Last Rodeo

Surgical Procedures and Outcomes Among Children with Sickle Cell Disease

Hyder O, Yaster M, Bateman BT, Firth PG.

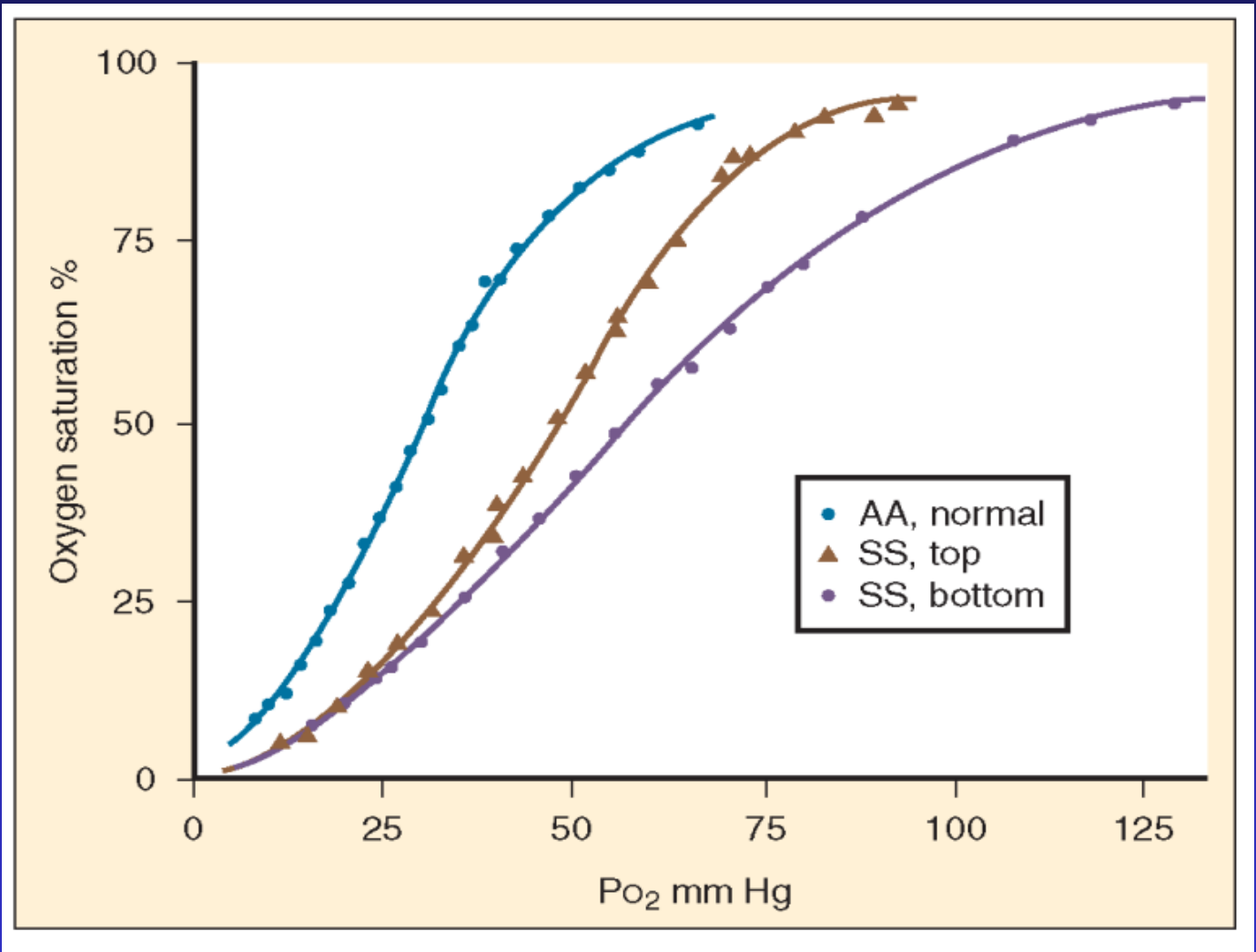
Anesth Analg 2013; 117(5):1192-6.

