



McMaster Children's Hospital



**DIVISION OF PEDIATRIC
GENERAL SURGERY**

RESIDENT MANUAL

INTRODUCTION

The purpose of this manual is to help you get acquainted with some of the special surgical problems in infants and children. They are different from adults!

The primary goal of this service is to provide excellent surgical care for children in this region. In general, there is very little that we as a service cannot manage. The answer to any call should be "We will be happy to see the patient and I will be there as soon as possible". If you are unsure as to what we can provide please ask the fellow or attending on call. Never turn anyone anyway or refer to another service without the express instruction by the fellow or attending.

Parents are worried and anxious so communication is critical. It will help to be understanding and polite despite the late hour and often-hurried workload. Care plans should be discussed with the attending or fellow before discussion with families to avoid confusion. As a general rule: DO NOT ARGUE WITH PARENTS. Having a sick child in the hospital is a very stressful situation for most parents and probably is at an increased level compared to that which you have experienced on most adult services.

Despite your medical knowledge, parents probably know their child better than you do, especially those children with chronic health problems when there has been frequent contact with the health care system. Problems that occur with parents regarding patient management, questions, etc, should be brought to the attention of the fellows and attending. If a disagreement does occur, a safe response is to say "I don't know. I will ask your surgeon". In the long run this will instill parent's confidence in you and make for a smoother hospital stay.

We are conducting a number of clinical research studies at any given time and you will be given information regarding them. Your participation in these studies is greatly appreciated.

If you have suggestions for this manual, please share them with us. They may be incorporated into a future printing of this manual.

(January, 2010)

TABLE OF CONTENTS

| | |
|--|----|
| I. TELEPHONE NUMBERS | 4 |
| II. FELLOW / RESIDENT RESPONSIBILITIES | 6 |
| III. ACADEMIC ROUNDS | 8 |
| IV. PEDIATRIC SURGERY CLINIC | 9 |
| V. PERIOPERATIVE MANAGEMENT OF THE INFANT AND CHILD | |
| Fluid Management | 10 |
| Antibiotic Prophylaxis | 11 |
| Bowel Preparation | 11 |
| Apnea & Bradycardia Monitoring | 12 |
| VI. MANAGEMENT OF THE LINES AND TUBES | |
| Nasogastric tubes | 13 |
| Gastrostomy tubes | 14 |
| Central Venous Lines | 16 |
| Chest tubes | 18 |
| VII. COMMON PEDIATRIC SURGICAL PROBLEMS | |
| Appendicitis | 20 |
| Pyloric Stenosis | 21 |
| Intussusception | 21 |
| Incarcerated Inguinal Hernia | 22 |
| Hernias in premature and full-term infants | 22 |
| Testicular Torsion | 22 |
| Epididymitis | 23 |
| Aspirated Foreign Bodies | 23 |
| Ingested Foreign Bodies | 23 |
| Caustic Ingestions | 24 |
| Lower GI Bleed | 26 |
| VIII. SURGICAL PROBLEMS OF THE NEONATE | |
| Tracheo-esophageal fistula and esophageal atresia | 27 |
| Intestinal obstruction | 27 |
| Intestinal atresia | 27 |
| Hirschsprung's Disease | 28 |
| Meconium ileus | 28 |
| Malrotation | 29 |
| Omphalocele and gastroschisis | 29 |
| Necrotizing enterocolitis (NEC) | 30 |
| Congenital Diaphragmatic Hernia | 31 |
| IX. PEDIATRIC TRAUMA | 32 |
| X. APPENDICES | |
| APPENDIX 1 Medications | 38 |
| APPENDIX 2 Face Sheet completion | 40 |
| APPENDIX 3 Management of Spleen and liver injury | 41 |
| APPENDIX 4 Ten Commandments of Surgical Residency | 42 |

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TELEPHONE NUMBERS AT McMASTER CHILDREN'S HOSPITAL

PAGING: **Internal #** 76443
 Outside # 905-521-5030

Whenever possible use the automated paging service or web-paging or web-paging.

In the hospital dial 87- enter pager # of the person you want followed by your phone extension and page classification (i.e. *1= stat, *2= routine, *3= call when you get time, *4= physician or use your pager number to identify yourself). Finally, press # to complete the page, then hang up. Outside of the hospital dial 905-521-5070 and follow the instructions as above.

WARDS

| | |
|------------------|-------|
| 3C | 76345 |
| 3C – Stepdown | 76971 |
| 3B | 76120 |
| NICU | 76146 |
| Level II Nursery | 73753 |
| PICU | 72610 |

MISCELLANEOUS

| | |
|--------------------------------|-------|
| Admitting Office/Bed Booking | 75106 |
| Operating Room | 75645 |
| Ambulatory Surgery Clinic – 2Q | 75094 |
| - Surgery Clinic – chart room | 73457 |
| Hospital Pharmacy | 76419 |
| Page Operator | 76443 |
| Emergency Room | 75020 |
| Ultrasound | 75316 |
| Short Stay Unit | 75564 |
| 3D Sedation Clinic | 76697 |

II. FELLOW / RESIDENT RESPONSIBILITIES

1. Pediatric Surgery Fellows

The pediatric surgery Fellows are responsible for all NICU/Level II Nursery surgical patients, supervising the residents and reviewing new consults with the residents. The entire surgical team has responsibility for the surgical patients in the PICU, and should work closely with the intensivists in a collegial manner. One Fellow must be assigned as the on call person each day. A call schedule (8-5 and 5-8) must be provided to Paging two weeks prior to the next month.

2. Residents

The residents are responsible for all ward patients (3C, 3B), including writing progress notes on a daily basis, and all new consults outside of NICU. The entire team has responsibility for the surgical patients in the PICU, and should work closely with the intensivists in a collegial manner. One resident must be assigned as the on "all person" each day. A call schedule must be provided in a timely fashion to Paging for each month. The surgery residents are required to take 7 night calls per month, which are a combination of in house and home calls. The pediatric residents are required to take 5 night calls per month.

Daily ward rounds must be started early enough to see all patients prior to the OR. Make sure you communicate **directly** with the nursing staff regarding any new orders or change in existing orders. Residents should be in the O.R. by **7:50 AM** for the first case. When possible please arrange coverage for ward patients while you are scrubbed in OR. The resident who is designated to scrub on a case **must** review the pre-op history and physical on that patient.

Emergency Room consults: *See all consults as soon as possible, but respond to a page **immediately** and indicate when the patient will be seen. If you are unable to see the patient for an extended period then contact the fellow or staff surgeon to see the patient.* Never discharge any patient, or refer a patient to another service, without first asking the Fellow or Staff Surgeon. Testicular torsion, ovarian pathology and aerodigestive foreign bodies are treated by the pediatric surgery service. All females 12 years of age or older presenting with abdominal/pelvic pain must have a PREGNANCY TEST.

Trauma: The resident participates in the management of all trauma patients under the direction of the Trauma Team Leader (TTL) (**refer to Trauma section**). After initial resuscitation your main role is to coordinate the general surgical care of the patient. Ordering a series of tests and then leaving is unacceptable.

Consults to other services require that you fill out a requisition, **and** then call the consulting service. **All requests are to be made physician to physician. Please no orders for the nurse to call for a consult.**

Handover: Each morning contact the on-call resident from the night before to obtain handover on patients seen that night.

FOR ANY PROBLEM THAT ARISES REGARDING PATIENT CARE ALWAYS ERR ON THE SIDE OF TOO MUCH, RATHER THAN TOO LITTLE COMMUNICATION WITH THE FELLOWS OR STAFF.

Radiology: 'Interventional procedures' should be arranged **directly** with the radiologist and if possible be present for the procedure/study. However, plain films can be simply ordered on the chart and the appropriate requisition completed and left on the chart. If the films are needed urgently then speak directly to the ward clerk to call radiology.

Discharges: Please plan discharges as early in the day as possible!! Beds are needed for admissions. Encourage early discharge whenever possible. Please do your discharge paperwork before going to the OR. Check with the attending prior to D/C for follow up plans. **It is essential that you complete the facesheet on the chart. See Appendix 3 for appropriate diagnoses to use for completing the facesheet.**

ALL INPATIENTS REQUIRE A DICTATED DISCHARGE SUMMARY. THIS IS THE RESPONSIBILITY OF THE HOUSESTAFF.

MEDICAL STUDENTS

Students are routinely assigned to the service. These medical students are an integral part of the service and their participation is welcomed. Your responsibility as residents is to provide the students with a wide exposure to many topics in pediatric surgery. Participation in the care of patients is proportionate to their level of experience and expertise.

CONSENTS:

Parents or legal guardian must sign the consent when the patient is unable to fully comprehend the issues. Be aware that foster parents are not always legal guardians, and that Children's Aid Society may be involved. Consents must be specific to surgical site indicating left and/or right sides. Interpreters are available for all non-English speaking families. For the resident to obtain consent they must be familiar with the procedure and to explain the risks of and benefits of the surgery. If you don't feel you can explain the consent, then make sure that someone will complete it before the patient goes to the OR.

WEIGHT:

Weight is documented in *kilograms* only in the chart and on prescriptions. Do not estimate or round off patient weights. Use weight most recent to day of surgery.

PARENT PRESENT IN OR FOR INDUCTION:

For elective cases one parent is usually present during induction of anesthesia. Please refrain from any unnecessary talking and noise during induction of anesthesia.

EYEWEAR:

Residents must wear appropriate protective eyewear (side protection is also recommended) *before scrubbing* for all cases.

HAND WASHING:

Hand washing is the single most effective way to prevent the spread of infection and disease. Wash your hands before and after touching any patient. ***Avoid cross contamination!***

BETADINE:

The pediatric patient population is more prone to Betadine burns. When prepping, avoid dripping Betadine (especially near cautery pad) and avoid pooling of betadine under the patient. Clean Betadine off of the patient at the end of the procedure.

III. ACADEMIC ROUNDS

- Pediatric Surgery Rounds ¹

Monday 12:00 – 13:00 Room 4E20

Topics and 'supervising' staff surgeon will be assigned in advance.

- Academic Half-day

Thursday 9:00 – 10:30 Room 4E10

Patient Rounds:

The fellows and residents are responsible for presenting all the patients. We encourage the residents to assign the student(s) one patient to present. Please expect questions and read ahead.

