

A Costly Covenant: Ritual Circumcision and Urinary Tract Infection

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ABSTRACT: **Background:** Ritual circumcision in neonates may cause a urinary tract infection within 2 weeks of the procedure.

Objectives: To evaluate the prevalence of urinary tract infection among Jewish male circumcised neonates (≤ 28 days old) evaluated for fever in the emergency room.

Methods: All available medical records of neonates presenting to the pediatric emergency room for evaluation of fever over a 10 year period were reviewed. Data included gender, ethnic background, age (in days) on presentation to the emergency room, age (in days) when circumcision was performed (in males ≥ 8 days of age), and results of urine, blood and cerebrospinal fluid cultures. Families of males older than 8 days of age who had a UTI were contacted by telephone to verify the circumcision status when the infant presented to the ER, to ascertain whether the circumcision had been performed ritually by a *mohel** or by a physician, and, if not recorded in the chart, to verify the day of life on which circumcision was performed.

Results: Among neonates older than 8 days of age, 60 (24.7%) of the 243 febrile Jewish males had a UTI, as compared to 12 (8.4%) of 143 females ($P < 0.0001$). In 39 of 54 male neonates (72%) for whom circumcision was performed ritually on the eighth day of life, UTI occurred within 9 days of the circumcision. For females, there was no such clustering of UTI cases in the second week of life, nor during any other time period.

Conclusions: Febrile male neonates who have undergone ritual circumcision have a high prevalence of UTI and must be evaluated and treated accordingly

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[1] and subsequently substantiated in several well-designed studies [2-5]. Yet, traditional Jewish circumcision performed by a *mohel* has been associated with various complications [6-8], chief among them an increased risk for UTI in the first weeks following the procedure [9-13]. Since virtually all Jewish males in our patient population undergo ritual circumcision on the eighth day of life, we sought to determine the association between this procedure and the occurrence of UTI among male neonates with fever.

PATIENTS AND METHODS

A study we conducted on the prevalence of serious bacterial infection among febrile neonates who fulfill specific “low risk criteria” for sepsis was recently published [14]. The data assessed in this current study were part of the data collected for the previous one, but were neither analyzed nor reported in that publication. All available medical records of neonates (≤ 28 days) presenting to the pediatric emergency room of Shaare Zedek Medical Center for evaluation of fever during the 10 year period from June 1997 through May 2006 were reviewed. Neonates with a rectal temperature of $\geq 38^\circ\text{C}$ measured in the emergency room, or at home prior to arrival, were eligible for this study. All neonates were evaluated for the presence of a serious bacterial infection including UTI. All urine culture specimens were obtained by bladder catheterization or suprapubic aspiration. The following data were collected from the chart of each neonate:

- Gender, ethnic background, age (in days) on presentation to the ER; and for circumcised males, age (in days) when ritual circumcision was performed.
- Results of the urine culture.
- Results of the blood and cerebrospinal fluid cultures among infants with a positive urine culture.

Since the medical records of many of the male neonates did not state whether or not the child underwent circumcision by a *mohel* on the eighth day of life, a telephone survey was conducted to ascertain this information from the families of the males who had a UTI.

Urinary tract infection was diagnosed if there was: any growth of a single known urinary bacterial pathogen, isolated growth of > 1000 colony-forming units/ml of a single skin

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One of the medical benefits of circumcision in newborn males is its protective effect against urinary tract infection, particularly in infancy. This was first recognized in 1982

*A *mohel* is a Jewish man trained in the practice of *Brit milah* (circumcision).

UTI = urinary tract infection
ER = emergency room

bacteria, > 1000 cfu/ml of at least one known urinary bacteria pathogen if two bacteria were isolated, or > 10,000 cfu/ml of at least one known urinary pathogen if three organisms were isolated [15].