Factoids (I)

- Estimated 80-100,000 people in US with SCD
- 3.6% of hospital discharges of SCD have surgery
- Birth rbc 70-90% HgbF
- Normal Hgb profile by 4 months of age
- Normal adult Hgb – HgbA – 95%; HgbF < 2%

Factoids (II)

- In vivo rbc survival SCD 5-15 days
- In vivo rbc survival normal 120 days
- Right shift in dissociation curve
  - Heterogenous Hgb dissociation
  - ? ↑ 23DP6



(From Seakins M, et al: J Clin Invest 1973; 52:422)

Factoid (III)

- Clinical crises
  - Pain – vaso-occlusive
  - Sequestration
  - Aplastic
  - Hemolytic
- Major complications
  - ACS, mortality 2-12%
  - Stroke frequently asymptomatic

Factoids (IV)

- Chronic anemia, ↑ SV, ↑ EDV, vent dilation
- ↑ PAH, 20-30%, many asymptomatic
- Pulmonary: dyspnea, pulmonary fibrosis, restrictive, obstructive, V/Q abnormal, RAD
- Renal impairment

Methods (I)

- Nationwide Inpatient Sample (NIS) Database
  - Agency for Healthcare Research & Quality
  - 20% sample of nationwide discharges from inpatients
- Patients less than 18 years
- SCD by ICD-9 codes
- Procedure by ICD-9 codes
- Complications by ICD-9 codes

Table 1. ICD-9 Codes Used for Classification of Patients, Procedures, and Complications

Patients	
Sickle cell anemia	282.60, 282.61, 282.62, 282.63, 282.64, 282.68, 282.69
Procedures	
Appendectomy	47.0, 47.01, 47.09, 47.1, 47.11, 47.19
Inguinal or femoral hernia repair	17.11–17.13, 17.22–17.24, 53.00–53.05, 53.10–53.17, 53.21, 53.29, 53.31, 53.39
Tonsillectomy or adenoidectomy	28.2, 28.3, 28.6, or 28.7
Myringotomy	20.01, 20.09
Cholecystectomy	51.2, 51.21–51.24
Splenectomy	41.42, 41.43, 41.5
Umbilical hernia repair	53.41, 53.42, 53.43, 53.49
Cesarean delivery	74.0, 74.1
Hip replacement	81.51, 81.52, 81.53
Blood transfusion	99.00–99.04
Complications	
Acute chest syndrome	517.3
Splenic sequestration	289.52
Stroke	433, 434, 436, 437.0, 437.1, 437.4, 437.5, 437.7, 437.8, 437.9
Fever accompanying a diagnosis of sickle cell disease	780.61
Transfusion-related reactions	999.6, 999.7, 999.89

Methods (II)

- Complications post surgery in patients with elective admissions
- Study from 2000 to 2010

Results 1

- Types of surgery varied by age
- 6 most frequent surgeries
  - Cholecystectomy
  - T&A
  - Splenectomy
  - Umbilical hernia
  - Appendectomy
  - Myringotomy

Table 2. Demographic and Clinical Characteristics of Pediatric Patients with Sickle Cell Disease in the Nationwide Inpatient Sample Database Who Underwent a Surgical Procedure

Characteristics	*n* (%)
Age group (y)	
0–4	2265 (22.77)
5–9	2635 (26.49)
10–14	2824 (28.38)
15–17	2224 (22.36)
Gender	
Female	5042 (50.68)
Male	4906 (49.31)
Race[a]	
African American	7086 (88.43)
Caucasian	168 (2.10)
Other	759 (9.46)
SCD type[b]	
Hb-SS	5123 (85.30)
HB-SC	460 (7.66)
Other SCD	423 (7.04)
Admission type[c]	
Elective	5579 (59.79)
Urgent	1794 (19.22)
Emergency	1958 (21.00)
Income quartile	
Top	1588 (15.96)
3rd	1869 (18.78)
2nd	2391 (24.03)
Lowest	4100 (41.22)
Primary expected payer	
Medicaid	6444 (64.78)
Private insurance	2817 (28.32)
Other/self-pay/no charge/medicare/missing	686 (6.90)
No. of procedures recorded during admission	
1	8676 (87.21)
2	1185 (11.92)
3	86 (0.87)

