Perioperative Antibiotic Use In Neonatal Surgery

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Introduction / Background

What is a surgical site infection and why is it significant?

- A surgical site infection (SSI) is defined as an infection related to an operative procedure that occurs at or near the surgical incision within 30 days of the procedure[1]
- They account for:
  - approximately 500,000 infections, annually.[1]
  - nearly 4 million excess hospital days, annually.[1]
  - nearly $2 billion in increased health care costs, annually.[1]

What is an effective way of reducing SSI?

- Perioperative antibiotic prophylaxis prevent SSI, prevent SSI-related morbidity and mortality, and reduce the duration and cost of health care.[2]

What is the optimal perioperative antibiotic strategy in neonates?

- No standardized guidelines exist. [2]
- Recommendations are based on data from adult patients.[3]

Do neonates need longer antibiotic prophylaxis?

- Neonates may be at increased risk for SSI due to immature immune systems.[4]
- Arguably, neonates need to be treated differently than adults [4].

Why does this matter?

- Without specific guidelines, prolonged routine antibiotic administration may encourage the development of multidrug-resistant organisms and may be associated with long-term adverse effects.[6]

Aims of Study

1. **To determine if there is a correlation between length of perioperative antibiotic prophylaxis and surgical site infections**
2. **To recommend the most effective length of perioperative antibiotic prophylaxis for neonates that limits exposure to antibiotics**

Methods

- This is a retrospective analysis.
- We queried EPIC medical records to identify the patients based on the inclusion and exclusion criteria.

INCLUDE
- ≤28 days old (Neonate)
- Underwent gastrointestinal, respiratory tract, or urogenital surgery at Beaumont Hospital Royal Oak and Beaumont Hospital Dearborn from January 2014 and April 2019.

EXCLUDE
- Died on the same day of the operation
- Required multiple surgeries
- Had additional comorbidities
- Had dirty or infected procedures

RESULT
- 155 patients identified

- MRNs were used to collect patient-specific data from EPIC charts
- Variables we collected included: demographics, procedural details, antibiotic medications and dosages, and post-operative outcomes.
- Data was stored on SharePoint and uploaded to a Redcap project file.
- When comparing surgical site infection and perioperative antibiotics given with the other variables, T-Tests and Chi-Square tests were used for continuous and categorical variables, respectively.
- Any P-Value < 0.05 (P < 0.05) indicates a statistically significant association.
- All analysis was done in SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

Table 1: Patient characteristics and incidence of surgical site infection (SSI)

	SSI (n = 19)	No SSI (n = 136)	P-Value
Gestational Age (Weeks)			
Mean (Standard Deviation)	36.15 (4.46)	37.99 (2.47)	0.0927
Birth Weight (kg)			
Mean (Standard Deviation)	2.60 (1.04)	3.01 (0.69)	0.1095
Gender of Patient			
Male	10 (9.62%)	94 (90.38%)	0.1520
Female	9 (17.65%)	42 (82.35%)	
Age of Surgery (Days)			
Mean (Standard Deviation)	10.71 (8.66)	11.41 (9.68)	0.7644
Weight at Procedure (kg)			
Mean (Standard Deviation)	2.70 (0.97)	3.11 (0.76)	0.0317
Length of Procedure (Hours)			
Mean (Standard Deviation)	2.43 (1.35)	1.97 (0.86)	0.1587
Perioperative Antibiotics Given			
Yes	17 (17.00%)	83 (83.00%)	0.0152
No	2 (3.64%)	53 (96.36%)	
Length of Perioperative Antibiotics (Days)			
Mean (Standard Deviation)	3.47 (2.67)	2.07 (2.49)	0.0241
Contamination Status			
Clean	7 (8.75%)	73 (91.25%)	0.1690
Clean-Contaminated/Contaminated	12 (16.00%)	63 (84.00%)	

Table 1 shows 17% of the neonates who received antibiotics developed a SSI, compared to 3.64% of neonates who did not receive antibiotics developed a SSI.

Table 2: Comparing the three duration groups, Clean Wounds

	(1) 0 Hours (n = 45)	(2) 1 - 48 Hours (n = 21)	(3) > 48 Hours (n = 14)	Overall P-Value
Gestational Age (Weeks)				
Mean (Standard Deviation)	38.94 (1.57)	38.90 (1.69)	36.77 (4.05)	0.0060
Birth Weight (kg)				
Mean (Standard Deviation)	3.24 (0.60)	3.39 (0.67)	2.85 (0.72)	0.0527
Age at Surgery (Days)				
Mean (Standard Deviation)	18.88 (7.52)	16.23 (9.16)	6.83 (8.22)	< 0.0001
Weight at Procedure (kg)				
Mean (Standard Deviation)	3.43 (0.60)	3.47 (0.68)	2.86 (0.78)	0.0127
Length of Procedure (Hours)				
Mean (Standard Deviation)	1.48 (0.36)	2.08 (1.31)	2.16 (0.59)	0.0018
Gender of Patient				
Male	41 (91.11%)	15 (71.43%)	6 (42.86%)	0.0006
Female	4 (8.89%)	6 (28.57%)	8 (57.14%)	
Development of SSI				
Yes	2 (4.44%)	3 (14.29%)	2 (14.29%)	0.3030
No	43 (95.56%)	18 (85.71%)	12 (85.71%)	

Table 2 shows that there was no significant difference in SSI rates between the different antibiotic durations, specifically in clean cases.

