Rok v přehledu – co jsme nestihli letos ještě přečíst

Dětská anestezie a intenzivní péče

Michal Fedora
KDAR LF MU a FN Brno
Cardiac arrest in anesthetized children: recent advances and challenges for the future

Jeffrey P. Morray

Pediatric Anesthesia 21 (2011) 722–729

Summary

Over the past 50 years the incidence of anesthesia-related cardiac arrest has declined, despite increased patient co-morbidities, the most significant determinant of anesthetic risk. Multiple factors have contributed to this improvement including safer anesthetic agents, better monitoring devices and the development of a specialized pediatric environment. Provider skill has benefitted from improved training and recognition of high-risk situations. Further improvements will depend on international, multispecialty efforts to standardize terminology and analyze large numbers of these infrequent adverse events.
<table>
<thead>
<tr>
<th>Author</th>
<th>Country</th>
<th>Year</th>
<th>Definition anesthesia-related arrest</th>
<th>Age (years)</th>
<th>Cardiac arrests/10 000 anesthetics</th>
<th>Mortality/10 000 anesthetics</th>
<th>Common etiologies</th>
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<tbody>
<tr>
<td>Beecher 1</td>
<td>US</td>
<td>1954</td>
<td>Directly responsible/important contributor</td>
<td>&lt;11</td>
<td>14</td>
<td>3.7</td>
<td>Anoxia aspiration</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All</td>
<td></td>
<td></td>
<td>Anesthetic overdose</td>
</tr>
<tr>
<td>Rachow 2</td>
<td>US</td>
<td>1961</td>
<td>Same as Beecher</td>
<td>&lt;1</td>
<td>13.9</td>
<td>2.9 (all ages)</td>
<td>Failure to ventilate, Hypoventilation</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1–12</td>
<td>4.3</td>
<td></td>
<td>Anesthetic overdose</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&gt;12</td>
<td>3.9</td>
<td></td>
<td>Halothane overdose</td>
</tr>
<tr>
<td>Keenan 3</td>
<td>US</td>
<td>1985</td>
<td>Due solely</td>
<td>&lt;12</td>
<td>4.7</td>
<td>1.6</td>
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<td>Olsson 4</td>
<td>Sweden</td>
<td>1988</td>
<td>Cannot be excluded as cause</td>
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<td></td>
<td>1–9</td>
<td>4.6</td>
<td></td>
<td>Anoxia aspiration</td>
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<tr>
<td>Tret 5</td>
<td>France</td>
<td>1988</td>
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<td>19</td>
<td>0</td>
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<td></td>
<td></td>
<td></td>
<td>1–14</td>
<td>2</td>
<td>0.3</td>
<td>Halothane anaphylaxis arrhythmia</td>
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<tr>
<td>Cohen 6</td>
<td>Canada</td>
<td>1990</td>
<td>Not defined</td>
<td>&lt;1 month</td>
<td>28</td>
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<td>Airway obstruct, laryngo-spasm</td>
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<td></td>
<td></td>
<td></td>
<td>&lt;1</td>
<td>12</td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>&gt;1</td>
<td>3.5</td>
<td></td>
<td></td>
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<tr>
<td>Morray 7</td>
<td>US</td>
<td>2000</td>
<td>Contribut in any way</td>
<td>0–18</td>
<td>1.4</td>
<td>0.36</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&gt;1</td>
<td>3.5</td>
<td></td>
<td>Hypovolemia, blood loss</td>
</tr>
<tr>
<td>Braz 8</td>
<td>Brazil</td>
<td>2006</td>
<td>Totally or partially</td>
<td>&lt;1 month</td>
<td>28</td>
<td>0</td>
<td>Unable to intubate/ventilate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;1</td>
<td>12.7</td>
<td></td>
<td>Halothane, blood loss</td>
</tr>
<tr>
<td>Flick 9</td>
<td>US</td>
<td>2007</td>
<td>Attributed</td>
<td>0–18</td>
<td>0.65</td>
<td>0.21</td>
<td>Failure to intubate</td>
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<tr>
<td>ASA physical status</td>
<td>Rate of serious complications per 10 000 anesthetics*</td>
<td></td>
<td></td>
<td></td>
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<td>1</td>
<td>4</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>34</td>
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<td>3</td>
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<td></td>
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<td></td>
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<tr>
<td>4–5</td>
<td>164</td>
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</table>

* $P < 0.001$. 
### Table 3  Multivariate analysis of predictors of mortality

<table>
<thead>
<tr>
<th>Factor</th>
<th>Odds ratio</th>
<th>95% confidence intervals</th>
<th>Estimated coefficient</th>
<th>P value</th>
</tr>
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<tbody>
<tr>
<td>American Society of Anesthesiologists</td>
<td>12.99</td>
<td>2.9–57.7</td>
<td>2.56</td>
<td>0.007</td>
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<tr>
<td>physical status 3–5</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Emergency surgery</td>
<td>3.88</td>
<td>1.6–9.6</td>
<td>1.35</td>
<td>0.0036</td>
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</tbody>
</table>
Faktory, které snižují incidenci zástavy oběhu spojených s anestezií

Bezpečnější anestetika

Monitorace

Pediatriký anesteziolog
Faktory, které snižují incidenci zástavy oběhu spojených s anestezií

Bezpečnější anestetika

Halotan → Sevofluran
Faktory, které snižují incidenci zástavy oběhu spojených s anestezií

Monitorace

Pulsní oxymetrie
Detekuje desaturaci lépe než zkušený anesteziolog

Kapnografie
Detekuje extubaci, obstrukci ET...