Table 4. Numbers of InPatient Procedures Among all Pediatric and Sickle Cell Disease Patients <18 Years Between Years 2000 to 2010

Procedures	Number of pediatric patients	Number of SCD pediatric patients	SCD patients as proportion of all patients
Cholecystectomy	5254	4610	87.74
Splenectomy	20640	1956	9.48
Hip replacement	2812	148	5.26
Umbilical hernia repair	21059	588	2.79
Tonsillectomy and adenoidectomy	177373	2538	1.43
Myringotomy	93362	482	0.52
Inguino-femoral hernia repair	76097	185	0.24
Cesarean delivery	305149	254	0.08
Appendectomy	961934	545	0.06

Results (II)

- Medicaid ~ 65%
- Blood transfusion during hospitalization 33-45%
- Except appendectomy and Cesarean, all elective

Results (III)

- Complications
  - Acute chest syndrome (ACS) 3.0%
  - Postop fever 0.47%
  - Stroke 0.2%
  - Splenic sequestration and death < 0.2%
  - No transfusion reactions
  - Complication: ↑ LOS 5.5 vs 2.0 days

Result (IV)

- ACS
  - Cholecystectomy 3.9%
  - T&A 1.9%
  - Splenectomy 2.76%
  - Umbilical Hernia 4.24%
  - Appendectomy 8.7%
  - Myringotomy 2.28%
  - Cesarean section 5.95%

The Frequency of Cardiac Arrests in Patients with Congenital Heart Disease Undergoing Cardiac Catheterization

Odegard KC, Bergersen L, Thiagarajan R, Clark L, Shukla A, Wypij D, Laussen PC.
Anesth Analg 2014; 118: 175-82.

Factoids I

- Adverse events 4-10%
- Mortality low
- 2007 BCH reported CA 0.8 per 100 procedures

Cardiac Arrest Frequency & Mortality by Age

Inability to wean from CPB excluded

Age	Non-cardiac (10,000 anesthetics)		Cardiac (10,000 anesthetics)		Overall (10,000 anesthetics)	
	Arrest	**Mortality**	Arrest	**Mortality**	Arrest	**Mortality**
0-30 days	39.4	**39.4**	137	**389**	68.9	**144**
31 days – 365 days	4.3	**-**	13.1	**196**	5.1	**19**
< 1 year	8.7	**5.0**	58.4	**266**	15.1	**39**
1-3 years	2.7	**0.5**	35.3	**117**	4.2	**5.7**
4-9 years	2.9	**1.6**	26.3	**35**	3.9	**3.1**
10-18 years	1.9	**1.3**	38.0	**28**	2.8	**2.1**
0-18 years	2.9	**1.6**	40.1	**115**	4.6	**6.8**

*Inability to wean from CPB excluded

Methods I

- This paper from 2004 through 2009 (6 yrs)
- Jan 2004 through Dec 31, 2009
- Jan 2006 change in practice

Methods II

- CA defined cessation of flow and chest compressions
- 2 time periods
  - Different # of cath labs
  - Different # of anesthesia attendings
  - Different method of assigning nurse sedation and GA

Table 1. Definition of Anesthesia-Related Cardiac Arrests

Not related	The event is clearly related to other factors such as the catheterization procedure or underlying clinical condition.
Possibly related	The event follows a compatible temporal sequence from induction of anesthesia to completion of the catheterization procedure. The event could have been related to anesthesia, but co-contributing causes could also not be excluded.
Likely related	The event cannot be reasonably explained by factors other than those related to administration of anesthesia and were temporally related to either the induction of anesthesia, intubation of the trachea with controlled ventilation, or administration of anesthetic agents.

