

Pediatric Anesthesia Mortality: the U.S. Perspective



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Disclaimer

- Co-investigator Wake Up Safe
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Objectives

- Present Pediatric Anesthesia Mortality Data from the U.S.
 - Review historical trends
 - Define strengths and gaps
- Data Impacts on Clinical Practice

Beecher H & Todd D:

Ann Surg 1954 ;140: 2-35

- Retrospective review, 10 academic sites
- Collected 1948 – 1952
- Nearly 600,000 anesthetics
- Anesthesia-related mortality
 - 3.7/10,000 procedures
 - 14/10,000 procedures in children under 10 yr

Rackow H, et al:

***Pediatrics* 1961; 28: 697-704**

- Retrospective review, single center (Columbia-Presbyterian)
- Collected 1947 – 1956
- 166,167 anesthetics
- Anesthesia related mortality
 - 3.9/10,000 (adults)
 - 6.0/10,000 (children 1-12 yr)
 - 16.2/10,000 (children <1 yr)

Graff T, et al:

Anesth Analg 1964; 43:407-14

- Retrospective review, multiple centers (Baltimore Anesthesia Study Committee)
- Data collected 1953 – 1964
- 335 operative deaths
- Operative mortality 12.9/10,000 procedures
- Anesthesia-related mortality rate
 - 2.7/10,000 (all ages)
 - 3.3/10,000 (children < 15 yrs)

Keenan R & Boyan C:

JAMA 1985; 253:2373-7

- Retrospective review, single center (U Va)
- Data collected 1969 – 1983
- 163,240 anesthetics
- 27 anesthesia-related cardiac arrests
 - 1.7/10,000 anesthetics
 - 4.7/10,000 in children (< 12 yrs)
- 14 deaths (0.9/10,000 procedures)

Holzman R:

Anesth Clinics N Am 1994; 41:239-56

- Retrospective review, single center (Boston Children's)
- Over 150,000 anesthetics
- Anesthesia-related mortality rate
 - 1.8/10,000 procedures (1954 – 1966)
 - 0.8/10,000 procedures (1966 – 1978)

Cohen M et al:

Anesth Analg 1990; 70:160-7

- **PROSPECTIVE** (self report), single center (Winnipeg Children's)
- Data collected 1982 – 1987
- 29,220 anesthetics
- Rate of adverse perioperative events
 - Operative
 - Recovery
 - Post-operative (3 days)
- No attempt to identify cause

Cohen M, et al:

Anesth Analg 1990; 70:160-7

	Cardiac Arrests		Deaths	
Age	n	Rate/10,000	n	Rate/10,000
< 1 month	1	28	3	83
1 – 12 months	3	12	2	8
1 – 5 years	4	3	4	3
6 – 10 years	3	4	1	1
11 + years	3	5	1	2
TOTAL	14	5	11	4

Keenan R, et al:

J Clin Anesth 1991; 3:433-7

- Retrospective, single center (U Va)
- Data collected July 1983 – March 1990
- 103,267 anesthetics
- Cardiac arrests
 - All: 12/103,267 (1.2/10,000)
 - Children <12 yr: 4/13,693 (2.9/10,000)

Keenan R, et al:

J Clin Anesth 1991; 3:433-7

- Pediatric (< 12 years) cardiac arrests
 - Children <12 yr: 4/13,693 (2.9/10,000)
 - 1-12 yrs 0/6,232
 - < 1 yr 4/4,343 (9.2/10,000)
 - Pediatric fellowship training or equivalent
 - Yes – 0/2,310
 - No – 4/2,033 (19.7/10,000)

Murray J, et al:

Anesthesiology 1993; 78:461-7

- ASA Closed Claims Database
- Retrospective review 2400 insurance claims
 - 1970s and 1980s data
- **NO DENOMINATOR (incidence) DATA**
- 238 pediatric (<16 yrs) claims identified
- Severe injury (death: 50% ped v 35% adult)
- Substandard care (54% v 44%)
- Respiratory etiology (43% v 30%)

Murray J, et al:

Anesthesiology 2000; 93:6-14

- Pediatric Perioperative Cardiac Arrest (POCA) Registry
- PROSPECTIVE, MULTICENTER (n=63)
- Voluntary (self), standardized reporting
- Data collected 1994-97

Murray J, et al:

Anesthesiology 2000; 93:6-14

- Anesthesia-related
 - Cardiac arrest = 1.4/10,000
 - Deaths = 0.4/10,000
 - Multivariate predictors (ASA PS and emergent)
- Cause for arrest
 - ASA 1-2 = medication
 - ASA 3-4 = cardiovascular etiology

Bhananker S, et al:

Anesth Analg 2007; 105:344-50

- POCA Update #1 (1998 – 2004)
- Multicenter (n=80)
- No Denominator Data
- Fewer ASA 1-2 patients
- Fewer medication-related (halothane) arrests
- Hypovolemia / hyperkalemia most common CV etiology

Flick R, et al:

Anesthesiology 2007; 106:226-37

- Retrospective, single center (Mayo Clinic)
- Data collected Nov 1988 – June 2005
- Mandatory self reporting
- 92,881 anesthetics in children < 18 yrs
- Cardiac arrests
 - 54/4,242 cardiac cases (127.3/10,000 cases)
 - 26/88,639 non-cardiac (2.9/10,000 cases)
- Anesthesia-related CA (0.7/10,000 cases)

Flick R, et al:

Cardiac Arrests

	Total		Non-cardiac		Cardiac	
Age	n	Rate	n	Rate	n	rate
< 1 m	23/1451	158.5	4/1014	39.4	19/437	434.8
1-12 m	18/7807	23.1	3/7045	4.3	15/762	196.9
1-3 yr	15/19205	7.8	5/18354	2.7	10/851	117.5
4-9 yr	11/25650	4.3	7/24510	2.9	4/1140	35.1
10-18 yr	13/38768	3.4	7/37716	1.9	6/1052	57
TOTAL	80/92881	8.6	26/88639	2.9	54/4242	127.3

Flick R, et al:

Mortality

	Total		Non-cardiac		Cardiac	
Age	n	Rate	n	Rate	n	rate
< 1 m	21/1451	144.7	4/1014	39.4	17/437	389
1-12 m	15/7807	19.2	0/7045	0	15/762	196.9
1-3 yr	11/19205	5.7	1/18354	0.5	10/851	117.5
4-9 yr	8/25650	3.1	4/24510	1.6	4/1140	35.1
10-18 yr	8/38768	2.1	5/37716	1.3	3/1052	28.5
TOTAL	63/92881	6.8	14/88639	1.6	49/4242	115.5

Odegard K, et al:

Anesth Analg 2007; 105:335-43

- Retrospective, single center (Boston)
- Data collected 2000 – 2005
- 5213 anesthetics for cardiac procedures
- 41 cardiac arrests (79/10,000 cases)
- Anesthesia-related (21/10,000 cases)
 - More common neonates (45/10,000 cases)
 - No mortality

Ramamoorthy C, et al:

Anesth Analg 2010; 110:1376-82

- POCA Update #2 (1994 – 2005)
- Multicenter (n=80)
- No Denominator Data
 - Voluntary (under) reporting
 - Disproportionate reporting
- Patients with no HD (n=245) v HD (n=127)

Ramamoorthy C, et al:

Anesth Analg 2010; 110:1376-82

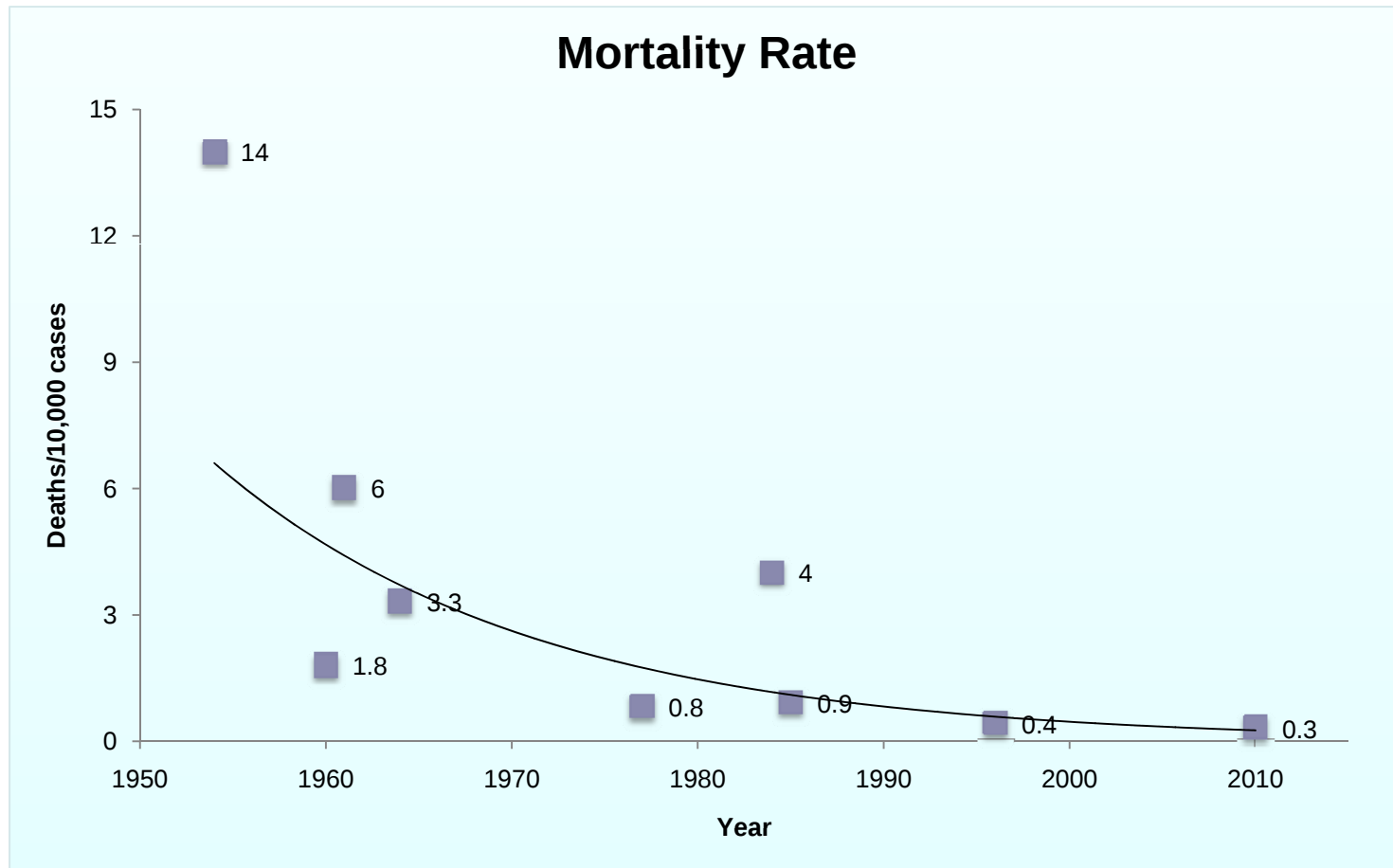
- POCA Update #2 (1994 – 2005)
- Multicenter (n=80)
- No Denominator Data
- 373 cardiac arrests

	Heart Disease	No Heart Disease
ASA 3-5	92%	62%
Emergency	14%	24%
CV etiology	50%	38%
Mortality	33%	23%

Seattle Children's Audit

- Retrospective, single center
- Data collected July 2005 – June 2010
- Voluntary (self) reporting
- 89,140 anesthetics
- 16 perioperative deaths (1.8/10,000)
- 3 anesthesia-related deaths (0.3/10,000)
 - All ASA 3 or 4

Historical U.S. Mortality Rate



Next Steps

- Wake Up Safe ®
 - Sponsored by SPA and FAER
 - 12 U.S. centers
 - Prospective, mandatory reporting
 - Total case numbers (incidence reporting)

Conclusion

- Pediatric Anesthesia Mortality Rates
 - Significant gaps in data
 - Decreasing rate over time
- Risk factors for mortality
 - Infants
 - Cardiac disease
 - Emergency surgery



What questions do you have?