Thursday 10:30 - 11:30 Room 4E10

Chapter Rounds (wk 1)

M&M Conference (wk 2)

Journal Club (wk 3)

REC Meeting (wk 4)

- Surgery/Radiology/Pathology Rounds 8-9 each

4th Thursday

- Pediatric Grand Rounds

Thursday 12:00 – 13:00 Room 4E20

Instructions to presenter:

Each resident will be assigned one or more topics to present each month. You will be assigned a staff surgeon who will help you find appropriate resources for the presentation (textbooks, articles, slides). Limited photocopying will be available through our secretaries in the Department of Surgery.

The rounds are attended by clinical clerks, residents, fellows, staff surgeons/pediatricians and occasionally nursing staff. The topic of the rounds should be given to Dr. Cameron at least one week prior to the rounds. Identify and write down 3-4 "learning objectives". Your presentation should take no longer than 45 minutes, allowing at least 15 minutes for discussion.

The presentation should contain material relevant to all levels of learners, but be focused mostly at the clerk/junior resident level.

The format for the rounds is as follows:

- Case presentation, with appropriate x-rays and slides if available.
- Limited review of the appropriate embryology, anatomy and pathophysiology for the problem.
- Review of the medical and surgical management of the problem.
- Review of "what's new" in the management of this problem.
- Five to fifteen minutes at the end for general discussion.

Be early for your presentation and organize your slides and x-rays. Speak to the audience and not to your slides.

The presentation should be **interactive**. You have to ask questions!! A one hour didactic talk by the speaker, without any questions to the audience is unacceptable. If you have no "volunteers" to answer your questions you must ask individuals directly. You may not know the names of the individuals attending so you will have to point at an individual to indicate you wish them to answer the question. If that individual cannot answer the question, try one additional person and if they don't know the answer, then answer it yourself. Feel free to ask staff surgeons about controversial aspects of the problem.

Be aware of the time and if you are running late, and if key elements of your presentation are at the end, then delete some of the less essential material from your talk and get to the key elements.

IV. PEDIATRIC SURGERY CLINICS

Clinics are an important aspect of your rotation and attendance is expected. Whenever possible avoid wearing greens in clinic. The clinic affords an opportunity to assess new patients, complete postoperative checks and assess complex long-term patients.

2Q Clinic schedule:

Monday: 9:00 – 12:00
13:00 – 16:00

10:00 – 12:00 Chest wall anomalies clinic.

Tuesday: 13:00 – 16:00

Thursday: 13:00 – 16:00

All written clinic notes should be legible, concise and if appropriate always include the side of the patient's problem (i.e. left inguinal hernia, etc.). Each patient scheduled for surgery should have a signed consent and be given a pre-op package (yellow pack). There is no need to dictate for clinic patients.

V. PERIOPERATIVE MANAGEMENT OF THE INFANT AND CHILD

1. Fluid Management:

a) NPO Orders for procedures:

- <2 years: NPO for solids after midnight. Full fluids or breast milk up to 6 hours prior to surgery.
- >2 years: NPO for solids after midnight. Full fluids up to 8 hours prior to surgery.

b) Indications for preoperative intravenous fluids:

- If surgery has been delayed more than 6 hours in infants (0-1 years of age) and more than 8 hours in children, an IV should be started to give replacement fluids.

c) Maintenance fluids:

- Newborn Day 1: 80ml/kg/d D10W
- Newborn Day 2: 100ml/kg/d D10W1/4 NS
- Older Children:
 - 100 ml/kg/d or 4ml/kg/hr for first 10 kg body weight
 - 50 ml/kg/d or 2ml/kg/hr for second 10 kg
 - 20 ml/kg/d or 1ml/kg/hr for every kg remaining > 20kg
- Increase allowances for fever, bili-lights and prematurity
- **Practical: D5W 1/2 NS with 20mEq KC1/L is standard maintenance solution**

➤ **Calories:**

- a) Term neonate 100 - 120 kcal/kg/day
- b) Preterm 120 - 130 kcal/kg/day
- c) Very Low Birth Weight (< 1kg) > 150 kcal/kg/day
- d) Expect weight gain of 20-30 g/day

➤ **Estimated blood volume:**

- a) Newborn: 90ml/kg
- b) Child: 80ml/kg
- c) Teenager: 70ml/kg
- d) Rough rules of thumb for blood replacement:
 - 10ml/kg of packed RBC's - Raise Hct 3-4%
 - 1 unit platelets /10 kg - Raise platelet count by 25,000
 - 10-15 ml/kg of FFP for coagulopathy
 - 1 unit/5kg of CRYO to replace Fibrinogen
- e) Safe volumes to push empirically:
 - Packed RBC's 10ml/kg
 - 5% albumin 20ml/kg

➤ **Deficit therapy:**

- a) Gastric losses: D5W1/2NS + 20 mEq KCL per liter to replace measured loss
- b) Distal G.I. losses: D5W RL to replace measured losses
- c) Body Fluid Compositions: If in doubt, send fluid for electrolytes

2. Prophylactic Antibiotics:

a) Newborns are relatively immunodeficient and hence, prophylactic antibiotics are used for all major surgical procedures, whether clean or not. The usual choice is Ampicillin (25-50mg/kg/q6h) + gentamicin (5mg/kg/day). For bowel surgery Flagyl should be added (10 mg/Kg/dose).

b) Use American Heart Association guidelines for prophylactic antibiotic coverage in children with congenital heart disease.

3. Bowel Preparation:

Check with your staff surgeon regarding bowel preparation preferences. In the absence of specific direction the following guidelines can be used.

| Age | 2 days prior to surgery | Day before surgery |
|---------------|--|---|
| < 1 yr | 4.25 mg (2.5 ml) Senokot at bedtime (1/2 teaspoon) | - Regular breakfast then Clear fluids from noon until midnight. 4.25 mg (2.5 ml) Senokot - Breastmilk or formula from noon until 6 hrs before procedure. |
| 1-5 yrs | 17 mg (10 ml) of Senokot at 4 pm (1 teaspoon) | - Regular breakfast - Clear fluids or breastmilk only from noon until midnight. - 1/4 sachet of Pico Salax at noon - 1/4 sachet of Pico Salax or 1 litre of apple juice at bedtime |
| 6-12 yrs | 25.5 mg (15 ml) of Senokot at 4 pm | - Regular breakfast - Clear fluids only from noon until midnight. - 1/2 sachet of Pico Salax at noon - 1/2 sachet of Pico Salax at 4 pm or 1 litre of apple juice at bedtime |
| Over 13 years | 25.5 mg (15 ml) of Senokot at 4 pm | - Regular breakfast - Clear fluids from noon until midnight. - 1 sachet of Pico Salax at noon - 1 sachet of Pico at 4 pm |

4. Apnea & Bradycardia Monitoring:

Former preterm infants that are less than 56 weeks post-conceptual age should be admitted and monitored overnight post surgery.

Term infants (term being defined as 37 weeks gestation or greater at birth) that are less than 44 weeks post-conceptual age should be admitted and monitored overnight post surgery.

VI. MANAGEMENT OF THE LINES AND TUBES

1. Nasogastric tubes:

Nasogastric 'drainage' tubes are used for gastrointestinal decompression and also for gavage feeding in neonates

- a) Gavage feeding: in neonates use a 6-8 Fr NG tube as a feeding tube. When a feeding tube is to be used in older infants and children for continuous delivery of formula, one can use a soft enteral feeding tube (Corpak, 8-12Fr). When gastro-esophageal reflux is a problem, the tube may be advanced radiologically into the third portion of the duodenum or upper jejunum.
- b) GI decompression: Use one of the pediatric sump tubes (Salem). The air vent on the sump tube will reduce the likelihood of occlusion of the tube - a common complication in small suction tubes. The Replogle tube is preferred in infants with esophageal atresia because the two holes are at the end of the tube.
- c) Tube placement is checked by auscultation of the stomach while injecting a small amount of air and then aspirating back into the syringe attached to the tube.
- d) Change the tube if it is not functioning properly. With an infant in urgent need of gastrointestinal decompression, a large red rubber catheter can be passed through the mouth as an effective means of aspirating gastric contents.
- e) Unless instructed by the attending nasogastric tubes should never be clamped since the infant may vomit and aspirate around them.
- f) If high output of bilious (green) is noted, check AXR to see if tip of NGT is in duodenum.

NG tube sizes for GI decompression:

| | |
|------------|-------------|
| Premie | 6 Fr. |
| Infant | 8 - 10 Fr. |
| Child | 10 – 12 Fr. |
| Adolescent | 12-14 Fr. |

2. Gastrostomy tubes:

Types of Gastrostomy Tubes:

MIC TUBES (clear plastic tubes that extend out from abdominal wall 6" and have an access port to inflate balloon with water and 1 or 2 ports for gastric and/or jejunal feeds.

MIC-KEY TUBES (skin level device that has a round clear plastic flange that anchors onto the skin with a side access port to inflate the balloon with water.

BARD BUTTONS (skin level device that has a firm mushroom-shaped end (not a balloon) anchoring it on the stomach wall. Only someone skilled in placing or removing these tubes should attempt do this procedure (a metal obturator is usually needed to stretch out the mushroom end to replace and/or remove). These tubes can take significant force to insert and remove so care must be taken.

MALECOT or PEZZAR (mushroom) – used most commonly in infants. Open placement under general anesthesia, initially sutured in place.

FOLEY CATHETER - to be used only as a temporary measure

PEG Gastrostomy Tube - Inserted endoscopically and has an outside crossbar and an inner disc.

Gastrostomy Tube Placement:

a) *Methods of initial Placement:*

- Open Gastrostomy - primary or adjunct to another open procedure
- Percutaneous endoscopic gastrostomy (PEG) tube in OR under general anesthesia with a gastroscope
- Laparoscopic G-tube placement

b) *Postoperative Management*

- Initiate nutrition and homecare referrals immediately. G-tube to gravity until following am. After 18-24 hrs initiate *Pedialyte* at a low rate for several hours. If tolerated, change to an appropriate enteral formula, advancing toward the nutritional goal. (Nutrition can help determine). Children who can eat *safely* PO may gradually resume oral feeds. Home care consult is required prior to discharge for supplies and nursing support. Anticipate discharge 2nd or 3rd post op day.

c) Excessive granulation tissue at the exit site can be cauterized with silver nitrate sticks. Protect the surrounding skin with vaseline. Skin irritation around a leaking gastrostomy site can be treated with Maalox applied topically q4-6h, and the tube can be stabilized by passing it through a plastic nipple

d) Procedure for unclogging occluded feeding tubes.