STATISTICAL ANALYSIS

Data were typed into a computerized questionnaire written in Epi-Info 6.04d and analyzed by this program and by Epi-Info 3.5.1 (both from the Centers for Disease Control, Atlanta, USA) and PEPI for Windows (Abramson JH & Gahlinger PM, www.brixtonhealth.com). We applied the *t*-test for continuous variables, and the chi-square test (Fisher exact where applicable) for categorical variables. Approval for this study was granted by the Helsinki Committee of Shaare Zedek Medical Center

RESULTS

There were 449 febrile neonates who presented to the ER during the study period for whom complete medical records were available for analysis. Of them, 290 (65%) were males. UTI was found in 67 (23.1%) of the 290 males and 15 (9.4%) of the 159 females (*P* ≤ 0.001). Among neonates older than 8 days of age, 60 (24.7%) of the 243 febrile Jewish males had a UTI, as compared to 12 (8.4%) of 143 females (*P* < 0.0001). Ritual circumcision was verified as having been performed on the eighth day of life in 54 of the 60 males. Of the 54 males, 52 had growth of a single organism and 2 had growth of two organisms. Of the 12 females, 10 had growth of one organism, 1 had two and the other had three organisms. The distribution of bacteria isolated from the urine of the 54 males and 12 females is shown in Table 1. When more than one organism was isolated, the bacteria with the predominant growth were listed. As shown

cfu = colony-forming units

Figure 1. Distribution of UTI cases among 54 males circumcised on the 8th day of life, and all females

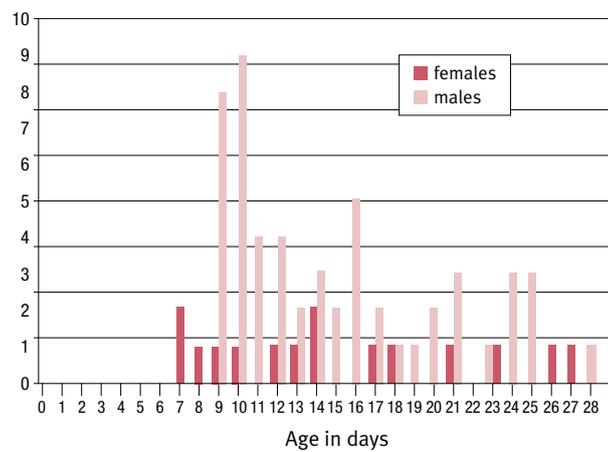


Table 1. Bacteria isolated from urine of the 66 neonates (> 8 days) depicted in Figure 1

Bacteria	No. of cases (%)
<i>E. coli</i>	46 (70)
<i>Klebsiella</i>	7 (11)
<i>Enterobacter</i>	3 (5)
Group B <i>Streptococcus</i>	3 (5)
<i>Citrobacter</i>	2 (3)
<i>S. aureus</i>	2 (3)
<i>Enterococcus</i>	1 (1)
<i>Proteus</i>	1 (1)
<i>Pseudomonas</i>	1 (1)

in Figure 1, among the 54 male neonates, 27 (50%) of the UTI cases occurred within 5 days subsequent to their circumcision, and 39 (72%) within 9 days following circumcision. For females, there was no such clustering of UTI cases in the second week of life, or during any other time period. Trend analysis for UTI among males showed two-tailed *P* < 0.002 by Mann-Kendall, Kendall's tau and Spearman's rho tests.

Importantly, 12 (10 male, 2 female) of the 82 neonates (14.6%) of all ages with UTI were bacteremic with the same organism that was isolated from their urine. Two of the neonates (both males) with UTI and bacteremia also had meningitis, with growth of the same organism in the CSF as was isolated from their urine.

DISCUSSION

In this study we found that febrile male neonates who underwent Jewish ritual circumcision were significantly more likely to have a UTI than their female counterparts. Approximately one-quarter of all Jewish neonates who presented to the ER with fever had a UTI. In the majority of cases the UTI occurred within 9 days following the circumcision.