Respirační příčiny → CV příčiny
Faktory, které snižují incidenci zástavy oběhu spojených s anestezíí

Pediatričtý anesteziolog
Faktory, které snižují incidenci zástavy oběhu spojených s anestezií

Pediatrický anesteziolog (rozeznání rizikových situací)

- Původně nezralý novorozenec
- Hypovolemie (krevní ztráty)
- Reaktivní dýchací cesty
- Onemocnění srdce
- Zajištění CVK
<table>
<thead>
<tr>
<th>Anesthesia-related factor</th>
<th>% of hypovolemia-related arrests(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underestimation of blood loss</td>
<td>48</td>
</tr>
<tr>
<td>Inadequate peripheral venous access</td>
<td>22</td>
</tr>
<tr>
<td>Central venous pressure catheter not present or not transduced</td>
<td>22</td>
</tr>
<tr>
<td>Arterial catheter not present or malfunctioning</td>
<td>17</td>
</tr>
<tr>
<td>Underestimation of pre-existing hypovolemia or anemia</td>
<td>13</td>
</tr>
<tr>
<td>Not enough help available to treat blood loss</td>
<td>13</td>
</tr>
<tr>
<td>Delay in getting blood from blood bank</td>
<td>13</td>
</tr>
<tr>
<td>Hypocalcemia not appreciated or undertreated</td>
<td>13</td>
</tr>
<tr>
<td>Development of coagulopathy</td>
<td>9</td>
</tr>
</tbody>
</table>
Reaktivní dýchací cesty

Incidence laryngospasmu: 1 – 2%
0 – 3 měs, infekce HDC, op. výkon na DC

Onemocnění srdce

Aortální stenosa (mortalita 62%)
Kardiomyopatie (mortalita 50%)

Zajištění CVK

Pneumothorax, hemothorax
Anesthesia-Related Cardiac Arrest in Children with Heart Disease: Data from the Pediatric Perioperative Cardiac Arrest (POCA) Registry

Chandra Ramamoorthy, MD,* Charles M. Haberkern, MD, MPH,† Sanjay M. Bhananker, MD,† Karen B. Domino, MD, MPH,† Karen L. Posner, PhD,† John S. Campos, MA,†† and Jeffrey P. Morray, MD§

BACKGROUND: From 1994 to 2005, the Pediatric Perioperative Cardiac Arrest Registry collected data on 373 anesthesia-related cardiac arrests (CAs) in children, 34% of whom had congenital or acquired heart disease (HD).
Figure 1. Causes of anesthesia-related cardiac arrest associated with heart disease \((n = 127)\) versus nonheart disease \((n = 245)\). 
\(* P = 0.03, ** P = 0.01.\)
# Anesthesia-Related Cardiac Arrest in Children with Heart Disease: Data from the Pediatric Perioperative Cardiac Arrest (POCA) Registry

Chandra Ramamoorthy, MD,* Charles M. Haberkern, MD, MPH,† Sanjay M. Bhananker, MD,† Karen B. Domino, MD, MPH,† Karen L. Posner, PhD,† John S. Campos, MA,† † and Jeffrey P. Morray, MD§

<table>
<thead>
<tr>
<th>Mortalita</th>
<th>HD</th>
<th>Bez HD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>33%</td>
<td>23%</td>
<td>0.048</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>ASA I-II</th>
<th>ASA III-V</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortalita</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>34%</td>
<td>nevýzn</td>
<td></td>
</tr>
</tbody>
</table>
Perioperative management of the pediatric patient with traumatic brain injury

Tarun Bhalla¹, Elisabeth Dewhirst¹, Amod Sawardekar¹, Olamide Dairo¹ & Joseph D. Tobias¹,²

