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Intrauterine Pressure Catheter in Labor: Associated Microbiology

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ABSTRACT

Objective: **The purpose of this study was to determine if bacterial growth occurred in the amniotic fluid of laboring women. Twenty patients who required an intrauterine pressure catheter (IUPC) during labor were studied. Amniotic fluid samples were aspirated during labor and at the time of delivery.**

Methods: **IUPCs were placed in laboring patients for a variety of reasons. Cervical cultures were taken prior to insertion of an IUPC. After the IUPC was placed, amniotic fluid cultures were taken both at the time of placement and 30 minutes prior to delivery. These cultures were sent for aerobic, anaerobic, *Mycoplasma,* and *Ureaplasma* cultures.**

Results: **The increase in bacterial concentration from the initial sample to the final sample was statistically significant ($P < 0.01$) for both aerobes and anaerobes. Amniotic fluid samples demonstrated a median of 0 bacterial species per patient on initial collection and 2 bacterial species per patient in final collection. The mean count of cfu for aerobes in the initial amniotic samples was 3.5×10^4, compared to that of the second samples, which was 1.4×10^5. The mean count of cfu for anaerobes in the initial amniotic fluid samples was 4.1×10^2, compared to that of the second samples, which was 8.0×10^3. Only 3 of 20 patients developed chorioamnionitis, with only 1 patient having an increased number of bacterial species significantly higher than the median. Although 80% of patients had a colony count $\geq 10^2$ cfu/cc, only 19% of this group developed chorioamnionitis.**

Conclusions: **The number of bacterial species and colony counts increased significantly during labor, but this factor alone was not enough to cause chorioamnionitis in a significant number of patients.** © 1993 Wiley-Liss, Inc.

KEY WORDS

Intrauterine pressure catheter, bacterial colonization, amniotic fluid, chorioamnionitis, endomyometritis

Intrauterine pressure catheters (IUPCs) are frequently employed to assess labor by monitoring the intensity and frequency of uterine contractions. Recently, the IUPC has been utilized to perform amnioinfusion in situations where the amniotic fluid is significantly decreased to prevent cord compression during uterine contractions.[1] The IUPC may also provide a potential route for endogenous bacteria of the lower genital tract to gain access to the uterine cavity.[2,3] Miller et al.[4] found no differ-

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Clinical Study

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TABLE 1. Demographics of patient population (N = 20)

Race	
Black	3
Hispanic	13
White	3
Pakistani	1
Age	
Mean	26.5 years
Mode	24 years
Range	14–40 years
Gravidity	
Mean	3.2
Mode	2
Range	1–9
Parity	
Mean	1.2
Mode	0
Range	0–6
Vaginal exams	
Mean	6.5
Mode	6
Range	3–10
Delivery	
Vaginal (spontaneous)	12
Vaginal (forceps)	4
Cesarean section	4
No. of hours of rupture of membranes	
Mean	11 hours 38 minutes
Mode	6.5 hours
Range	2 hours 10 minutes–33 hours 29 minutes

ences among culture results of amniotic fluid samples obtained by aspiration through an IUPC, amniocentesis, and collection at the time of cesarean section. However, being a qualitative bacteriologic study, it did not reveal the dynamic relationship that may occur between the bacteria and amniotic fluid with respect to time.

The relationship between bacterial colonization of the intrauterine environment and bacterial growth during labor in nulliparous women has been previously described.[5] This study was designed to identify and quantitate the bacterial flora of the intrauterine cavity during labor in patients requiring an IUPC and to examine the effect of time on bacterial colonization.

MATERIALS AND METHODS

This study was conducted on Baylor College of Medicine's Obstetrics Service at Ben Taub General Hospital, a county hospital that serves the indigent and lower socioeconomic population of Harris County, TX. IUPCs were placed in laboring patients for one of the following reasons: dysfunctional labor (50% of patients), trial of labor with history of cesarean section (25%), amnioinfusion on the basis of frequent occurrence of variable decelerations of the fetal heart rate (15%), or the inability to adequately monitor uterine contractions (10%).

Prior to placement of the IUPC, a cervical specimen was collected with a sterile cotton-tipped applicator and placed in anaerobic brain-heart infusion broth transport media. After the IUPC was in place, amniotic fluid was aspirated for the culture of bacteria. The initial 5 cc of amniotic fluid aspirated was discarded. Then, an additional 3 cc was aspirated and placed in anaerobic brain-heart infusion broth transport media. A second specimen was obtained 30 minutes prior to delivery. All specimens were stored at 4°C immediately after collection and processed within 24 hours. Remel blood agar, chocolate agar, and McConkey's medium were inoculated for the isolation of aerobic bacteria. The following media were inoculated for the isolation of anaerobic bacteria: CDC blood, KVKDK, and PEACDC agar. A-7 medium was inoculated in an attempt to isolate *Mycoplasma* and *Ureaplasma*. Qualitative and quantitative bacteriology were performed on all specimens except *Mycoplasma* and *Ureaplasma* as previously described.[6,7]

The number of vaginal examinations were recorded, commencing at the time of IUPC placement until the time of the second amniotic fluid collection.