Flushing the tube with water before and after using the tube can help prevent clogging from occurring. A combination of sodium bicarbonate and pancrelipase capsules have also been employed with success as described below. (Note: a variety of other fluids, including cola or cranberry juice, have been used for unblocking tubes. However, these products are acidic and may actually contribute to the problem.)

1. Using a 20-60 ml syringe, aspirate as much liquid as possible from the feeding tube and discard the fluid.
2. Instill 5-10 ml warm water with the same syringe under manual pressure over one minute and use a back and forth motion to help dissolve the blockage.
3. Clamp tube for 5-15 minutes.
4. Attempt to aspirate and flush with warm water.
5. You may need to clamp tube a few times to allow the blockage to break up.
6. If the tube is still occluded, repeat steps 2 to 4 using the following mixture:
 - a. 1 X sodium bicarbonate 500 mg tab, crushed
 - b. 1 X Cotazym (pancreatic enzymes), empty powder- filled capsule
 - c. 10 ml of warm sterile water
7. Take care not to flush this enzyme solution through the tube once the blockage breaks up. Aspirate the blockage and the enzyme solution and discard. Flush the tube with warm water afterwards.

Changing G-tubes & Buttons & other GT Problems:

1. Early, inadvertant removal requires consultation with Ped Surg Fellow or Attending before attempting replacement. (<4 weeks open, <8 weeks PEG, <12 weeks for immuno-compromised patient)

2. Prompt response to calls about dislodged GT's is critical as stoma tracts may close within hours.

3. If called to ER or inpatient floor to replace button or g tube that has come out PLEASE respond ASAP.

4. If the family brings a spare button or tube use it. If not, replace with largest size Foley you can safely get in. Non-traumatic replacement in a mature site does not require radiologic confirmation. **However, always confirm correct placement by aspiration of gastric contents. If you are not certain the tube is in the stomach then order a contrast study via the G-tube.**

5. If you cannot get anything into the stoma, consult the Pediatric Surgery Fellow or Attending promptly.

If the gastrostomy tube falls out early (e.g. before POD14):

- The resident or fellow should contact the radiologist immediately. Remember that this tract can close completely in six hours; this must be done expeditiously. The g-tube should be repositioned under fluoroscopy.

- Gently pass a smaller diameter Foley catheter rather than the previous tube. **DO NOT re-insert the same tube using a hemostat or metal probe!**

- Once the tube is in the stomach, inflate the balloon and pull it back snugly up against the abdominal wall and stabilize securely with tape. Then confirm the tube's intragastric position using aqueous contrast, not barium.

- If any resistance is met, STOP! You will thus avoid separating the stomach from the abdominal wall. If one cannot successfully replace the tube, it is necessary to return the child to the operating room. If there is ANY question of tube placement, the patient should return to the OR. NOTE: GJ tubes are inserted by interventional radiology and not by the surgery service.

3. Central Venous Lines

When consulted for central venous access obtain information about indication of access, estimated duration, whether home IV therapy is being considered and any other relevant information.

a) Short-term Central Venous lines:

- For patients <8Kg or <8 months of age the Pediatric Surgery Service is responsible for insertion of a central line. The line insertion is done at the bedside with local or in the OR under GA.
- For patients >8kg and >8 months of age the Interventional Radiology Service is responsible for insertion of a PICC line.
- For patients <8kg and >8 months of age or >8kg and <8 months of age will be first assessed by the Pediatric Surgery Service.

b) Long-Term Central Venous Lines:

The following lines are usually done by the Pediatric Surgery Service and are done in the OR.

Single Lumen: Broviac or Hickman 2.7, 4.2, 6.6, 9.0 Fr

Double Lumen: Hickman 7.0 Fr

- Placed in the OR under fluoroscopic guidance
- Cap the line with an injection port that is available in the O.R. If continuous IV solution is not being given, instill heparin flush 10 u/cc to fill the catheter.
- Dress with a Tegaderm and the lines should be looped & taped securely with waterproof tape (pink) to prevent inadvertent removal.

Implantable Port Devices - 6.6 Fr, 9.0 Fr

- If an implantable device is inserted, place a Huber (non-coring) right angle needle attached to extension tubing into the septum. Instill heparin flush to fill the tubing if not being used. If the device is to be used, the needle & tubing should be dressed & taped.

b) Broken or Leaking Broviac/Hickman Catheter

- This is considered an emergency & repair should be performed expeditiously before the line is lost. If you have no experience with line repair, request assistance from someone who does.
- *The size of the repair kit must match the size of the catheter in the patient.* Determine the line size and type (single or double) from the label on the catheter or from the operative note. Repair kits are kept on Ward 3B.

c) Catheter insertion site infection:

- Local infection of a CVL is defined as purulent drainage from the exit site. Tenderness or erythema along the catheter tunnel also suggests an infection.
- Diagnosis: Clinical examination usually establishes the diagnosis. Cultures should be obtained from the catheter site along with peripheral and central blood cultures from each lumen of the CVL. Drainage should always be sent for gram stain.
- Treatment: Local wound care. Empiric antibiotic coverage through the line before cultures are back. Specific antibiotic coverage when cultures available
- Indications for catheter removal: Continued local infection after 48 to 72 hrs of specific antibiotics, development of a systemic infection and/or a Fungal infection.

d) Systemic catheter infections:

- Systemic catheter infection is defined as septicemia resulting from infection of a CVL. While the definition is straightforward, the diagnosis is often difficult to make. Usually the catheter site appears normal. Frequently, children with CVL's are neutropenic or have other maladies that put them at high risk for other infections. Distinguishing catheter-related sepsis from infection elsewhere can be difficult.

1) Diagnosis: Catheter-related sepsis is a diagnosis of exclusion. When a patient with a CVL develops a fever, all other possible causes of sepsis should be ruled out before the diagnosis of catheter sepsis is made.

2) Blood Cultures: When catheter sepsis is suspected in a patient, at least one, and preferably two, blood cultures should be obtained from venipuncture and from each lumen of the line. The diagnosis of CVL infection is more likely if peripheral cultures are negative and the line culture is positive.

Antibiotic coverage is maintained per Infectious Disease.

e) Relative indications for catheter removal:

- Ongoing sepsis despite appropriate antibiotic coverage for 2-4 days
- Continuously positive blood cultures after 2-4 days of antibiotic coverage.
- Positive culture for Candida or other fungus
- Hypotension and /or pressor support.

f) Broviac or Hickman catheters:

These catheters should be removed by the Surgical service. If there is resistance during the removal of a tunneled line, do not continue to pull the line as inadvertent line fracture may occur.

g) Implantable Port Infections:

If you suspect a patient with an implantable port has a pocket abscess, culture by sterile aspiration from the pocket. **NEVER I & D** the area over an implantable port. Involve the fellow or attending if there is any question.

4. Chest tubes:

a) Site:

- For pneumothorax, a chest tube should be placed in the anterolateral aspect of the chest wall.
- For pleural effusion or hemothorax, the tube should be placed more posterolaterally, in the dependent position for drainage. Larger tubes are recommended for drainage of blood or exudative effusions.

b) Chest Tube Sizes:

| | |
|------------|-----------|
| Neonate | 10-12 Fr. |
| 6 m-18 m. | 12-14 Fr. |
| 1-3 yr. | 16-20 Fr. |
| 4-7 yr. | 20-24 Fr. |
| 8-12 yr. | 28-32 Fr. |
| Adolescent | 28-40 Fr. |

c) Insertion Technique:

- Insertion is usually done under GA or conscious sedation with local.
- Estimate the proper intrathoracic length of the tube prior to insertion.
 - A small skin incision is made at a selected site over the ribs.
 - A curved hemostat is used to tunnel superiorly and subcutaneously over the next higher rib and into the pleural cavity - the hemostat is then spread to enlarge the opening.
- TROCARS ARE TO BE AVOIDED. It is important to displace the site of entry from the skin margin by tunneling so that pneumothorax will not recur when the chest tube is removed, especially in babies with small amounts of subcutaneous tissue.
- Introduce the tube into the chest cavity and make certain that all sideholes are intra-thoracic.
- Suture the tube tightly against the chest wall. Connect the tube to Pleurovac suction; the amount to be determined by the indication for the tube and the size of the child (usually -10 to -20 cm of water).

d) Chest Tube Removal:

- If there is no air leak, the tube is usually first placed to water-seal and a CXR obtained. Give analgesia prior to removal and for select patients sedation may be required.
- Removal is performed with the tube clamped at the skin level and a Vaseline occlusive dressing applied as the tube is removed. If the child is cooperative, the tube can be removed either at end inspiration or with a Valsalva maneuver. For younger children, pull the tube while the child cries. The actual removal should be done **quickly** in order to minimize the chance of air being sucked through the tube and site. A repeat chest X-ray is then obtained. The entry site usually seals within hours but the dressing should be left on at least 48 hours.

e) Clotted Chest Tube Care:

- Clamp proximal to the clot if possible using sterile technique, open the chest tube at the connection and see if the clot can be manually removed with a cotton applicator. Use a twirling motion to keep the clot intact.
- Check with the attending to see if they prefer tube replacement vs. thrombolysis at this point. Prepare the solution using 80,000 units tPA in 50ml NS. Use 60ml syringe with a 25-gauge needle. Prep 5cm longitudinal area of connector tubing (not chest tube itself) with Betadine. Penetrate tubing with needle at a very oblique angle to make sure that an adequate tunnel through the tube will be formed when the needle is removed. Once tPA is injected, withdraw needle and cover the puncture site with Tegaderm. Keep tubing upright with respect to patient, but not clamped; to make sure that gravity forces the tPA through the tube. Leave in for two hours then resume suction. Repeat up to two additional times daily if necessary.

f) Pleural Effusion:

When you are asked to see a patient with a pleural effusion it is important to obtain an ultrasound of the affected hemi-thorax to assess for loculations.

