Surgical complications of pediatric oncological surgery

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Surgical approaches – complications?!
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Content

- Definition/Classification
- Selected entities
- Prevention
- Management strategies
Classification of surgical complications

- Element of quality assessment
- Rarely used!, often only resection status given
- Comparability of surgical procedures/results
- Definition!
Negative outcome

- Failure to cure
- Sequelae
- Complications
Definition: Negative surgical outcomes

Complication: Any deviation from normal postoperative course (including asymptomatic events)
=> cardiac arrhythmia, hemorrhage,…

Sequela: “After-effect” of surgery inherent to the procedure
=> Walking impairment after limb amputation,…

Failure to cure: Purpose of surgery not achieved
=> tumor residual,…
Dindo/Clavien Classification

- Based on therapy used to treat complication (retrospective documentation)
- Pro and retrospective analyses
- Not relying on subjective appraisals
- Independent from varying definitions
- Validation of reproducibility and acceptability

Dindo/Clavien Classification

Complications Grade I

- Any deviation from normal postoperative course without the need for pharmacological treatment or surgical/endoscopic/radiological intervention
Dindo/Clavien Classification

Complications Grade I

- Any deviation from normal postoperative course without the need for pharmacological treatment or surgical/endoscopic/radiological intervention

- Allowed: antiemetics, antipyretics, analgetics, diuretics, electrolytes, physiotherapy

Dindo/Clavien Classification

Complications Grade I

- Any deviation from normal postoperative course without the need for pharmacological treatment or surgical/endoscopic/radiological intervention

- Allowed: antiemetics, antipyretics, analgetics, diuretics, electrolytes, physiotherapy

> Atelectasis requiring physiotherapy, transient serum creatinine elevation, wound infection treated on bedside

Dindo/Clavien Classification

Complications Grade II

- Requiring pharmacological treatment other than allowed for grade I
- Includes blood transfusion, TPN

Dindo/Clavien Classification

Complications Grade II

- Requiring pharmacological treatment other than allowed for grade I
- Includes blood transfusion, TPN

> Pneumonia treated with antibiotics, UTI requiring antibiotics, wound healing disorder with phlegmoneous infection

*Dindo, Ann Surg 2004; Clavien, Surgery 1992*
Dindo/Clavien Classification

Complications Grade III

- Requiring surgical/endoscopic/radiological intervention
  IIIa: Not under general anesthesia
  IIIb: Under general anesthesia

Dindo/Clavien Classification

Complications Grade III

- Requiring surgical/endoscopic/radiological intervention

  IIIa: Not under general anesthesia
  IIIb: Under general anesthesia

  - IIIa: Bilioma after liver resection requiring percutaneous drainage,
    Pneumothorax requiring drainage
  - IIIb: Ureteral stenosis requiring stenting, hemorrhage requiring re-operation,
    intestinal anastomotic leakage requiring relaparotomy

Dindo/Clavien Classification

Complications Grade IV

- Life threatening complication including CNS requiring IC/ICU management
  IVa: Single organ dysfunction
  IVb: Multiorgan dysfunction

Dindo/Clavien Classification

Complications Grade IV

- Life threatening complication including CNS requiring IC/ICU management

IVa: Single organ dysfunction

IVb: Multiorgan dysfunction

➤ IVa: Lung failure requiring intubation, renal insufficiency requiring dialysis

➤ IVb: Lung failure combined with renal insufficiency, renal insufficiency combined with hemodynamic instability

Dindo/Clavien Classification

Complications Grade V

- Death of patient

Suffix “d”

- Denotes disability after discharge => outcome, surveillance! (cardiomyopathy, hearing disorders,…)
Dindo/Clavien Classification

Summary

- Simple, objective, and reproducible approach for comprehensive outcome assessment
- Applicable irrespective of individual variations
- Usable for all procedures/anatomical areas
- Evaluation and comparison of outcomes among different study populations (surgeons, centers, therapies)
Complications in selected tumor entities
Complication rates of pediatric tumor surgery

- Neuroblastoma: 8.7 – 34.8%
- Nephroblastoma: 8 – 25%
- Hepatoblastoma: 9 – 23%
- Sarcoma (RMS): 9.8 – 28.5%

Complications Neuroblastoma

- Gross total resection (GTR) ↔ overall survival
- Tumor resectability ↔ tumor relapse
- IDRF-based staging system ↔ INSS
- Complications higher in GTR patients

Intraoperative bleeding (midline neuroblastoma)
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Intraoperative bleeding (midline neuroblastoma)
Complications Stage IV Neuroblastoma

- Overall 35%
- 74% grade I, 3% grade IIa, 22% Grade IIib, 1% grade IVb
- GTR in 94% of patients despite IDRF
- Preservation of kidneys (nephrotoxic treatment)

Complications Stage IV Neuroblastoma

- Most common: Renal/polar atrophy, hydronephrosis, GI disorders
- Grade III/IV: GI, kidneys, vascular, abscess
- Morbidity comparable to overall NB results
- IDRF should not preclude GTR in high risk NB

Complications Nephroblastoma

- Preop chemotherapy
  => tumor shrinking, less ruptures, stage distribution
- Pretreated: 8-10%, primary operated: 20-25%
- Tumor rupture: up-staging, treatment intensification
- (Small bowel obstruction after chemotherapy)