For the purposes of this study, chorioamnionitis was defined as an infection of the chorioamniotic membranes and the amniotic cavity clinically manifested by maternal fever $\geq$38°C, uterine tenderness, and/or foul-smelling amniotic fluid. Postpartum endomyometritis was considered to be an infection of the endometrium or decidua with extension to the myometrium with clinical findings of 2 readings of maternal temperature elevation $\geq$38°C after the first 24-hour postpartum period, uterine tenderness, and leukocytosis [white blood cell counts (WBCs) >15,000].

Statistics

The number of bacterial isolates was expressed as means ± standard deviation, and the median number of isolates for each group, aerobes and anaerobes, was determined. The Student's t-test was used

TABLE 2. Cervical cultures at time of IUPC insertion

Aerobes			Anaerobes		
Species	No. positive cultures	%	Species	No. positive cultures	%
Staphylococcus not *aureus*	14	23.7	*Peptostreptococcus anaerobius*	1	7.7
Diphtheroids	14	23.7	*S. morbillorum*	3	23
Lactobacillus	6	10.1	*P. magnus*	1	7.7
S. aureus	2	3.4	*Propionibacterium*	1	7.7
S. agalactiae	3	5.1	*Clostridium* sp.	1	7.7
Enterococcus faecalis	4	6.8	*Bacteroides bivius*	1	7.7
Gardnerella vaginalis	13	22.1	*B. intermedius*	1	7.7
Pseudomonas aeruginosae	1	1.7	*B. oralis*	2	15.4
Klebsiella pneumoniae	1	1.7	*B. melaninogenicus*	1	7.7
Acinetobacter	1	1.7	*Fusobacterium*	1	7.7
Totals	59			13	

to compare mean numbers of bacterial isolates and concentrations between the initial and second samples. A two-tailed test was employed with $P < 0.05$ considered significant. The median numbers of isolates were compared between the initial and second samples using the Wilcoxon rank-sum analysis.

RESULTS

The demographic data of the 20 patients in this study are presented in Table 1. Twelve patients (60%) had a spontaneous vaginal delivery, 4 (20%) had forceps vaginal delivery, and 4 (20%) required cesarean section. Two of the patients who were delivered by cesarean section and one who was delivered by low forceps developed chorioamnionitis (3/20 or 15%). All 3 of these patients had oral body temperatures ≥38°C, elevated WBCs, and uterine fundal tenderness. The WBCs on admission for patient nos. 5, 10, and 14 were 9,200, 11,300, and 9,700, respectively. The WBCs at the time chorioamnionitis was diagnosed were 32,300, 17,300, and 12,000, respectively. No patient developed postpartum endomyometritis.

The spectrum of bacterial species from the cervical cultures at the time of IUPC insertion is shown in Table 2. The bacterial flora of the amniotic fluid collected at the beginning and near the time of delivery are listed in Table 3. Quantitative results from amniotic fluid samples at the two collecting times are summarized in Table 4.

Ureaplasma was isolated from the cervix of 80% (16/20) of the patients. Forty percent (8/20) of the amniotic fluid cultures from the initial collection grew *Ureaplasma*, compared to 45% (9/20) of the final fluid samples. *Mycoplasma* was isolated from the cervix of 15% (3/20) of patients. Five percent (1/20) of the amniotic fluid samples at the initial collection and final collection had positive *Mycoplasma* cultures.

The number of different aerobic and anaerobic species per patient from the first and second amni-

TABLE 3. Amniotic fluid cultures

	No. of positive cultures		
At time of IUPC placement	No.	Within 30 minutes of delivery	No.
Aerobes			
Lactobacillus	4	*Lactobacillus*	7
Diphtheroids	3	*Diphtheroids*	6
Staphylococcus not *aureus*	3	*Staphylococcus* not *aureus*	4
Enterococcus faecalis	1	*S. aureus*	1
S. agalactiae	1	*E. faecalis*	1
Klebsiella pneumoniae	1	*K. pneumoniae*	1
Gardnerella vaginalis	2	*G. vaginalis*	6
		Escherichia coli	2
Totals	15		28
Anaerobes			
S. morbillorum	2	*S. morbillorum*	2
Bacteroides intermedius	1	*S. subterminale*	1
		B. oralis	1
		B. urealyticus	1
		B. bivius	1
		Fusobacterium	1
		Veillonella sp.	1
Totals	3		8

TABLE 4. Quantitative analysis of amniotic fluid bacteria[a]