- if the ultrasound shows a simple effusion then a pigtail catheter can be placed by interventional radiology.
- if the ultrasound shows a loculated effusion then a pigtail catheter is inserted by interventional radiology followed by instillation of Alteplase according to the following protocol.

ALTEPLASE (tPA) PROTOCOL:

The following should be checked:

1. Ultrasound shows significant fluid with loculations.
2. X-ray shows the tube in good position.
3. Suction apparatus is working well with suction of 15 to 20 cm water.
4. Check to make sure the chest tube is not blocked:
 - Flush chest tube to remove fibrin clots (5 ml NS to flush and clear tube and then aspirate to see if drainage increases.
 - Turn patient on side with chest tube down.

Once the above has been completed then instill the Alteplase:

- Dose is 0.1 mg/kg (max 6 mg) diluted with NS as follows:
 - <10 Kg add 10 ml NS
 - 10-20 Kg add 25 ml NS
 - >20 Kg add 50 ml NS

Instill mixture and clamp tube for 1 hour with positioning q20 minutes. Monitor respiratory status. Unclamp tube and see if drainage increases (may appear serosanguinous initially). Can be used once a day for 3 days or until CXR is improved and drainage has decreased

VI. COMMON PEDIATRIC SURGICAL PROBLEMS

This section focuses on the pediatric surgical problems commonly seen in the emergency room setting.

A complete diagnosis and therapeutic review of each entity is not attempted, but rather pertinent points to facilitate initial patient management are stressed.

1. Appendicitis:

a) The most frequent surgical problem in the emergency room will be to evaluate "abdominal pain, rule out appendicitis". Appendicitis is by far the most common abdominal surgical problem in childhood. If an appendectomy is appropriately performed soon after the onset of symptoms, the child is usually discharged from the hospital within two days.

b) Guidelines:

- Abdominal pain begins in the periumbilical area and usually (but not invariably) shifts to the right lower quadrant. Remember that the localized pain will reflect where the appendix or its inflammatory fluid resides (e.g. retrocecal or pelvic appendix). Perforation commonly occurs at approximately 36 hours (\pm 10 hours) after the pain begins.

- Abdominal pain usually PRECEDES vomiting.

- Appendicitis is at times accompanied by anorexia, nausea, and vomiting, but these are not discriminating signs. Diarrhea is common with gastroenteritis but can also be due to irritation of the rectum by pus, abscess or phlegmon. Diarrhea is therefore not an exclusion criteria for appendicitis.

•Consistent, localized point tenderness is the most reliable sign of appendicitis, whereas other physical findings tend to be variable.

- Fever and leukocytosis tend to be minimal in early appendicitis.

- For suspected GYN pathology in sexually active young teens, a pelvic exam should be done by the fellow/staff with a chaperone.

- A calcified fecalith on KUB is strong evidence for appendicitis, but is found in only 10-15% of the cases. If a fecalith is present, always err on the side of early operation. Neither an U/S nor a CT scan is needed if the history and physical examination strongly suggest appendicitis.

- In the child less than 2 years of age, the appendix is usually perforated by the time the patient is brought to the emergency room. Fortunately, appendicitis in this age group is infrequent (approximately 2% of all cases).

- An abdominal U/S or CT scan may be useful in cases where there is an equivocal history and physical exam and further information is needed in order to establish a diagnosis. A CT scan is not a substitute for an accurate history and physical (few CT's should be needed).

c) Antibiotics:

- Flagyl 10 mg/kg plus Gentamicin 5 mg/kg once the diagnosis is made. (note: Clindamycin can be substituted for the Flagyl)

For suspected perforated appendicitis consider the addition of Ampicillin 50 mg/kg.

Note: Interval appendectomy in 6-8 weeks may be the chosen plan in patients presenting late in their course (i.e. > 4-5 days of symptoms).

2. Pyloric Stenosis:

a) Pyloric stenosis is a gastric outlet obstruction caused by hypertrophy of the pyloric muscle. Pyloric stenosis is extremely rare in the first week of life. It usually occurs in the first 2-6 weeks of life.

b) If the pyloric olive can be felt, no further diagnostic tests are necessary. Give the infant a pacifier to suck or a small amount of sugar water, because the olive is impossible to feel if the patient is crying. Be patient. Re-examine. **Consider POINTS study prior to NG use.** If a NG tube is inserted it may help to palpate the pyloric olive.

- Elevate the baby's feet to relax the abdominal wall and palpate over the spine at the midline.

The olive can be palpated by rocking it superiorly and inferiorly.

- If the story is good, but a mass is not palpable, an ultrasound is a good diagnostic test in experienced hands. Infants referred from other hospitals will often come with a barium study that may reveal a typical "string" or "double track" sign. If pyloric stenosis is not the cause of vomiting in this scenario, gastroesophageal reflux should be considered. All outside films need to be reviewed by the attending radiologists here!

- A clinical assessment of the patient's hydration should be made, and serum electrolytes should be checked immediately upon admission to rule out a serious **hypokalemic hypochloremic metabolic alkalosis**. This MUST be corrected (so CL >90 and CO₂<30) with boluses of intravenous ½ Normal Saline or Normal Saline until urine output is established. Then IVF can be changed to D5W 0.45 NS with 20 meq KCl at 1-1.5 X maintenance prior to elective pyloromyotomy. Electrolytes must be normal prior to general anesthesia and surgical correction. Ancef 50 mg/kg should be administered pre-operatively.

c) Postoperative management:

- Diluted formula, Breast milk, Pedialyte or sugar water can usually begin 6-12 hours postoperatively. Parents should be informed that the baby may vomit postoperatively as part of the normal postoperative course. Patient may be discharged when alert, feeding normally and examined by a physician (usually 24-48 hrs).

3. Intussusception:

An invagination of a portion of the intestine into the lumen of an immediately adjoining part.

a) The common age range is 4 months to 2.5 years with the highest incidence at age 8 months. If the patient is younger or older, one should be suspicious of a lead point for the intussusception such as a Meckel's diverticulum, or an intestinal polyp.

b) The typical triad of colicky abdominal pain, abdominal "sausage-like" mass, and currant jelly stools is well known, but all these components are late findings and are not invariably present. The most common location is ileocecal.

c) Diagnostic studies typically begin with plain films (3 views) of the abdomen. Air/stool throughout the colon rules out intussusception. If the films cannot rule out intussusception, then an ultrasound is performed. This is followed by an air contrast enema that is diagnostic and in most cases also therapeutic. The following guidelines must be observed:

- The fellow/staff should see the patient and the usual preoperative preparations should be made before any attempt at reduction is made. **Place an IV, hydrate the patient and give one dose of Flagyl and Gentamicin in the Emergency Room (Clindamycin can be substituted for Flagyl). The patient must have a functioning IV in place at the time of the enema. The radiology suite should be warm and the patient must be monitored.**

- Enema reduction should not be performed if the child is sick with peritoneal signs. This child should be fluid resuscitated, placed on intravenous antibiotics, have a nasogastric tube passed, and be taken to the O.R. expeditiously.

- Reduction is not considered successful unless there is free reflux of air or contrast into the ileum. A repeat attempt can be made if the baby's condition will permit.

- The patient is usually admitted for 24 hours observation after reduction. Keep NPO for the first 8 hours; then gradually advance the diet. Warn parents and staff that high temperatures can follow reduction. If symptoms recur an ultrasound should be performed again and a reduction enema if needed. Operation is mandatory if reduction cannot be accomplished. The recurrence rate after either enema reduction is approximately 5% and after surgical reduction approximately 1%.

4. Incarcerated Inguinal Hernia:

a) This condition is age-related occurring most often in infants during the first year of life. Most, if not all, can be reduced manually, which obviates the need for emergency surgery.

b) Reduction techniques:

- Check with fellow or attending regarding use of pain medication or sedation prior to attempted reduction. Occasionally, simply holding the baby in very steep Trendelenburg position reduces the hernia, due to the pull of the mesentery.

- Have an assistant hold the infant above the knees in a frog leg position to relax the abdominal wall.

- Fingers of one hand should attempt to fix the hernia while the other hand should press the incarcerated mass upward toward the canal. A considerable length of steady pressure (5 minutes) may be required to produce the desired reduction, so the surgeon should be in a comfortable position. Try to milk the bowel contents out of the incarcerated bowel, until it “pops” back into the abdomen.

- Some hernias reduce easily, others require several attempts.

c) If successful, the patient is always admitted, and the repair is performed electively within the next 24-48 hours after the edema has resolved.

d) Emergency surgical intervention is required if the hernia cannot be reduced, or if there is post-reduction evidence of persistent intestinal obstruction, or nonviable bowel. This is a rare, but possible event.

e) It is imperative to differentiate an incarcerated hernia from a hydrocoele of the cord. Hydrocoele of the cord is often tense. Hydrocoele in the first year rarely requires operative intervention.

- One can often get “above” a hydrocele and feel a normal empty inguinal canal, excluding an inguinal hernia. These infants can be sent home and booked for elective surgery.

f) An unfortunate complication of an incarcerated hernia is hemorrhagic infarction of the testicle.

Reduction will usually reinstitute blood flow to the testis.

g) Incarcerated inguinal hernias in girls invariably are sliding hernias containing ovary and tube. If asymptomatic, these can usually be repaired on a semi-elective basis if the mass is non-tender. The blood supply to the ovary is usually not impaired.

If symptomatic then urgent repair is required.

5. Hernias in premature and full-term infants:

a) If consulted on an inpatient preemie with multiple problems, it can be repaired just prior to discharge home. Former preterm infants that are less than 56 weeks post-conceptual age should be admitted and monitored overnight post surgery.

Term infants (term being defined as 37 weeks gestation or greater at birth) that are less than 44 weeks post-conceptual age should be admitted and monitored overnight post surgery.

6. Testicular Torsion:

a) The peak age group for this condition is adolescent boys ages 12-18. Torsion also can occur in the infant particularly in the undescended testis.

b) Major considerations:

- Early operative intervention if diagnosis is suspected in order to save the testicle (6 hour golden-period).

- The patient may reveal a painful, high riding, horizontal and swollen testicle.

- The differential diagnosis includes primarily torsion of the appendix testis or epididymitis.

- Duplex US can usually assist in the diagnosis but should not delay definitive management if there is a high index of suspicion.

c) Torsion of the appendix testis:

- Symptoms are very similar to testicular torsion, but the child is often pre-teen.

