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A Comparison Between Bacterial Resistance to Common Antibiotics in Breast-Fed and Bottle-Fed Female Infants With Urinary Tract Infection

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Background: Urinary tract infection (UTI) is a common cause for diseases in infants. Various studies have suggested that infants with UTI benefit from a lower rate of breastfeeding compared to control groups. Our experimental evidence showed if breastfed infants are infected with a UTI, their response to treatment is faster and better.
Objectives: The aim of this study is to compare bacterial resistance to common antibiotics in breastfed and bottle-fed female infant.
Patients and Methods: In this cross-sectional analytical study, urine cultures (Uc) were conducted on female infants, under 2 years old, with UTIs. Antibiograms were conducted for Gentamicin, Ampicillin, Amikacin, Ceftriaxone, Cefixime, Cephalexin, Nitrofurantoine, Nalidixic acid, and *Cotrimoxazole*. The results of the two groups were compared: 1) breastfed infants (BrF) and 2) bottle-fed infants (BoF).
Results: Based on our inclusion criteria, 377 female infants suspected of having UTIs were introduced to the study. Among them, 73 infants were excluded from the study. In both groups, the lowest resistance was against Nitrofurantoine (0.7% in BrF vs. 11.2% in BoF) and the highest resistance was against Cotrimoxazole (30.6% in BrF vs. 68.4% in BoF).
Conclusions: Breastfeeding causes lower bacterial resistance to common antibiotics compared to bottle-feeding.

Keywords: Urinary Tract Infection; Breastfeeding; Drug Resistance, Bacterial

1. Background

Now a days, breastfeeding is widely suggested by pediatricians, because its nutritional benefits on the gastrointestinal (GI) system, host defense, and psychosocial aspects of the infant (1, 2). Many studies have suggested that breastfeeding can decrease the rates of upper and lower respiratory tract infections, as well as infections of the GI system (3, 4). Urinary tract infection (UTI) is a common cause of diseases in infants, and it is more common in females due to their shorter urethras (5). Various studies have suggested that infants with UTIs had a lower rate of breastfeeding compared to control groups (6, 7). In these studies, infants with UTIs were compared with control groups and infants suffering from other acute diseases (8). Wold et al. suggested that secretory IgA in mother's milk attaches to *E. coli* type-1 pili and prevents urinary tract infection (9). In addition, Adleberth et al. stated that there are fewer enterococci in the GI system of breastfed infants than in bottle-fed infants, and that *E. coli* isolated from the GIs of breastfed infants had less invasive characteristics (10).

2. Objectives

The aim of this study was to compare bacterial resistance against common antibiotics in two groups of female infants (breastfed (BrF) and bottle-fed (BoF)).

3. Patients and Methods

In this cross-sectional analytical study, all female infants under 2 years of age who were admitted to Amirkabir Hospital (center of pediatric diseases) Arak, Iran, entered into the study based on the inclusion and exclusion criteria. Inclusion criteria were: 1) clinical evidence of UTI; 2) no history of congenital or underlying kidney disorder and 3) no administration of antibiotics by mother or the infant 4 weeks prior to the study. Exclusion criteria were: 1) colony count lower than 100000, 2) urine culture with more than one pathogen or pathogens that do not produce UTI and 3) urine sample contamination. This study was approved by the research ethics committee of Arak University of Medical Sciences. After signing an agreement with the infants' parents, the urine samples were collected in sterile bags. The samples were cultured on

Implication for health policy/practice/research/medical education:
Urinary tract infection (UTI) is a common cause of diseases in infants. We have shown that breastfeeding causes lower bacterial resistance to common antibiotics compared to bottle-feeding.

MacConkey agar, blood agar, and EMB agar for 72 hours. Then, antibiograms were conducted for nine common antibiotics: Gentamicin, Ampicillin, Amikacin, Ceftriaxone, Cefixime, Cephalexin, Nitrofurantoine, Nalidixic acid, and Cotrimoxazole. The data was analyzed with SPSS version PASW Statistics 18 (SPSS Inc, Chicago, IL, USA), using odds ratio, chi-square tests, and logistic regression tests.

4. Results

A total of 377 female infants suspected to UTIs were introduced to the study based on our inclusion criteria. Among those, 73 infants were excluded from the study: in 33 cases (13 BrF and 22 BoF) the urine sample was contaminated, and in 40 cases (24 BrF and 16 BoF) the colony count was lower than 100000. Out of the 304 remaining patients, 117 were admitted to the hospital (53 BrF and 64 BoF) and 187 were ambulatory (99 BrF and 88 BoF); 169 were under 1 year of age (79 BrF and 90 BoF) and 135 were between 1 and 2 years old (73 BrF and 62 BoF). The minimal bacterial resistance rate in the breastfed group was 0.7%, in respond to Amikacin and Nitrofurantoine. The maximal rate was 30.6%, related against Cotrimoxazole. The minimal bacterial resistance rate in the BoF group was 11.2%, in respond to Nitrofurantoine, and the maximal rate was 68.4%, in respond to Cotrimoxazole. There was a significant difference between the BrF and BoF infants in bacterial resistance rate (Table 1).