Results I

- 7289 procedures
- CA
  - 70 cardiac arrests = 0.96 arrests per 100 procedures
  - Interventional procedures > diagnostic > biopsy

Table 2. Catheterization Procedures January 2004 Through December 2009 (n = 7289)

Procedure	*N* (%)	Age, y median (IQR)	Weight, kg median (IQR)	Arrests *n* (per 100 procedures; [99% CI])
Biopsy	1420 (19)	13.8 (6.7–17.1)	45.0 (20.5–60.0)	2 (0.1; [0.01–0.7])
Diagnostic	1654 (23)	4.9 (0.6–16.3)	17.0 (6.5–54.5)	10 (0.6; [0.02–1.3])
Interventional	4215 (58)	4.2 (0.9–13.8)	15.4 (7.4–46.3)	58 (1.4*; [1.0–1.9])

IQR = interquartile range; CI = confidence interval.
*$P < 0.001$ for cardiac arrest during an interventional procedure.

Results II

- Interventional CA
  - Ventricular device closure 11.9 per 100
  - Intact atrial septum with restricted flow 10.0 per 100
  - Mitral valve balloon dilation 5.0 per 100
  - Pulmonary vein dilations 3.6 per 100
  - PA dilations 0.6 per 100

Results III

- Arrest outcomes
  - 69% resuscitated to a perfusing rhythm
  - 26% required ECMO
  - 6% unsuccessful
  - 7% required emergent OR
  - 9 deaths after resuscitation
- Overall mortality in arrested patients 19%
- Overall mortality for all patients 0.2%

Table 8. Frequency of Cardiac Arrests and Percentage of Cases Managed by the CAS Over Time

Year group	Total cases (*n*)	Cases managed by CAS*	Cardiac arrests†	ECMO (*n*)	Died before discharge (*n*)
2004–2005	2300	1163 (51%)	34 (1.5%)	7	7
2006–2009	4989	3322 (67%)	36 (0.7%)	10	8

Year 2004–2005: 15/100 catheterizations (99% confidence interval [CI], 10–20).

Year 2006–2009: 7/100 catheterizations (99% CI, 5–10).

CAS = Cardiac Anesthesia Service; ECMO = extracorporeal membrane oxygenation.

*$P < 0.001$ (compares proportions of cases in the 2 time periods).

†$P = 0.002$ (compares proportions of cardiac arrest in the 2 time periods).

Table 6. Anesthesia-Related or Nurse-Managed Sedation-Related Cardiac Arrests (CAs) by Age Group

	Total patients (*n*)	Anesthesia-related CA (*n*)	Nurse-managed sedation-related CA (*n*)	Procedure-related CA (*n*)
<1 y	1703	2	2	37
1–10 y	2810	2	0	17
11–18 y	1560	0	1	5
>18 y	1216	0	0	4

Table 7. Categorization of Causes and Outcomes at the Time of Cardiac Arrest in the Catheterization Laboratory

	Total, *n*	ROC, *n* (% discharged)	ECMO CPR, *n* (% discharged)	Died, *n*
Arrhythmia	38	30 (93)	8 (75)	0
Perforation (vascular or cardiac)	13	9 (89)	4 (50)	0
Myocardial ischemia	6	3 (100)	3 (0)	0
Hypotension	3	0	1 (0)	2
Airway or ventilation failure	4	4 (100)	0	0
Hypoxemia	6	2 (100)	2 (100)	2
Total	70	48 (94)	18 (55)	4

ROC = return of circulation; ECMO = extracorporeal membrane oxygenation; CPR = cardiopulmonary resuscitation.

Results IV

- 2004 – 2006 Arrest 1.5 per 100
- 2006 – 2009 Arrest 0.7 per 100

Summary

- Arrest rate of cath similar to rate cardiac surgery
- Arrest rate 4-35 fold greater than reported for general pediatric anesthesia
- Cath lab
  - High risk environment
  - ? Who should perform the anesthetic
- Changes in epochs data driven
- Think globally, act locally

(Stevens J. Anesth Analg 2014; 118:10-11)

Thank you

A Retrospective Identification of Gastroesophageal Reflux Disease as a New Risk Factor for Surgical Site Infection in Cerebral Palsy Patients After Spine Surgery

Chidambaran V, Gentry C, Ajuba-Iwuji C, et al.
Anesth Analg 2013; 117(1): 162-8.