- Examination may reveal localization of the pain to the upper pole of the testis, and examination may reveal the “blue dot” sign.

- Later presentation may reveal erythema, diffuse tenderness, and reactive hydrocele,

making differentiation impossible.

- If one is certain of diagnosis, this condition can be treated with analgesia and scrotal support. Symptoms usually subside after 5-12 days. If uncertain, err on the side of operation.

7. Epididymitis:

•It is rare in children <14 years, except in association with mumps. If present in the younger child without mumps, then urinary tract imaging (VCUG, etc.) may be necessary to rule out ectopic ureter to vas, or other urologic conditions.

•Elevation of the testis sometimes gives relief with epididymitis, but usually not with torsion.

After a thorough, but expeditious evaluation, if any doubt exists, exploration should be performed as a safe, practical and accurate method of diagnosis and treatment.

8. Foreign Bodies:

Aspirated (airway) Foreign bodies:

You must have a high index of suspicion and a very low threshold to recommend endoscopic examination if there is any question of aspiration of a foreign body. Otherwise, excessive morbidity and mortality results. Foreign body problems occur most commonly in the toddler age group, but may be seen in older children as well.

a) Laryngeal foreign bodies:

•A foreign body lodged in the oropharynx or glottis may warrant immediate attention to clear the airway, the Heimlich maneuver, direct laryngoscopy, or bronchoscopy. If possible, a mask airway should be maintained and more controlled laryngoscopy performed in the operating room.

•If the patient is ventilating adequately when seen, no maneuvers should be performed until the patient is in the O.R. where conditions and equipment are ideal.

b) Tracheobronchial foreign bodies:

•Less than 10% of foreign bodies are located above the carina. Most slip into the bronchus with the majority located in the right main stem bronchus.

•History alone may be sufficient to warrant admission and endoscopy, even in the absence of physical and X-ray findings.

•Plain chest X-ray will reveal the foreign body if it is radio-opaque. However, most foreign bodies such as wood, plastic objects, peanuts, carrots, celery, or aluminum "pop-tops" are not radio-opaque and may only manifest as hyper- or hypo-inflation. Inspiration/expiration views may show air trapping and suggest the presence of a foreign body.

•A foreign body which totally obstructs the bronchus leads to slow lung collapse and slow mediastinal shift toward the side of the offending object. Partial occlusion of the lumen causes the more common ball-valve effect, with subsequent air trapping and hyperinflation on the side of the lesion and mediastinal shift away from the side of the foreign body.

•The Storz bronchoscope or optical forceps greatly facilitate foreign body removal from the tracheobronchial tree. A complete set of foreign body instruments is available in the O.R.

•The consequences of the neglected foreign body are quite serious and include atelectasis, recurrent pneumonia, and eventual destruction of the segment or lobe. Since there is minimal morbidity using the bronchoscopic approach, an aggressive approach is warranted. All patients should have a postoperative CXR.

Ingested (GI tract) foreign bodies:

a) Esophageal foreign bodies:

•An esophageal foreign body can cause respiratory distress in small children. Objects tend to lodge just near the cricopharyngeus muscle, usually behind the larynx or cervical trachea, thereby impinging or obstructing the airway.

•Diagnostic tests:

-A CXR will locate the object if it is radio-opaque; a PA and lateral view is essential to determine position and the possibility of two superimposed objects. An abdominal film will determine if the object has slipped through to the stomach.

-A contrast study is occasionally required, but must be done carefully to avoid aspiration.

•Esophageal foreign bodies should be removed endoscopically, under general anesthesia. After the object has been removed, the esophagoscope can be reintroduced to assess the status of the esophageal wall at the site of impaction and manipulation. Passage of the rigid scope beyond the site of impaction is generally not necessary and can increase the risk of esophageal perforation.

•Special consideration should be given to batteries which can burn the esophagus and should be considered a caustic ingestion and require emergent endoscopy.

b) Gastrointestinal foreign bodies:

•Once in the stomach, most ingested foreign bodies will safely traverse the gastrointestinal tract, usually within 4-5 days. The problem sites are usually the pylorus, the ligament of Treitz, and the ileocecal valve.

•If the object is radio-opaque, it can be followed with serial X-ray films, but this is usually not necessary. The stools should be checked for appearance of the object. The child should be followed for abdominal pain, vomiting, or blood in the stool.

•If after 4-8 weeks the object is still in the stomach, it can be retrieved by gastroscopy

8. Caustic Ingestions:

a) Determine amount, brand, and container.

- Is it liquid or granular?
- Has the patient vomited?
- Previous home or hospital Rx?

Note the amount ingested is a poor predictor. Establish the need for airway management and consider CXR and AXR if physical exam suggests. Most patients with suspected significant ingestion of a caustic material are admitted for esophagoscopy under general anesthesia in 12-18 hr from injury. Although many patients with esophageal injury show burns of the oropharynx as well, this is not a completely reliable guideline. **DO NOT INDUCE VOMITING!**

b) Upper airway injury as well as face and hands should be assessed. Pharyngeal burns may be so severe as to require tracheostomy. Symptoms can occur between 1-5h after ingestion.

c) Bases (alkali): Include NaOH, KOH, ammonia, electric dishwasher soaps, some denture cleaners, non-phosphate detergents, hair straighteners. These chemicals cause **liquefaction necrosis** and may involve full thickness injury.

d) Acids: Includes toilet bowl cleaners, rust removers (HF1). These cause **coagulation necrosis**.

e) Bleaches: Clorox (Na Hypochlorite) Experimentally causes superficial burns and ulceration, no strictures.

f) DISK BATTERY ingestion: NaOH, KOH, Hg.

g) PILLS: Can get stuck, adhere, prolonged contact. NSAIDs-hemorrhage and stricture. Potassium Chloride-strictures, hemorrhage, death. Quinidine-strictures.

h) Most ingestions occur at home in the kitchen. 85% of esophageal injuries are due to bases; acids tend to injure stomach. Caustic flakes or powder tend to stick and cause localized oropharynx and upper esophagus injury, lead to segmental strictures. Always think about battered child syndrome, Munchausens by proxy (8%). 78% of poisonings occur with patient near parent.

i) Management:

•DO NOT INDUCE VOMITING. The child should be kept NPO and placed on intravenous fluids. Wash skin & eyes; wash out mouth with water. **Contraindicated: gastric lavage, vomiting.**

•Barium swallow does not adequately determine if the esophagus has been injured, but should be obtained as a baseline sometime during the first 2-3 weeks after injury. If it shows atonic dilated esophagus, serious injury is implied.

•Esophagoscopy is done under general anesthesia within 24-48 hours of admission. Wait a minimum of 15h for full extent of injury to be seen. Esophagoscopy is done only to the point of injury and then stopped once the diagnosis is made.

If the injury is very severe, a gastrostomy may be indicated for feeding and a string can then be passed through the nares, down the esophagus, into the stomach, and out the gastrostomy. This string will insure a lumen in the strictured area and aid in future dilatations. Absence of oropharyngeal lesions does not exclude esophageal or gastric injury—between 8-20% of patients without oropharyngeal lesions have esophageal injury. Do not scope in presence of severe burn with laryngeal edema. Esophageal or gastric perforation may not be present for 2 to 3 days.

Circumferential burns are more likely to cause strictures. Repeat esophagoscopy is usually performed in 14 days, at which time a dilatation may be performed if a stricture is present. These children demand close follow-up.

•PATHOLOGY: Acute necrosis 1-4d, granulation 4-15d, Scarring begins 21d-worst in second month. Bases cause liquefaction necrosis, solubilize proteins, saponify fat, and are progressive. Acids cause coagulation necrosis, leaving supporting structures intact.

10. Lower GI Bleed:

NEONATES: WORKUP

Swallowed maternal blood: Apt test
Hemorrhagic disease of the Newborn :Coags
Anal fissure: Anal exam
NEC: KUB, cross table lateral
Malrotation and volvulus: UGI +/- U/S
Allergic colitis from formula: Eosinophilia

INFANTS 3-18mo: WORKUP

Anal fissure: Anal exam
Intussusception: U/S, Colon study-air or contrast
Intestinal volvulus: KUB, UGI
Duplication: Meckel's scan for ectopic gastric mucosa (Zantac prior to study increases the sensitivity)
Gastroenteritis

TODDLERS and PRESCHOOL: WORKUP

Anal fissure: Anorectal exam
Rectal prolapse :Anorectal exam
Meckel's diverticulum: Meckel's scan (Zantac prior to study increases the sensitivity)
Juvenile polyp: Lower endoscopy

OLDER CHILDREN and TEENS 6-18y: WORKUP

Polypoid diseases/IBD/PUD: Upper and/or lower endoscopy
Hemorrhoids/ Anal fissure: Anorectal exam
Meckel's diverticulum: Meckel's scan (Zantac prior to study increases the sensitivity)

VII. SURGICAL PROBLEMS OF THE NEONATE

SPECIFIC NEONATAL SURGICAL CONDITIONS

1. Tracheo-esophageal fistula and esophageal atresia:

- a) This infant should be kept head up at 45 degrees and a Replogle NG tube (10 Fr) should be passed via the nose or the mouth to keep the upper pouch empty with continuous low suction.
- b) Ventilation using mask and bag should be avoided if there is a distal TEF to prevent gastric distention with further respiratory impairment or gastric perforation.
- c) Do CXR and AXR to assess level of upper pouch and to confirm then presence of gas below the diaphragm (i.e. distal fistula present)
- d) Look for VACTERL anomalies and investigate appropriately. VACTERL = Vertebral, anal, cardiac, tracheal, esophageal, renal, limb anomalies.
- e) If patient's abdomen is distended, it is a surgical emergency. Gastric distention can cause 1) cardiac arrest due to pericardial compression and 2) reflux into the trachea with acute life-threatening pneumonitis.
- f) An echocardiogram is required in all patients to determine whether the child has congenital cardiac anomalies and to ascertain if there is a right or left aortic arch. This helps determine which side a thoracotomy is to be performed.