Table 3: Comparing the three duration groups, Clean-Contaminated/Contaminated Wounds

	(1) 0 Hours (n = 10)	(2) 1 - 48 Hours (n = 21)	(3) > 48 Hours (n = 44)	Overall P-Value
Gestational Age (Weeks)				
Mean (Standard Deviation)	39.16 (1.11)	37.01 (3.08)	36.39 (2.20)	0.0350
Birth Weight (kg)				
Mean (Standard Deviation)	3.19 (0.52)	2.69 (0.74)	2.58 (0.78)	0.0693
Age at Surgery (Days)				
Mean (Standard Deviation)	11.32 (9.29)	6.51 (7.42)	5.00 (5.88)	0.0354
Weight at Procedure (kg)				
Mean (Standard Deviation)	3.46 (0.68)	2.77 (0.79)	2.61 (0.77)	0.0082
Length of Procedure (Hours)				
Mean (Standard Deviation)	1.44 (0.36)	2.22 (0.98)	2.55 (0.97)	0.0037
Gender of Patient				
Male	6 (60.00%)	12 (57.14%)	24 (54.55%)	0.9447
Female	4 (40.00%)	9 (42.86%)	20 (45.45%)	
Development of SSI				
Yes	0 (0.00%)	4 (19.05%)	8 (18.18%)	0.3319
No	10 (100.00%)	17 (80.95%)	36 (81.82%)	

Table 3 shows that there was no significant difference in SSI rates between the different antibiotic durations, specifically in clean-contaminated/contaminated cases.

Results Cont'd

Table 4: Perioperative antibiotic use stratified by patient characteristics

	Antibiotics (n = 100)	No Antibiotics (n = 55)	P-Value
Gestational Age (Weeks)			
Mean (Standard Deviation)	37.10 (3.17)	38.98 (1.49)	< 0.0001
Birth Weight (kg)			
Mean (Standard Deviation)	2.81 (0.79)	3.23 (0.58)	0.0003
Gender of Patient			
Male	57 (54.81%)	47 (45.19%)	0.0003
Female	43 (84.31%)	8 (15.69%)	
Age of Surgery (Days)			
Mean (Standard Deviation)	7.93 (8.43)	17.50 (8.32)	< 0.0001
Weight at Procedure (kg)			
Mean (Standard Deviation)	2.86 (0.82)	3.44 (0.61)	< 0.0001
Length of Procedure (Hours)			
Mean (Standard Deviation)	2.33 (1.02)	1.47 (0.36)	< 0.0001
Contamination Status			
Clean	35 (43.75%)	45 (56.25%)	< 0.0001
Clean-Contaminated/Contaminated	65 (86.67%)	10 (13.33%)	

Table 5: Variable Importance Indices for SSI Development

Variable	Relative Importance
Gestational Age (Weeks)	100.00%
Age at Surgery (Days)	71.41%
Birth Weight (kg)	62.30%
Length of Antibiotics (Days)	47.87%
Weight at Procedure (kg)	34.40%

Table 5 shows that gestational age was the most important variable looked at to determine SSI development, followed by age and birth weight.

Conclusion

- Perioperative antibiotics were associated with higher rates of SSI (P = 0.0152).
- Patients who developed a SSI, on average, had a lower weight at time of procedure (P = 0.0317).
- There was no significant difference in SSI incidence between the different antibiotic durations in clean cases (P=0.303).
- There was no significant difference in SSI incidence between the different antibiotic durations in clean-contaminated/contaminated cases (P=0.3319).
- Neonates were more likely to receive perioperative antibiotics if they were female, had a lower gestational age, younger age at the time of surgery, had a lower birth weight, had a lower weight at the time of surgery, or if they had a clean-contaminated/contaminated wound. (P = < 0.0001).
- Risk factors for SSI development were gestational age, birthweight, and age at surgery.
- Overall, antibiotic prophylaxis greater than 48 hours was not associated with decreased incidence of SSI. Risk factors for SSI development were gestational age, birthweight, and age at surgery. These factors should be taken into account when considering SSI prophylaxis in neonates

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