Table 1. Bacterial Resistance in Female Infants Under Two-Year-Old With UTI In Both Groups

Antibiotics	Bottle-Feed, No. (%)	Breast-Feed, No. (%)	P value	Odd's Ratio
Gentamicin	29 (19.1)	3 (2)	< 0.001	11.71
Ampicillin	87 (57.2)	40 (26.3)	< 0.001	3.748
Amikacin	18 (11.8)	1 (0.7)	< 0.001	20.284
Ceftriaxone	64 (42.1)	7 (4.6)	< 0.001	15.065
Cefixime	76 (50)	9 (5.9)	< 0.001	15.889
Cephalexin	48 (31.6)	5 (3.3)	< 0.001	13.569
Nitrofurantoin	17 (11.2)	1 (0.7)	< 0.001	19.015
Nalidixic acid	85 (55.9)	26 (17.1)	< 0.001	6.148
Co-trimoxazole	104 (68.4)	46 (30.3)	< 0.001	4.993

No bacterial resistance against Gentamicin, Amikacin, or Nitrofurantoine was reported in under one-year-old BrF infants, and the maximal resistance was against Ampicillin. In bottle-fed infants of this age, minimal resistance was against Nitrofurantoine, and maximal resistance was against Cotrimoxazole, then Ampicillin. There was a significant difference between the two groups (Table 2).

Table 2. Bacterial Resistance in Female Infants Under One-Year-old With UTI in Both Groups

Antibiotics	Bottle-Feed, No. (%)	Breast-Feed, No. (%)	P value	Odd's Ratio
Gentamicin	19 (21.1)	0 (0)	< 0.001	-
Ampicillin	51 (56.7)	21 (26.6)	< 0.001	3.612
Amikacin	15 (16.7)	0 (0)	< 0.001	-
Ceftriaxone	32 (35.6)	3 (3.8)	< 0.001	13.977
Cefixime	34 (37.8)	3 (3.8)	< 0.001	15.381
Cephalexin	21 (26.7)	1 (1.3)	< 0.001	28.364
Nitrofurantoin	11 (12.2)	0 (0)	< 0.001	-
Nalidixic acid	46 (51.1)	6 (7.6)	< 0.001	12.72
Co-trimoxazole	54 (60)	19 (24.1)	< 0.001	4.737

In breast-fed infants between one and two years of age, minimal bacterial resistance was against Amikacin and Nitrofurantoine, and maximal resistance was against Cotrimoxazole, then Nalidixic acid. In the bottle-fed group of this age, the lowest resistance was against Amikacin and the highest resistance was against Cotrimoxazole, then Cefixime. Except for Amikacin, there were significant differences in the bacterial resistance rates between the two groups at this age (Table 3).

Table 3. Bacterial Resistance in Female Infants Between One to Two Years Old With UTI in Both Groups

Antibiotics	Bottle-Feed, No. (%)	Breast-Feed, No. (%)	P value	Odd's Ratio
Gentamicin	10 (16.1)	3 (4.1)	< 0.05	4.487
Ampicillin	36 (58.1)	19 (26)	< 0.001	3.935
Amikacin	3 (4.8)	1 (1.4)	0.333	3.661
Ceftriaxone	32 (51.6)	4 (5.5)	< 0.001	18.4
Cefixime	42 (67.7)	6 (8.2)	< 0.001	23.45
Cephalexin	24 (38.7)	4 (5.5)	< 0.001	10.895
Nitrofurantoin	6 (9.7)	1 (1.4)	< 0.05	7.714
Nalidixic acid	39 (62.9)	20 (27.4)	< 0.001	4.493
Co-trimoxazole	50 (80.6)	27 (37)	< 0.001	7.099

E. coli was the most common pathogen in both breastfed and bottle-fed groups. The least common pathogens were *Citrobacter* and *Klebsiella* in the breastfed and bottle-fed groups, respectively. Among *E. coli*, *Klebsiella*, and *Citrobacter*, maximal resistance was against Cotrimoxazole. *E. coli* had the lowest resistance to Nitrofurantoine. *Klebsiella* was completely sensitive to Gentamicin, Amikacin, and Nitrofurantoine, and Citrobacter was sensitive to Amikacin.