Complications unilateral Nephroblastoma (SIOP 93-01/GPOH)

Fuchs, Ann Surg 2009
Complications unilateral Nephroblastoma (SIOP 93-01/GPOH)
Complications Hepatoblastoma

- Hemorrhage, biliary leakage, tumor rupture,…
- Intra-/ early postoperative mortality
- Tumor shrinkage through neoadjuvant chemotherapy
- Postoperative complications! (pleural effusion, ascites, GI disorders, bile duct disorders,…)
- SIOPEL 1: morbidity 18%, intraop mortality 5%, biopsy complications 7%

Biliary leakage (HB, mesohepatectomy)

- 4-year old boy, central HB, PR after chemo-Tx
- Mesohepatectomy, no intraoperative complications
- Postoperative bile leakage, conservative treatment unsuccessful
Biliary leakage (HB, mesohepatectomy)

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Biliary leakage (HB, mesohepatectomy)

- Further course: Bile leakage stopped after 8 days
- Stent removed after 6 weeks via endoscopy
- NED after 11 months follow up
Complications Bladder/prostate-Rhabdomyosarcoma

- Secondary surgery: 29%
  => Bowel perforation, intestinal fistula, abscess, ileus, UTI, hemorrhage, ureteral stenosis, peritonitis, erectile dysfunction, neurogenic bladder,…
- Complication rates 2.5% higher without biopsy
- Late complications in up to 54% (but! radiation…)

Seitz, Pediatr Blood Cancer 2011; Cechetto, Cancer 2007; Spunt, JCO 2005
Selected aspects of prevention
Prevention of surgical complications

- Patient selection
- Diagnostic workup
- Operation planning
- Surgical strategy
- OR-preparation
- …
Indication as element of complication prevention

- Example: 3.5-year old boy with multilocular stage IV hepatoblastoma
- Thrombus IVC, right HV
- PR after neoadjuvant chemotherapy, Lung mets cleared
- Extended resection ⇐ Primary transplantation
Indication as element of complication prevention
Indication as element of complication prevention

Procedure:
- LRLTx (Seg. II, III)
- No surgical complications
- ICU 5 days, hospital stay 21 days
Reduction of surgical treatment intensity

Pre-/ intraoperative labeling of lung metastases
Preop/intraop CT-guided labeling
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Management of selected surgical complications
Vascular stenosis (midline neuroblastoma)

- 3-year old boy, midline NB stage III
- Chemotherapy + irradiation (dose?)
- Intraoperative subtotal laceration of left renal artery
- Autotransplantation of left kidney
- Postoperative stenosis of both art. ren.

=> Interventional treatment
Vascular stenosis (midline neuroblastoma)
Vascular stenosis (midline neuroblastoma)

- 3-year old boy, midline NB stage III
- Chemotherapy + irradiation (dose?)
- Intraoperative subtotal laceration of left renal artery
- Autotransplantation of left kidney
- Postoperative stenosis of both art. ren. => Intervention

Postoperative course:
- Increasing failure right kidney, nephrectomy (r) after 10 months
- Outcome: NED, normal renal function (5y1m)
Nerve reconstruction/replacement

- 11-year old girl, Desmoid-tumor relapse proximal Ulna with infiltration of ulnar nerve

- Preoperative significant loss of ulnar nerve function

- En-bloc resection of tumor and nerve with interposition using sural nerve
Nerve reconstruction/replacement

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Nerve reconstruction/replacement

- En-bloc resection of tumor and nerve with interposition using sural nerve
Nerve reconstruction/replacement

- Outcome: Near-total restoration of nerval function, NED after 3.5 years follow-up
Advanced pediatric surgical oncology is regularly associated with a relevant surgical morbidity.

Classification of complications should be performed in any analysis of surgical procedures.

A complete prevention of surgical events is unrealistic. However, the extension of surgical complications can be limited through distinct measures.

The consequent, target-oriented, and rapid management of surgical complications is essential for achieving the best possible outcome.

As for pediatric oncology in general, the treatment of surgical complications requires an interdisciplinary approach.
Only to those that do nothing, nothing will happen…
4th World Congress of Pediatric Surgery (WOFAPS)
October 2013, Berlin, Germany
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Survival stage IV Neuroblastoma

- Local control and overall survival correlate with GTR in high risk-NB
- Encasement of major vessels does not preclude GTR

Preop/intraop CT-guided labeling

- No. of patients: $n = 6$
- Preop/intraop: $n = 4/2$
- Age at surgery: $8.5 \text{y} (4.3-15.5)^*$ (*median, range)
- $R_0$ after surgery: $n = 6$
- Complications: ./.
Pyelon resection and reconstruction in central BWT

Fuchs, J Urol 2011
Management of renal remnant

Area of bipolar coagulation
Area of selective vascular suturing
Reconstruction of renal pelvis

Fuchs, J Urol 2011
LPN in a 2.9 year-old boy

Fuchs, J Urol 2011
Results - complications

- Urinary leakage \( n = 2/6 \)
  - Re-operation \( n = 1 \)
  - CT-guided drainage \( n = 1 \)

- Blood transfusion \( 11.9 \ (0-33.3) \text{ ml/kg} \)
- FFP \( 21.9 \ (9.3-38.9) \text{ ml/kg} \)

Fuchs, J Urol 2011