Summary

TBI and its sequelae remain a major healthcare issue throughout the world. With an improved understanding of the pathophysiology of TBI, refinements of monitoring technology, and ongoing research to determine optimal care, the prognosis of TBI continues to improve. In 2003, the Society of Critical Care Medicine published guidelines for the acute management of severe TBI in infants, children, and adolescents. As pediatric anesthesiologists are frequently involved in the perioperative management of such patients including their stabilization in the emergency department, familiarity with these guidelines is necessary to limit preventable secondary damage related to physiologic disturbances. This manuscript reviews the current evidence-based medicine regarding the care of pediatric patients with TBI as it relates to the perioperative care of such patients. The issues reviewed include those related to initial stabilization, airway management, intraoperative mechanical ventilation, hemodynamic support, administration of blood and blood products, positioning, and choice of anesthetic technique. The literature is reviewed regarding fluid management, glucose control, hyperosmolar therapy, therapeutic hypothermia, and corticosteroids. Whenever possible, management recommendations are provided.
Intra-operative anesthetic care

Adekvátní anestezie a analgesie
Optimální podmínky pro chirurgický výkon
Eliminovat sekundární insulty

hypotense
hypoxemie
hypo- a hyperkapnie
hypo- a hyperglykemie

Adekvátní CPP
Bez elevace ICP
Respiratory support and mechanical ventilation

1. Maintain $\text{PaO}_2 \geq 60 \text{ mmHg (PaO}_2 \geq 8 \text{ kPa)}$
2. PEEP may increase ICP
3. Hyperventilation should only be used if impending herniation
4. Avoid intra-operative hypoxemia

Hemodynamic support

1. Effective control of intra-operative MAP
2. A single intra-operative episode of hypotension can effect outcome
3. Maintain optimal CPP
Anesthetic agents

1. No significant difference in outcomes comparing intravenous and inhalational anesthetic agents
2. Avoid nitrous oxide, increases $\text{CMRO}_2$ and possible increase in ICP
3. NMB are generally not recommended postoperatively, but are routinely used intra-operatively

ICP Monitoring

1. ICP $\geq 20$ mmHg warrants intervention
2. CPP should be maintained at $>40$ mmHg
3. Monitoring ICP helps to avoid further secondary injury
Positioning

1. Head of bed should be maintained at 15–30°
2. Reverse Trendelenburg may improve venous drainage, but may induce rebound increase in ICH
3. Patients' head should remain neutral and midline

Fluid management including glucose control

1. Intra-operative euvolemia is optimal
2. Normal saline should be used as maintenance fluid
3. Glucose containing fluids should not be infused unless the serum glucose is ≤70 mg·dl⁻¹ (3.9 mM)
Hyperosmolar therapy

1. Mannitol remains the standard for hyperosmolar therapy
2. Hypertonic saline, although efficacious, has not demonstrated improved neurologic outcome
3. Hypertonic saline should be considered for patients who may be refractory to mannitol therapy

Temperature control and therapeutic hypothermia

1. No class I evidence of improved outcomes for induced hypothermia
2. There are potential adverse effects with induced hypothermia, including hypotension, bradycardia, arrhythmias, sepsis, and coagulopathy
Corticosteroids

1. Steroids do not provide benefit in TBI patients
2. CRASH trial showed increased mortality in adults receiving methylprednisolone suffering from TBI

Blood product administration and coagulation function

1. There is no defined optimal transfusion endpoint
2. Treatment of clinical symptoms in conjunction with coagulation laboratory results should drive therapy
Anticonvulsant prophylaxis

1. Children are at higher risk of suffering from post-traumatic seizures
2. Seizure activity may worsen secondary brain injury
3. Prophylactic anticonvulsant therapy should be given for the first 7 days posttrauma
Transition from pediatric to adult health services: the perioperative care perspective

Liam J. Brennan & Paul M. Rolfe

Cystická fibrosa
(průměrné přežití)

1973: 7 let
Konec 90. let: 31 let

Spina bifida
(pravděpodobnost dožití 20 let)

70. léta: 30%
2005: > 80%

Vrozené srdeční vady

80 – 85% se dožívá dospělosti
250 000 lidí v UK
Case study 2

18 letá pacientka s Klippel-Feil syndromem
Case study 2

18 letá pacientka s Klippel-Feil syndromem

Krátký krk a omezená pohyblivost: předpokládaná obtížná intubace (fibroskop)

Plastická operace deformity hrudníku

Použita LM

Aspirace žaludečního obsahu

Zástava dechu a oběhu, neúspěšná intubace, exitus
Pediatric Anesthesia

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Pro-Con Debates

The placement of an intravenous cannula is always necessary during general anesthesia in children: a pro-con debate
Jonathan Smith, Anna-Maria Rollin

Pro con debate: the use of regional vs systemic analgesia for neonatal surgery
ADRIAN T BÖSENBERG, MARTIN JÖHR, ANDREW R WOLF

Pro-con debate: Transesophageal echocardiography (TEE) for pediatric cardiac surgery should routinely be performed and interpreted by a pediatric cardiac anesthetist
CAMERON GRAYDON, SALLY WILMSHURST, CRISPIN BEST

Pro–con debate: intravenous vs inhalation induction of anesthesia in children
MARZENA ZIELINSKA, HELEN HOLTBY, ANDREW WOLF
mfedora@fnbrno.cz