2. Intestinal obstruction:

- a) Causes for intestinal obstruction in infants differ from those in older children. The common causes of obstruction are intestinal atresias, Hirschsprung's Disease, meconium ileus, and malrotation. There are several points to emphasize which are common to all infants with intestinal obstruction.
- b) BILIOUS EMESIS IN AN INFANT DENOTES DUODENAL OBSTRUCTION AND ISCHEMIC BOWEL FROM A MIDGUT VOLVULUS UNTIL PROVEN OTHERWISE.
BILIOUS EMESIS IN AN INFANT IS A SURGICAL EMERGENCY.
- c) All infants require an adequate IV and a nasogastric tube when intestinal obstruction is suspected.
- d) On plain films, the newborn colon cannot be distinguished from small bowel because haustral markings are not yet detectable. Only by filling the colon with contrast agent can the dilated loops be accurately identified as colon or small bowel.

a. Intestinal atresia:

- a) Occurs in the following order of frequency:
 - jejunoileal
 - duodenum
 - colon
 - pylorus
- b) A careful antenatal history usually reveals polyhydramnios. Prenatal ultrasound diagnosis of dilated stomach and/or duodenum may be indicative of duodenal atresia (fluid double bubble).
- c) Abdominal distention is seen in most newborns with bowel atresia, although it may be minimal or absent with the more proximal atresias. Vomiting usually occurs within the first 48 hours of life. Emesis is bilious except in pyloric atresia and very proximal duodenal atresia.
- d) Plain films of the abdomen should be obtained in all cases. The **double bubble** of duodenal atresia is pathognomonic and no contrast study is indicated. When multiple loops of dilated bowel are seen, suggesting a distal atresia; a contrast study is mandatory.

- e) A contrast enema is helpful to identify a microcolon which is a highly reliable finding for small bowel obstruction and to ensure patency of the colon.
- f) Up to 1/3 of children with duodenal atresia have trisomy 21. Also 1/3 of these children may have complex cardiac anomalies. Therefore, all infants with duodenal atresia require a cardiology evaluation prior to operation.

b. Hirschsprung's Disease:

- a) Hirschsprung's Disease (congenital aganglionic megacolon) is a frequent cause of neonatal intestinal obstruction. In this disease there is an absence of ganglion cells that leads to ineffective conduction of peristalsis resulting in a functional obstruction. The aganglionic segment may be limited to the rectosigmoid or extend more proximally to involve the entire colon.
- b) Symptoms are non-specific and include episodic abdominal distension, constipation, obstipation or diarrhea. Symptoms specific to the newborn are the failure to pass meconium in the first 24-48h after birth.
- c) A contrast enema, which should be obtained in all cases, may show a transition zone at the narrowed rectum with a dilated colon proximally. However, this finding is often absent in infants.
- d) The diagnosis is confirmed by suction mucosal rectal biopsy or full thickness rectal biopsy showing an absence of ganglion cells and hypertrophied nerves in the myenteric plexus of the muscularis layer. There is increased acetyl cholinesterase in the aganglionic rectum. The presence of ganglion cells rules out Hirschsprung's disease.
- e) Hirschsprung's may be managed with rectal irrigations (some patients with distal transition zones) or a temporary colostomy above the aganglionic segment. The colostomy is usually made at the transitional zone between the normal and aganglionic bowel.
- f) A pull-through procedure is usually performed either in the first 6-8 weeks of life as a primary procedure or when the baby is thriving following a colostomy (i.e. 3-6 months of age).

c. Meconium Ileus:

- a) Meconium ileus occurs in about 15% of infants with cystic fibrosis. The incidence of cystic fibrosis in the Caucasian community ranges from 1 in 1150 to 1 in 2500 live births. It is extremely rare in non-caucasian communities, except for a known mutation prevalent in our Hispanic population. Males and females are equally affected.
- b) The diagnosis is suspected in the infant who develops generalized abdominal distention, bilious vomiting, and failure to pass meconium in the first 24 to 48 hours. A family history of cystic fibrosis is not uncommon, and there is a maternal history of polyhydramnios in 20% of patients.
- c) The meconium may be palpable as a doughy substance in the dilated loops of distended bowel. The anus and rectum are typically narrow.
- d) Plain film of the abdomen demonstrates bowel loops of variable size with a soap bubble appearance of the bowel contents. Calcifications on the abdominal film usually indicate meconium peritonitis resulting from an intrauterine intestinal perforation. Microcolon is a highly reliable finding for distal bowel obstruction, which may be intraluminal from inspissated meconium or atresia due to uterine volvulus. A contrast enema demonstrates a microcolon with inspissated meconium proximally.
- e) The initial treatment is nonoperative – contrast enemas. Under fluoroscopic control contrast is infused into the rectum and colon through a catheter. This usually results in a rapid passage of semi-liquid meconium which continues during the next 24 to 48 hours. Follow up KUB's are taken at 12 and 24 hours to evaluate progress. Multiple gastrografen enemas are frequently required.
- f) Operation is indicated in meconium ileus if the gastrografen enema fails to relieve the obstruction, if there are calcifications in the abdominal cavity, if the infant appears too ill to delay operation, or if the diagnosis of meconium ileus is in doubt.
- g) All infants diagnosed with meconium ileus require the gold standard, a sweat test (100% accuracy) to confirm the diagnosis of cystic fibrosis. This test is usually not practical prior to operation since the child has to be at least 2kg or > 72 hours in age. Genetic testing can confirm CF, but is only 80-90% sensitive because it looks for only the most common genetic mutations and new mutations appear all the time.
- h) Postoperatively all infants require vigorous pulmonary therapy. When oral feedings are begun a pancreatic enzyme preparation is given with each feeding, starting at 1 capsule every 4 hours.

d. Malrotation:

BEWARE OF THE INFANT WHO VOMITS BILE!

- Malrotation is an important cause of intestinal obstruction in infants and must be considered in every infant with bilious emesis. In classic malrotation, the duodenal sweep is not present; rather, the duodenum stays to the right of midline and corkscrews down; the cecum may be midline; the duodenum is anterior and/or lateral to the SMA. Ladd's bands are fibrous attachments from the retroperitoneum to the cecum which may partially obstruct the duodenum. The absence of a ligament of Treitz coupled with a midline cecum results in a narrow vascular pedicle, which predisposes the bowel to volvulus following normal peristalsis.

- Clinical Findings: Most present in first month of life (>50%), 30% present in first week. 95% have vomiting which becomes bilious (i.e., green). Bloody emesis is due to gastritis. Bloody stools are due to necrosis. Infants often are acutely ill. Plain x-rays may reveal either a gasless abdomen, dilated intestine suggesting SBO, or duodenal obstruction with a double bubble or normal findings. If uncertain, get UGI to look for position of the ligament of Treitz.

- **Midgut volvulus is one of the most serious emergencies seen in the neonate or infant, and delay in diagnosis can result in loss of the entire midgut, which is uniformly fatal.**

•Sudden onset of bilious emesis is the primary presenting sign. Abdominal distention is common, but may be absent. Abdominal tenderness varies.

•Plain films of the abdomen are variable, and a definitive diagnosis requires a contrast study. An upper GI is the preferred study and should be done in almost all cases. With shock or a clear indication for exploration, these contrast studies may be dispensed with.

If obtained, these studies should be done emergently, because a few hours may be the difference between a reversible condition and loss of the entire midgut.

•OPERATION: NGT, IV Hydration, OR. NO DELAYS. Ladd's Procedure.

•LATE PRESENTATION OF MALROTATION: Symptoms may occur in childhood to adults. Most have vague chronic symptoms, but 10-14% may have acute volvulus. Up to 30% may have intermittent vomiting (bilious), and colicky abdominal or recurrent partial SBO. Some have malabsorption and FTT.

e. Omphalocele and gastroschisis:

a) Omphalocele is a central abdominal wall defect at the site of the umbilical ring. The eviscerated contents are covered by a sac consisting of a translucent avascular membrane composed of peritoneum, Wharton's jelly and amnion. Gastroschisis is a smooth-edged abdominal wall defect located adjacent to (usually to the right of) a normal umbilical cord. The eviscerated contents are uncovered.

b) The sac or exposed intestines should be covered with warm saline soaked sponges, followed by a barrier-type dressing.

This can be Steri-drape, Lahey or Linton bag, or Saran wrap to decrease evaporative loss from the moist dressing. A large circumferential dressing is used last. Gauze bandages tend to stick to the bowels and can injure the bowels when removed.

c) With gastroschisis in particular, it is essential that the bowel be supported, usually with the baby on its side with the bowel supported by towels, to prevent angulation of the bowel and its mesentery with consequent bowel ischemia.

d) Gastrointestinal decompression with an NG tube is imperative to minimize further gastrointestinal distention and prevent the aspiration of gastric contents. A rectal irrigation should be done to evacuate meconium.

e) Systemic intravenous antibiotics (Ampicillin/gentamicin) are given to protect contaminated amnion and/or viscera. Infection can be a devastating problem if a mesh closure is necessary.

f) Intravenous hydration with balanced salt solution is essential.

g) Rule out associated anomalies, particularly in neonates with omphalocele. Omphalocele is associated with midline anomalies such as cardiac (get ECHO), renal (get renal U/S

postoperatively), chromosomal (trisomy 13, 18, 21), Beckwith-Wiedemann (large tongue, gigantism, hypoglycemia), and Down's. Look for imperforate anus. Gastroschisis is associated with intestinal atresia.

h) If a silo is necessary to accommodate viscera, then it is imperative that the silo be supported (attached to isolette above) to prevent it from falling to the side of the baby, which would kink the blood supply to the intestine

3. Necrotizing enterocolitis (NEC):

a) Highly lethal disease primarily seen in premature and/or low birth weight newborn infants. Characterized by ischemic necrosis of the gastrointestinal tract.

b) The time of onset is usually between the second and fifth day of life. The great majority of the infants will have been fed prior to onset of the disease. The most outstanding clinical feature is bloody diarrhea. Poor feeding, apneic spells, lethargy, abdominal distention, prolonged gastric emptying and bile-stained emesis characterize the disease.

c) Etiology: The basic mechanism appears to be circulatory ischemia, which results from a stress-induced reflex causing redistribution of blood away from the mesenteric, renal, and peripheral vasculature and towards the heart or the brain. Subsequently, there is invasion of the damaged tissue by bacteria. Prior feeding appears to be a significant factor. It appears that *injury to the mucosa, bacteria, and feedings* are three important factors in the development of the disease.

d) Pathology: The ileum, cecum, and right colon are the most common sites of involvement. The bowel becomes dilated, hemorrhagic and necrotic. Microscopically, the earliest finding is coagulation necrosis. With increasing severity there is mucosal ulceration, submucosal hemorrhage, and eventual necrosis of the entire bowel wall. A mononuclear infiltrate is present.