Factoids

- Neuromuscular scoliosis in CP 20-60%
- SSI in pediatric CP scoliosis 6-15%
- SSI in idiopathic scoliosis 0.5 to 6%
- Predisposing Factors:
  - Incontinence, instrumentation, VP shunts, enteric bacteria columnization

Methods (I)

- CP patients, ASA III, 2 spine surgeries, 10-year period
- Retrospective, matched case control
- National Nosocomial Infection Surveillance System definition for SSI

Methods (II)

- Incisional SSI – occurs within 30 days
  - Superficial – Skin and SQ
  - Deep – soft tissues within 30 days with no implant
    soft tissue within 1 year if implant
  - Organ space – Anatomy other than incised area that was open or manipulated
  - Included UTI, pneumonia, bacteremia
  - “Any” includes superficial, deep or organ

Methods (III)

- SSI (one of the following)
  - Purulent drainage ± lab confirmation
  - Positive culture
  - Signs and symptoms infection
  - Incision opened with positive culture
  - Diagnosis by surgeon/attending

Methods (IV)

- Infected patients identified with CP
- Selected CP scoliosis patients without infection (control)
- Univariable and multivariable models applied

Results

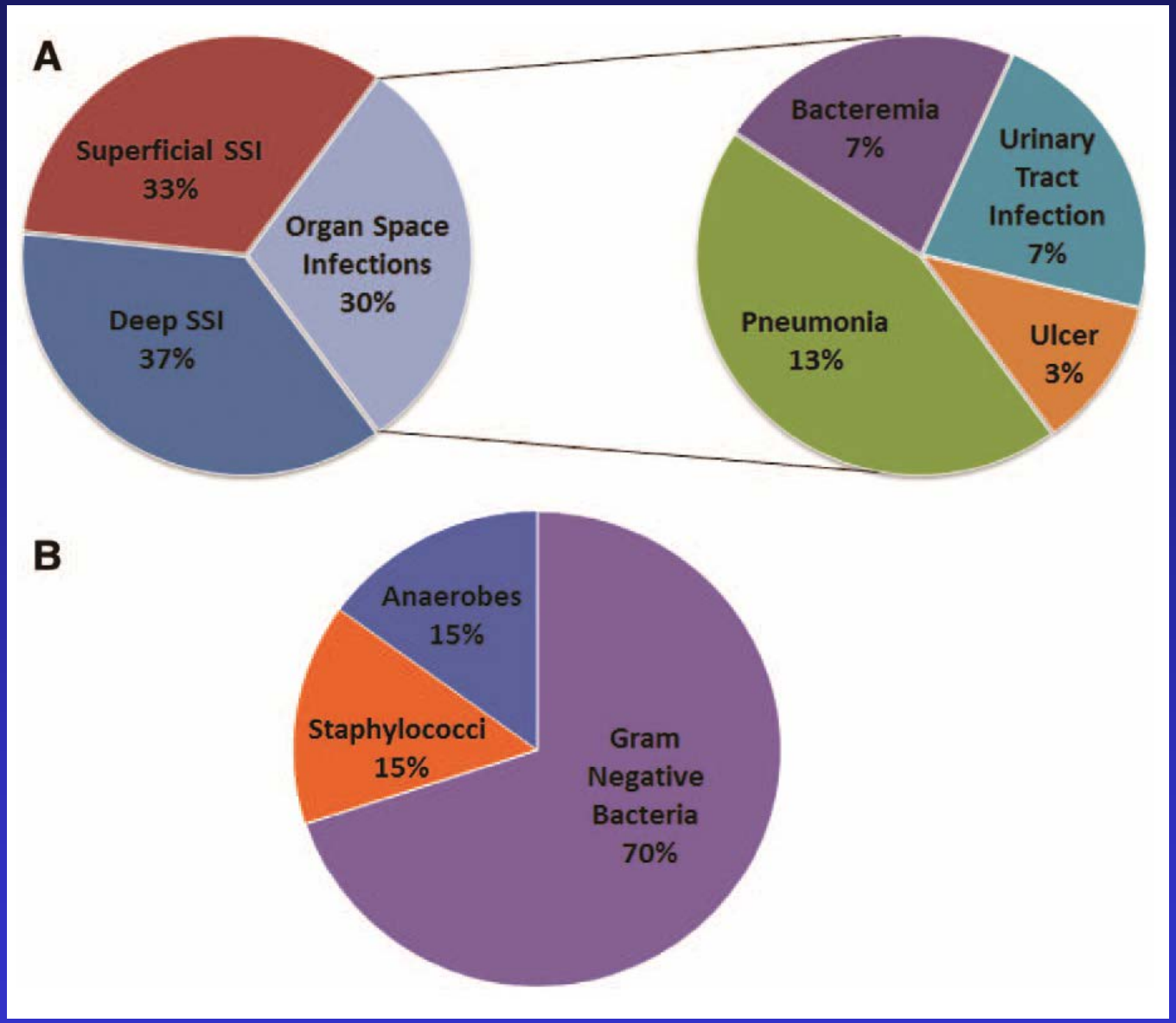
- 8.3% overall incidence of infection
- Similar demographics
- 46.3% of both groups had GERD
  - 66% infected group, 40% Rx gastric acid inhibited
  - 23% control group, 3% Rx