5. Discussion

According to the results of this study, *E. coli* was the most common organism in both groups, which was in accordance with many studies in this field (11-15). The level of *E. coli* was about 90% in both groups, however in the study of Mbanga et al. it was about 40.3% (11). In the current study, bacterial resistance rates were lowest against Amikacin and Nitrofurantoine in both infant groups, although the rate in the bottle-fed group was 16 times higher than in the breastfed infants. Our results were somehow different those reported by Caracciolo et al. They concluded that the lowest resistance rate was against Ceftazidime, Ceftriaxone, Nitrofurantoine, and Gentamicin (16), while in the current study, resistance against Ceftriaxone was high in the bottle-fed infants and below 5% in the breastfed group. Moreover, Senel et al. concluded that the lowest rates of bacterial resistance were against Imipenem, Amikacin, Netilmicin, and Ciprofloxacin (13). By comparison, in our study, the rate of resistance against Amikacin in BrF infants was 1%, while in BoF infants was 11.8%.

Our results showed that bacterial resistance to common antibiotics was lower in breastfed infants than in bottle-fed infants. For further elaboration on *E. coli*, it can be said that there are evidences, suggested a lower presence of *Enterobacteriaceae* in the feces of breastfed infants compared to bottle-fed infants; in addition, *E. coli* isolated from the feces of the breastfed infants had lower virulence factors (10). Knowing that the infants in the current study were suffering from UTIs gave us the impression that the bacteria in our study were highly virulent. Researchers do not have any proof of why bacterial resistance is lower in breastfed infants, which shows the need for another study in order to compare the different characteristics of bacteria isolated from these two groups.

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Authors' Contribution

Parsa Yousefi Chaijan participated in the design of the study, data collection. He also performed the statistical analysis. Mojtaba Sharafkhah participated in the study design, statistical analysis and manuscript finalization. Both the authors read and approved the final manuscript.

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References

1. Gartner LM, Morton J, Lawrence RA, Naylor AJ, O'Hare D, Schanler RJ, et al. Breastfeeding and the use of human milk. *Pediatrics.* 2005;**115**(2):496–506.
2. Chung M, Raman G, Trikalinos T, Lau J, Ip S. Interventions in primary care to promote breastfeeding: an evidence review for the U.S. Preventive Services Task Force. *Ann Intern Med.* 2008;**149**(8):565–82.
3. Hanson LA. Protective effects of breastfeeding against urinary tract infection. *Acta Paediatr.* 2004;**93**(2):154–6.
4. Hanson LA, Korotkova M, Haversen L, Mattsby-Baltzer I, Hahn-Zoric M, Silfverdal SA, et al. Breast-feeding, a complex support system for the offspring. *Pediatr Int.* 2002;**44**(4):347–52.
5. Zelikovic I, Adelman RD, Nancarrow PA. Urinary tract infections in children. An update. *West J Med.* 1992;**157**(5):554–61.
6. Marild S, Hansson S, Jodal U, Oden A, Svedberg K. Protective effect of breastfeeding against urinary tract infection. *Acta Paediatr.* 2004;**93**(2):164–8.
7. Marild S, Jodal U, Mangelus L. Medical histories of children with acute pyelonephritis compared with controls. *Pediatr Infect Dis J.* 1989;**8**(8):511–5.
8. Schlager TA, Dudley SM, Dunn ML, Lohr JA. Breast-feeding and urinary tract infections. *Journal Pediatr.* 1992;**121**(2):331.
9. Wold AE, Mestecky J, Tomana M, Kobata A, Ohbayashi H, Endo T, et al. Secretory immunoglobulin A carries oligosaccharide receptors for Escherichia coli type 1 fimbrial lectin. *Infect Immun.* 1990;**58**(9):3073–7.
10. Adlerberth I, Hanson A, Wold A. Ontogeny of the Intestinal Flora. In: Decker BC, editor. Development of the gastrointestinal tract; 2000. p. 279-92.
11. Mbanga J, Dube S, Munyanduki H. Prevalence and drug resistance in bacteria of the urinary tract infections in Bulawayo province, Zimbabwe. *East Afr J Public Health.* 2010;**7**(3):229–32.
12. Ismaili K, Lolin K, Damry N, Alexander M, Lepage P, Hall M. Febrile urinary tract infections in 0- to 3-month-old infants: a prospective follow-up study. *J Pediatr.* 2011;**158**(1):91–4.
13. Senel S, Karacan C, Erkek N, Gol N. A single-center experience of antimicrobial resistance patterns in pediatric urinary tract infection. *Med Princ Pract.* 2010;**19**(5):359–63.
14. Mashouf RY, Babalhavaeji H, Yousef J. Urinary tract infections: bacteriology and antibiotic resistance patterns. *Indian Pediatr.* 2009;**46**(7):617–20.
15. Guidoni EB, Berezin EN, Nigro S, Santiago NA, Benini V, Toporovski J. Antibiotic resistance patterns of pediatric community-acquired urinary infections. *Braz J Infect Dis.* 2008;**12**(4):321–3.
16. Caracciolo A, Bettinelli A, Bonato C, Isimbaldi C, Tagliabue A, Longoni L, et al. Antimicrobial resistance among Escherichia coli that cause childhood community-acquired urinary tract infections in Northern Italy. *Ital J Pediatr.* 2011;**37**:3.