Gas is found in the submucosa and subserosa. Thrombosis of major mesenteric arteries and veins is not present. Small blood vessels may be thrombosed, compatible with the intravascular coagulation and hemorrhagic state (frequently seen terminally).

e) Radiology: Since the clinical presentation is often nonspecific, radiography is important in early diagnosis, in addition to evaluation of progress and detection of early and late complications.

The main findings are dilated bowel, intramural gas (pneumatosis), portal venous gas and pneumoperitoneum.

•Dilatation: This is the earliest and most common sign.

•Intramural gas (Pneumatosis): In the proper clinical setting, this finding confirms the diagnosis. However, the amount of gas is not related to the severity of the disease, and it may disappear within 12 hours. Disappearance is not necessarily related to improvement.

•Portal venous gas: Not as early a sign as intramural gas. Those infants with portal vein gas are usually, but not always, more severely affected. As with pneumatosis, it may appear and disappear rapidly and its disappearance is not always associated with clinical improvement.

f) Treatment: Because there is evidence NEC is infectious in nature, both prevention and therapeutic regimens are directed toward the control of microbiologic agents.

•NPO, NG suction, broad-spectrum antibiotics (i.e. Ampicillin and Gentamicin) for 14 days empirically.

•Obtain KUB and left lateral decubitus films q6-8h and review with the radiologist.

•Serial CBC, platelet count, blood pH, electrolytes.

•Routine ID control measures, such as gown-glove, isolation, and good hand washing.

h) Indications that surgical intervention may be necessary:

•Pneumoperitoneum - most sensitive film is left lateral decubitus

•Abdominal wall cellulitis - Mass palpated on abdominal exam on exam

• Failure to respond to medical therapy / severe hemodynamic instability

•Persisting isolated dilated loop of bowel.

4. Congenital Diaphragmatic Hernia (CDH):

Overview:

- The incidence of congenital diaphragmatic hernia is estimated to be between 1 in 2000 and 1 in 4000 live births.
- The treatment protocol for congenital diaphragmatic hernia has recently undergone several changes designed to favor delayed surgical repair of the defect and to minimize iatrogenic barotrauma from excessive ventilation. During the initial stabilization period the child receives moderate levels of ventilatory support.
- Respiratory: Intubation, $FI_{O_2} = 100\%$, PIP enough to move chest but in general $< 30 \text{ cmH}_2\text{O}$, PEEP=0-3 $\text{cm H}_2\text{O}$, IMV 30-40.
- Tubes/Lines: UA line is placed to monitor postductal ABG's if desired and right radial line or pulse oximetry is placed to monitor preductal ABG's or O_2 saturation. NG tube is essential to prevent gaseous distention of the intestinal contents in the chest and must be functioning properly. IV: D10W plus electrolytes at maintenance.
- ABGs: Preductal $pO_2 > 60-90$ or preductal $SaO_2 > 90\%$, $pH > 7.25$. Ideally, aim for preductal $pO_2 > 60$ and $pH > 7.25$. However, watch for metabolic acidosis particularly in the setting of a mismatched preductal and postductal O_2 , since this situation demonstrates that O_2 delivery is poor. If there is no preductal ABG, then $O_2 \text{ sat} > 90\%$ is acceptable, since a $pO_2 > 60$ corresponds to $O_2 \text{ sats} > 90\%$. Give NaHCO_3 1-2mEq/kg for acidosis only.
- Drugs: Fentanyl 10mcg/kg/dose only if necessary for performing procedures.
- Other: Maintain temperature, check calcium, check blood glucose, and transport to Children's Hospital as soon as possible. Do not hyperventilate and risk creating barotrauma. Watch for a pneumothorax on the contralateral side.

Remember, barotrauma kills CDH babies.

Drugs: Minimize sedation

- Fentanyl 1-2 mcg/kg given by IVP or by continuous infusion **only** if patient is agitated.
- Systemic antibiotics begun.
- Dopamine or Dobutamine necessary for blood pressure support. If epinephrine becomes necessary the situation must be re-evaluated.

h) CDH Protocol:

- Conventional mechanical ventilation (CMV) on SIMV (neonatal pressure support) with minimal sedation. As previously mentioned, attention towards **avoiding barotrauma** by limiting peak airway pressures to 25-30 **is essential**.
- High frequency ventilation (oscillator) if patient fails CMV.
- Timing of surgical repair is dictated by clinical course. These infants require frequent physical exams.

Guidelines: $F_{I_{O_2}} < 40-50\%$

PIP < 25

Rate 30-40

No requirement for pressors

VIII. Pediatric Trauma

McMaster Children's Hospital is the Regional Pediatric Trauma Center for LHIN 3 & 4.

The pediatric trauma team will be called either by the emergency department or by the Trauma Team Leader (TTL) when a call is received about an injured child being en route. **After receiving a trauma page you should proceed immediately to the ER.** The guidelines are to adopt an 'overcall policy', in other words to call more frequently than perhaps needed as consequences of injuries are hard to predict with children.

You should not accept trauma referrals. All trauma referrals should be directed to the TTL. Please ask the referring physician to contact paging or Criticall and they will contact the Pediatric TTL.

If you are on call and receive a pediatric trauma team page you will see a number of possible codes.

Pediatric trauma team *2 = that the child is coming in (usually by ambulance) within 6 to 15 minutes (you need to proceed to the ER in 5 minutes).

Pediatric trauma team *1 = that the child is coming in five minutes or less (you need to proceed to the ER immediately).

Pediatric trauma team *0 = that the child is in the emergency department (you need to proceed to the ER immediately).

For the pediatric residents covering Pediatric General Surgery or for General surgery residents taking home call: When you receive a trauma page you are to immediately page the Pediatric Surgery Fellow and the in house General Surgery resident to inform them a trauma is arriving or has arrived.

Composition of the Pediatric Trauma Team:

- Trauma team Leader
- Pediatric Surgery Resident +/- Fellow
- Senior Pediatric Resident
- Anesthesia Resident
- ER Nursing staff X 2
- Respiratory Therapist X 2
- Radiology Technician
- (Social worker, Childlife, Healthcare aid, SAC coordinator)

Roles and Responsibilities:

The Trauma Team Leader (TTL):

Emergency Room Physician acts as the TTL until the on call TTL arrives (20 minutes or less). In sequence these two individuals are responsible for the supervision of the total management of the patient and co-ordination of the activation of various specialty services consulting on the patient's care.

- Directs the resuscitation.
- Supervises the individual completing the primary survey, including immobilization of the C-spine during transfer of the patient onto the ED stretcher.
- Will establish the priority of diagnosis and define the order of therapy.
- Directs and helps to perform the secondary survey once the initial resuscitation is completed.
- Responsible for direct orders to physicians and nurses during the resuscitation. May also reassign personnel roles as needed.
- Conveys all anticipated plans to the team.
- Requests additional physicians/service consults.
- Orders diagnostic tests, procedures and medications.

- Speaks with the family of the patient following the resuscitation.
- Documentation Responsibilities
- Documents course of resuscitation on the Physician Trauma Assessment Form.
- Determines the final disposition of the patient and MRP.

Surgical Resident:

Your role in the trauma is to participate in the initial assessment and management of the patient as instructed by the TTL and as outlined by the ATLS guidelines . Your focus is to help coordinate the surgical aspects of care. Whether you have done the ATLS course or not you will have timely backup from the pediatric general surgeon as well as the pediatric general surgery fellow.

- Goes directly to the ED when pediatric trauma page is activated.
- Performs invasive procedures such as vascular access, chest tube placement as directed by the TTL.
- Assures placement of NG tube, Foley catheter if needed.
- Follow-up on Investigations post resuscitation (CT scan, etc)
- Contact the pediatric Surgeon on call and write, and dictate, a consult note for the attending Pediatric Surgeon.
- Please assign a pediatric trauma score and Glasgow coma score in your assessment note.

Management of the Pediatric Trauma Patient:

Primary Survey:

AIRWAY (with C-spine precautions)

BREATHING

CIRCULATION

DISABILITY (Brief neurologic exam, GCS)

EXPOSURE

Remove all clothing

Keep in mind thermoregulation

May use heat lamps, bear hugger and warm IV fluids

IV Access

- Two “large” bore IV’s if possible.
- Use NS or LR for all trauma patients.
- May insert intraosseous needle into tibia if unable to place peripheral or central IV’s.
- IV Catheter:
 - Infant 20-22 g.
 - Young Child 18-20 g.
 - Older Child 16-18 g.

Fluids

- 20 ml/kg of NS or LR bolus (warmed fluid if possible)
- May repeat if necessary
- If no response to second bolus may transfuse with blood
- Transfusion- 10 ml/kg PRBC’s (Type specific or O negative)

Approximate Measurements

- Weight (kg) = 3(Age in yrs) +7
- Systolic BP = 2 (Age in yrs) + 80

Secondary Survey:

- AMPLE history (Allergies, Medications, Past History, Last meal, Events)
- Head to toe examination for specific injuries (including the back)

Blood work

- All patients have a CBC, amylase, and Type & Hold.
- Additional blood tests can be ordered as necessary.

NG Tubes

- NG tubes are placed in selected patients with thoracic or abdominal injury.
- **DO NOT** place an NG tube if there is a possibility of oropharyngeal trauma or skull fracture.
- An OG tube is placed if facial fractures or a basilar skull fracture is suspected.
- NG:

| | |
|--------|--------|
| Infant | 8 Fr. |
| Child | 10 Fr. |

Thoracostomy Tubes

| | |
|------------|-----------|
| Neonate | 10-12 Fr. |
| 6 m-18 m. | 12 -14Fr. |
| 1-3 yr. | 16-20 Fr. |
| 4-7 yr. | 20-24 Fr. |
| 8 12 yr. | 28-32 Fr. |
| Adolescent | 28-40 Fr. |

ETT Size

| | |
|-----------|----------------------------|
| Preemie | 2.5 - 3.0 mm ID |
| Newborn | 3.5 mm |
| 13 months | 4.0 mm |
| 2 years | 4.5 mm |
| > 2 years | {age (yrs)/4 } + 4 = mm ID |

$$\text{Tube length (cm)} = 12 \text{ plus age (yrs) } / 2$$

Radiology Sequence:

- Lateral C-spine (view C1-C7), CXR (AP), & AP pelvis in all patients
- Special studies (as indicated):
 - CT Scan (use oral contrast only when indicated)
 - Cystogram, Urethrogram
 - Arteriogram, etc

The cross-table C-spine X-ray need not be “cleared” prior to obtaining urgent films. The trauma team members will position all patients without C-spine clearance for subsequent X-rays (i.e. controlling the c-spine).