Points to Consider (I)

- Small sample size
- Combined operations more risk of SSI?
- Polymicrobial common and gram negatives common
- GERD – associated with ↑ respiratory complications

Points to Consider (II)

- pH > 4 supports GNB
- Bacterial overgrowth ↑ bile acids → ↑ translocation



(Chidambaran V, et al. Anesth Analg 2013; 117(1):162)

Table 2. Odds Ratios for Infection Outcome by Univariate Logistic Regression of Preoperative Risk Factors

Outcome	Predisposing risk factors evaluated	Odds ratio	95% CI	*P* value
Any infection	1. Previous infection	10.6	2.4–48.2	0.002
	2. GERD	9.8	3.1–30.3	<0.0001
	3. Gastric acid inhibitors	13.2	2.1–83.3	0.007
	4. Postoperative ventilation	5.1	1.5–18.0	0.01
	5. Preoperative presence of pressure ulcer	1.2	0.2–9.4	0.83
Deep surgical site infection	1. Previous infection	5.8	1.5–22.6	0.01
	2. GERD	10.6	1.7–66.6	0.01
	3. Gastric acid inhibitors	8.6	2.0–37.0	0.003
	4. Postoperative ventilation	4.6	0.7–30.1	0.11
	5. Preoperative presence of pressure ulcer	5.7	0.7–45.9	0.10

CI = confidence interval; GERD = gastroesophageal reflux disease.

(Chidambaran V, et al. Anesth Analg 2013; 117(1):162)

Table 3. Odds Ratios for Infection Outcome by Multivariate Logistic Regression of Preoperative Risk Factors

Outcome	Predisposing risk factors evaluated	Odds ratio	95% CI	*P* value
Any infection	1. GERD	6.4	1.9–21.3	0.002
	2. Gastric acid inhibitors	6.1	0.8–44.6	0.07
Deep surgical site infection	1. GERD	6.5	1.0–44.0	0.06
	2. Gastric acid inhibitors	4.1	0.9–19.0	0.07

Variables of interest retained in final multivariate model are presented here.
CI = confidence interval; GERD = gastroesophageal reflux disease.

(Chidambaran V, et al. Anesth Analg 2013; 117(1):162)

Table 4. Perioperative Factors and Risk for Infection

Variable	Control group (*N* = 37)	Infected group (*N* = 30)	*P* value
Simultaneous other procedure (%)	1 (0.03%)	6 (0.2%)	0.04
Surgical time (h; mean ± SD)	6.24 ± 1.62	6.79 ± 2.23	0.48
Intraoperative crystalloid mL/kg[a] (mean ± SD)	154.6 ± 52.6	83.2 ± 42.1	0.3
Estimated blood loss mL/kg[a] (mean ± SD)	52.15 ± 31.6	36.93 ± 47.03	0.21
Packed RBC unit/kg[a] (mean ± SD)	0.1 ± 0.1	0.07 ± 0.08	0.33
Blood glucose (mg; mean ± SD)			
Preoperative glucose	86.8 ± 13.4	88.0 ± 17.8	0.91
Intraoperative glucose	134.9 ± 44.8	117.5 ± 30.1	0.92
Immediate postoperative glucose	170.9 ± 44.8	165.4 ± 40.1	0.72
7-d postoperative maximal glucose	202.7 ± 1.6	200.0 ± 46.3	0.92

RBC = red blood cell.

