prophylaxis

<table>
<thead>
<tr>
<th>Vaccination status</th>
<th>Intervention</th>
<th>Regimen*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previously <em>unvaccinated</em></td>
<td>HRIG</td>
<td>20IU/KG Infiltrate as much as possible around/in wound and remainder IM at site away from vaccine site (deltoid or thigh) Four 1ml IM doses of HDCV or PCECV with 1st dose on day 0 and remaining doses on days 3,7,14</td>
</tr>
<tr>
<td></td>
<td>Vaccine</td>
<td></td>
</tr>
<tr>
<td>Previously vaccinated</td>
<td>HRIG</td>
<td>NONE</td>
</tr>
<tr>
<td></td>
<td>Vaccine</td>
<td>Two 1ml IM doses of HDCV or PCECV on days 0 and 3</td>
</tr>
</tbody>
</table>

Immunosuppressed pts should receive 5 doses on days 0,3,7,14,and 28
restraint
Scalp twisted hair technique

Reinforced with Derma bond spot welding
derma bond

before

after
Derma bond repair 2yrs later
Special wounds

Pigment in wound

New souvenir towel
Typical lip laceration

Left: Unrepaired vermilion border

Right: Repaired vermilion border