The final decision to discontinue C-spine immobilization will be made by the Trauma team leader in consultation with Radiology and Neurosurgery. It is expected that all patients return from radiology (CT, etc) with C-spine immobilization in place.

Children with obvious extremity fractures may require fracture X-rays within the resuscitation area if they are not stable for transport. Otherwise extremity and facial films should be obtained only after resuscitation and stabilization. *Only patients with abdominal crush mechanisms such as handlebar injuries or lap belt injuries should receive oral contrast prior to abdominal CT scan.*

Shock

- Children may maintain nearly normal vital signs even with severe hemorrhage.
- The primary response to hypovolemic shock in children is tachycardia.
- Hypotension is a **LATE** sign of shock in the injured child.
- Children may lose up to 40% of their total blood volume before becoming hypotensive.

Child Abuse:

The suspicion of child abuse must always be kept in mind when caring for injured children. Suspected abuse *must* be reported.

The following “red flags” will alert suspicion of child abuse:

- Failure to thrive, Delay in obtaining care
- Uninterested/absent caretaker
- Conflicting stories between parents/guardians
- History not consistent with injuries, previous injuries, etc.

PEDIATRIC TRAUMA SCORE (PTS)

| | +2 | +1 | -1 |
|--------------------|-----------|---------------------------------|----------------|
| size | >20kg | 10-20kg | <10 kg |
| airway | normal | maintainable with assistance | unmaintained |
| systolic BP | >90 mm | 50-90 | <50 |
| CNS | awake | obtunded | coma |
| open wound | none | minor | major |
| skeletal | none | closed | open/ multiple |

Add up the scores from the six categories max=12; min -6

GLASGOW COMA SCALE

Eye opening:

| | |
|---------------|---|
| Spontaneous | 4 |
| To loud voice | 3 |
| To pain | 2 |
| None | 1 |

Verbal response:

| | |
|-------------------------|---|
| Oriented | 5 |
| Confused, disoriented | 4 |
| Inappropriate words | 3 |
| Incomprehensible sounds | 2 |
| None | 1 |

Best motor response:

| | |
|----------------------------|---|
| Obeys commands | 6 |
| Localizes | 5 |
| Withdraws (flexion) | 4 |
| Abnormal flexion posturing | 2 |
| None | 1 |

MODIFIED GLASGOW COMA SCALE FOR INFANTS AND CHILDREN

Best eye response: (E)

4 - Eyes opening spontaneously

3 - Eye opening to speech

2 - Eye opening to pain

1 - No eye opening

Best verbal response: (V)

5 - Infant coos or babbles (normal activity)

4 - Infant is irritable and continually cries

3 - Infant cries to pain

2 - Infant moans to pain

1 - No verbal response

Best motor responses: (M)

6 - Infant moves spontaneously or purposefully

5 - Infant withdraws from touch

4 - Infant withdraws from pain

3 - Abnormal flexion to pain for an infant

2 - Extension to pain

1 - No motor response

Any combined score of less than eight represents a significant risk of mortality.

IX. APPENDICES

APPENDIX 1

Medications commonly used on the Pediatric Surgery rotation:

Always Triple-Check Pediatric Doses!

1) Antibiotics:

- a. Ancef 25-50 mg/kg/dose IV Q8H (50 mg/kg preop dose for line insertion)
- b. Flagyl 10 mg/kg/dose IV Q12H Max. 1 gm/day
- c. Gent 2.5 mg/kg/dose IV Q8-12H or **5mg/kg/dos Q24HRS** (Not to exceed 400mg) [**Not to be used in children with Renal Impairment**]
- d. Cefuroxime **30** (25-50)mg/kg/dose IV Q8H Max. 750 mg/dose
- e. Ampicillin 25-50 mg/kg/dose IV Q6H Max. 2 gm/dose
- f. Keflex 12.5 mg/kg/dose PO QID
- g. Clavulin
 - i. <40kg 10 mg/kg/dose PO TID
 - ii. >16 yrs 500 mg q 8hrs
- h. Clindamycin
 - i. PO: 10-20mg/kg/day divided q 6-8 hrs (Max dose 450 mg/dose)
 - ii. IV or IM: 25-40 mg/kg/day divided q 6-8 hrs (Max dose 900 mg/dose)
- i. Biaxin (clarithromycin) 7.5 mg/kg/dose PO q 12h (Max. 1 gm/day)
- j. Vancomycin 50 mg/kg/dose q8h (Max. 1 gm/dose)

1) Analgesics:

- a. Morphine is the preferred parenteral analgesic in children [NO Demerol]:
 - i. Infusion or PCA – as per protocol
 - ii. Individual dose - 0.1 mg/kg/dose Q3H +/- PRN
- b. Codeine 0.5 – 1.0 mg/kg/dose Q4H PRN
- c. Toradol 0.5-1.0 mg/kg/dose IV/PO Q4-6H +/- PRN [NB kidneys]

2) Laxatives and Bowel Prep:

- a. Golytely bowel prep: 20-30 ml/kg/hr by NGT for 6 hours/until clear
- b. Citro Mag 4 ml/kg/dose X 2-3 doses for bowel prep
- c. Colace:
 - a. 0-3 years 10-40 mg/day (divided Q8H)
 - b. 4-6 years 20-60 mg/day (divided Q8H)
 - c. 7-12 years 40-120 mg/day (divided Q8H)
- d. Lactulose 0.5cc/kg/dose BID PO
- e. Senekot 1-2 tabs or 1-2 tsp PO once daily
- f. PEG 3350 1 gm/kg up to 15 gm/day once a day (can push up to 25 gm/day)

1) Others:

a. Anti Emetic

Gravol 1.0-1.5 mg/kg/dose (max 50 mg) q4-6 hr PO or IV [avoid Stemetil, Compazine, and Maxeran]

Ondansetron : 0.15 mg/kg/dose q8h (Max. 8mg/dose)

- 4-11 yrs 4 mg PO TID

- >11 yrs 8 mg PO TID

H2- Blockers:

Zantac i. PO :2-5 mg/kg/dose BID

(Max. 300 mg/day)

ii. IV : 1-2.5 mg/kg/dose q6-8 h (Max. 50 mg q 6-8h)

iii. cont. infusion – initial – 1mg/kg/dose for 1 dose the 0.08-0.17 mg/kg/hr
or 2-4 mg/kg/day

PPI: Omeprazole : 1 (0.7-1.4) mg/kg/day OD or BID (Max. 40 mg/day)

<20kg : 10 mg PO OD

>20kg : 20 mg PO OD

Pantaloc : po/iv 1mg/kg q 24 hrs

Domperidone: 0.3 - 0.6 mg/kg/dose q6h

(1 ml = 1 mg)

5) ER Drugs:

Epinephrine 1:10,000 (0.1 mg/ml)

Dose: 0.1 ml/kg IV or IT, repeat q5min if needed.

Atropine (0.1 mg/ml)

Dose: 0.2 ml/kg IV or IT

Max dose infants & children = 1 mg

Max dose adolescents = 2 mg

Diazepam

1 mth – 5 yrs: 0.2-0.5 mg/kg IV q15-30 min (max dose 5 mg)

> 5 yrs: 0.2-0.5 mg/kg IV q15-30 min (max dose 10 mg)

Succinylcholine

1-2 mg/kg/dose IV (duration 10 min)

Pancuronium

0.1 mg/kg/dose IV (duration 1-2 hrs)

Ketamine

2-3 mg/kg/dose IV

APPENDIX 2

FACE SHEET COMPLETION

Accurate completion of the face sheet is essential for the hospital to obtain appropriate funding from the Ministry of Health. Each case is assigned a weighting based on age, diagnosis, complications and associated illnesses. The higher the weighting the more funding the hospital will receive.

It is important to list ALL the chronic conditions a patient has and all medical/surgical problems experienced while in hospital. It is not acceptable to simply list the single diagnosis the patient was initially admitted with.

Here is a list of the some of the more common diagnoses / complications / associated conditions that should be considered for inclusion on the face sheet.

- Fever
- Ileus
- Peritonitis
- Shortness of breath
- Urinary retention
- Post-op infection
- Electrolyte imbalance
- Malnutrition
- Drug reaction
- Anemia
- UTI
- Etc, etc

If you have any questions regarding the face sheet please ask the staff surgeon.

APPENDIX 3

EVIDENCE-BASED GUIDELINES FOR THE MANAGEMENT OF SPLEEN AND LIVER INJURIES

Injury Grading by CT Scan:

- Grade 1 – Minor subcapsular tear or haematoma
- Grade 2 – Parenchymal injury not extending to the hilum
- Grade 3 – Major parenchymal injury involving vessels and hilum
- Grade 4 – Shattered spleen

Guidelines for Resource Utilization in Children with Isolated Spleen or Liver Injury

| | I | II | III | IV |
|----------------------------|------|------|------|------|
| ICU Stay (d) | None | None | None | 1 |
| Hospital stay (d) | 2 | 3 | 4 | 5 |
| Pre-discharge Imaging | None | None | None | None |
| Post-discharge Imaging | None | None | None | None |
| Activity Restriction (wk)* | 3 | 4 | 5 | 6 |

*. The guidelines for return to unrestricted activity include “normal” age-appropriate activities. Return to full-contact, competitive sports should be at the discretion of the individual pediatric surgeon.

APPENDIX 4

Ten Commandments of Residency

1. Enjoy your residency.
2. See it yourself.
3. Do it now.
4. Be complete, double check.
5. Write it down.
6. Don't complain, fix it.
7. Delegate with discretion, you are still responsible.
8. Ask if you don't know.
9. Read about it.
10. Wash, wash, wash your hands.