[a]Data were not available for all patients.

(Chidambaran V, et al. Anesth Analg 2013; 117(1):162)

Table 5. Cardiac Arrests Likely and Possibly Related to Anesthesia or Nurse-Managed Sedation

	Diagnosis	Procedure	Age (y)	Weight (kg)	Presumed etiology
Likely anesthesia-related					
1	PV stenosis	PV BD	0.5	5.4	GETA; respiratory arrest after extubation
2	SV s/p BDG and BTS	Shunt BD and stent placement	2.0	12.6	GETA; bradycardia and hypotension after induction of anesthesia
3	Congenital AS, s/p Ross procedure	Aortic valve BD	0.5	6.1	GETA; PEA after induction of anesthesia
Possibly anesthesia-related					
4	s/p Cardiac TX	Biopsy	1.2	7.8	Asystole after neostigmine, acute rejection on biopsy, ECMO cardiopulmonary resuscitation
Likely nurse-managed sedation-related					
5	Congenital PS	Pulmonary valve BD	1 day	2.9	Respiratory arrest after morphine and midazolam bolus
6	Heterotaxy, SV, PV stenosis s/p mBTS	PV BD, BTS dilation	18.1	63.2	Respiratory arrest at completion of the case, due to airway obstruction and pulmonary edema
7	Congenital PS	Pulmonary valve BD	0.25	6.0	Bradycardia and respiratory arrest after sedation bolus

PV = pulmonary vein; GETA = general endotracheal anesthesia; SV = single ventricle; BDG = bidirectional Glenn; BD = balloon dilation, ECMO = extracorporeal membrane oxygenation PS = pulmonary valve stenosis; mBTS = modified Blalock Taussig shunt; AS = aortic stenosis; TX = transplantation; PEA = pulseless electrical activity; s/p = status/post.

Table 4. Events and Demographics According to Technique

	Cardiac anesthesia service		Nurse sedation
	General anesthesia (*n* = 3843)	MAC (*n* = 642)	*n* = 2804
Cardiac arrests	51	4	15
Age (y), median (IQR)	2.6 (0.5–9.7)	9.6 (2.1–15.8)	13.6 (4.8–19.4)
Weight (kg), median (IQR)	12.0 (5.6–29.4)	28.5 (11.0–53.0)	45.0 (16.6–63.2)
Procedure type (%)			
Biopsy	538 (2)	172 (0)	710 (0)
Diagnostic	764 (5)	197 (1)	693 (4)
Intervention	2541 (44)	273 (3)	1401 (11)

CA = cardiac arrest; *n* = number; IQR = interquartile range; MAC = monitored anesthesia care; CAS = Cardiac Anesthesia Service.

$P = 0.003$ comparing cardiac arrests in CAS versus nurse-managed sedation.

$P < 0.001$ comparing proportion of interventional cases between CAS and nurse-managed cases.

Table 3. Catheterization Procedures Performed

Intervention	Intervention site	*N* (%)[a]
Devices		969 (23)
	ASD or PFO	416 (10)
	VSD	42 (1)
	Fontan baffle fenestration closure	190 (5)
	Other	321 (8)
Angioplasty		1796 (43)
	Pulmonary artery	948 (22)
	Systemic artery	284 (7)
	RVOT	285 (7)
	Pulmonary vein	185 (4)
	Other	349 (8)
Stent placement or redilation		1130 (27)
	Pulmonary artery	561 (13)
	Systemic artery	166 (4)
	RVOT	217 (5)
	Pulmonary vein	37 (1)
	Other	222 (5)
Valvotomy		482 (11)
	Mitral	60 (1)
	Pulmonary	226 (5)
	Aortic	194 (5)
	Tricuspid	9 (<1)
Coils		869 (20)
Balloon atrial septostomy		50 (1)
Atrial septum static dilation or stent placement		142 (3)