Patient no.	Initial collection				Final collection			
	Aerobes	Anaerobes	Mycoplasma	Ureaplasma	Aerobes	Anaerobes	Mycoplasma	Ureaplasma
1	5×10^2 LB	2×10^2 BI			2.4×10^3 LB	No growth		
2	No growth			(+)	3×10^2 LB 2.2×10^3 DIP 6×10^2 SNA 5×10^3 GV	1.2×10^4 SM		(+)
3	10^5 GV 3.5×10^3 SNA 2×10^3 DIP		(+)	(+)	10^6 GV 5×10^2 SNA 2×10^2 DIP 5×10^4 LB	2×10^2 V	(+)	(+)
4	No growth			(+)	1×10^4 LB 10^5 GV			(+)
5	No growth				10^6 GV	10^5 F		(+)
6	4×10^3 KP				5×10^4 KP			
7	2×10^4 LB 10^4 DIP 7×10^3 SNA				2.4×10^4 LB 1×10^4 SNA			
8	No growth				No growth			
9	5×10^5 LB 1.2×10^3 GBBS				8×10^3 LB 5×10^5 GBBS			
10	3×10^4 DIP 6×10^3 GV 1×10^4 LB	7×10^3 SM		(+)	3×10^3 DIP 1.2×10^4 GV 1×10^3 LB	2×10^3 SM		(+)
11	4×10^3 EF			(+)	2×10^3 EF 3×10^3 DIP	1×10^4 BIV		(+)
12	4×10^3 SNA							
13	No growth				No growth			
14	No growth			(+)	8×10^3 LB 1×10^3 DIP			(+)
15	No growth			(+)	2×10^3 SA 1.4×10^4 DIP 5×10^3 GV	9×10^3 CS		(+)
16	No growth				No growth	2×10^3 BU		
17	No growth	1×10^3 SM		(+)	2×10^3 SNA 1×10^3 GBBS	5×10^3 BO		(+)
18	No growth							
19	No growth				No growth			
20	No growth				1×10^3 EC			

[a]BI = *Bacteroides intermedius;* BIV = *B. bivius;* BO = *B. oralis;* BU = *B. urealyticus;* CS = *Clostridium* sp.; DIP = *Diphtheroids;* EC = *Enterococcus;* EF = *E. faecalis;* F = *Fusobacterium;* GBBS = group B *beta-strep;* GV = *Gardnerella vaginalis;* KP = *Klebsiella pneumoniae;* LB = *Lactobacillus;* SA = *Staphylococcus aureus;* SM = *S. morbillorum;* SNA = *Staphylococcus* not *aureus;* V = *Veillonella* sp.

otic fluid samples varied from 0 to 4 species (Table 4). The mean number of bacterial species in the initial fluid samples was 0.9 and the median was 0. The mean number of bacterial species in the final fluid samples was 1.8 and the median was 2. The mean count of cfu for aerobes in the initial amniotic fluid samples was 3.5×10^4, compared to that of the second sample, which was 1.4×10^5. This increase in bacterial count was statistically significant ($P < 0.01$). Likewise, the mean count of anaerobic cfu from the first collection was 4.1×10^2, compared to that of the second sample, which was 8.0×10^3. This increase was also statistically significant ($P < 0.01$).

DISCUSSION

IUPCs are used in laboring patients for monitoring purposes and for performing amnioinfusions. Because they are placed transvaginally, the possibility exists of introducing vaginal flora into the amniotic cavity. The lower genital tract, especially the vagina, represents a unique microsphere of microbiological life.[8] Surveying the microbiology of the genital tract during labor is important to determine

the dynamics of the microbiological ecology of amniotic fluid, e.g., which organisms become dominant and their relationship to the development of chorioamnionitis and endomyometritis. In patients with acute chorioamnionitis, a polymicrobial contamination of the amniotic cavity occurs following rupture of membranes and labor. Gilstrap and Cunningham[9] reported a mean per patient of 2.5 microorganisms, 72% of which were gram-positive cocci. In this study, a mean of 0.9 bacterial species was noted, and final samples demonstrated a mean of 1.8 bacterial species per patient. Of the 3 of 20 patients who developed chorioamnionitis in this study, only 1 patient had bacterial species numbers significantly higher than the means noted.

Inoculum size is a significant factor in the development of chorioamnionitis and postpartum endomyometritis. Both Miller et al.[4] and Gibbs et al.[10] demonstrated that intraamniotic infection occurred with greater than 10^2 cfu. While 80% of the patients in our study had colony counts $\geq 10^2$ cfu, only 19% of this group developed chorioamnionitis. Thus, colonization alone appears not to be the only significant factor. According to Larsen et al.,[11,12] the amniotic fluid contains an active bacterial inhibitor. It was noted in our study that growth occurred despite this amniotic fluid inhibitor. Although bacterial growth occurs, clinical evidence of an infection does not necessarily ensue. Clinical infection may depend on a number of issues, such as pathogenicity (virulence) and tissue invasion. Concentration may also play a role in this process.

In conclusion, our study demonstrated that both the number of bacterial species and the quantitative cfu increase significantly during labor. This factor alone was not enough to result in chorioamnionitis or postpartum endomyometritis in all patients.

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