Our findings are consistent with those of other studies performed in Israel that also found an increased incidence of UTI following Jewish ritual circumcision, with most occurring between 1 and 12 days after [9-13,16]. *Escherichia coli* was the causative organism in the majority of cases in most of the studies, followed consistently in frequency by *Klebsiella*. The data from these various studies are concisely summarized in Table 2. As shown in Table 2, the time period following circumcision during which the incidence of UTI peaks was shorter than reported in other studies.

Recently, Prais et al. [13] retrospectively analyzed the incidence of UTI during the neonatal period among 87 males circumcised by a mohel according to Jewish ritual custom, as

CSF = cerebrospinal fluid

Table 2. Clinical features of male neonates with UTI following ritual circumcision

Author, year [ref]	No. of infants	Percentage of UTIs due to <i>E. coli</i> (E) and <i>Klebsiella</i> (K) respectively	Range in days of post-circumcision period	No. (%) of UTI cases occurring during post-circumcision time range	No. (%) of UTI cases attributed to circumcision with bacteremia
Amir et al., 1984 [9]	8	E - 88 K - 25*	0–17**	8 (100)	3 (38)**
Cohen et al., 1992 [10]	32	E - 67 K - 18	1–12	27 (84)	2 (7)
Goldman et al., 1996 [11]	20	E - 43 K - nr	2–13	14 (70)	4 (29)
Harel et al., 2002 [12]	49	E - 84 K - 13‡	1–22	nr	10 (18)‡
Prais et al., 2009 [13]	42	nr	1–22	nr	nr
Present study	54	E - 70 K - 11	1–9	39 (72)	9 (17%)§

*One urine culture had growth of both organisms

** Reference 16

‡ Out of a total of 55 infants, 6 were circumcised by a physician

§ One of these nine neonates had meningitis with the same organism isolated from the CSF as from the blood and urine

nr = not reported.

compared to 24 males circumcised by a physician according to standard medical practice. They found that 48% in the former group and 25% in the latter developed a UTI, rendering infants circumcised by a mohel 2.8 times (95% confidence interval 1–9.4) more likely to develop a UTI during the neonatal period than infants circumcised by a physician. Harel and colleagues [12] assessed the circumcision technique performed among 55 neonates who subsequently developed a UTI compared to a combined control group of 160 healthy young infants. In this prospective study the authors detected an even greater risk for UTI among neonates circumcised by a mohel compared with those circumcised by a physician, with an odds ratio of 4.34 (95% CI 1.62–12.27). The method of achieving hemostasis varied between the two practices, with the former using a gauze dressing wrapped around the penile shaft, and the latter the application of brief local pressure, calcium-sodium alginate fiber, and a wound cavity dressing that disintegrates within 2–3 hours. Importantly, the mean duration of hemostasis was found to be longer among neonates with UTI than among the control group without (25.6 ± 21.8 vs. 16.6 ± 12.7 hours, $P = 0.007$). Urinary retention caused by gauze pressure, as well as post-circumcision periurethral colonization worsened by the shaft wrapping were therefore suggested as the mechanisms for the development of UTI following ritual circumcision. Previously suggested mechanisms for UTI occurring subsequent to ritual circumcision include non-sterile technique and pain-induced urinary retention [11].

CI = confidence interval

Since in our patient population virtually all males undergo circumcision on the eighth day of life, we were unable to assess UTI incidence in a control group of uncircumcised males. However, data from a large and seminal study by Wiswell et al. [2], which compared the incidence of neonatal UTI among circumcised and uncircumcised males, lend support to the notion that ritual circumcision causes UTI. Of the 100,157 males circumcised by a physician in U.S. Army hospitals, only 20 (0.02%) developed a UTI during the neonatal period. Neonatal UTI was 12 times more common among the 35,929 uncircumcised males in this study, occurring in 88 (0.24%) of such infants. The strong preventive effect of circumcision by a physician against UTI, which this and other studies [1,3–5] have demonstrated, further highlights the phenomenon that we and others [9–13] have described. Not only does ritual circumcision not have a protective effect against UTI in the neonatal period, it appears to have a causative one.

Furthermore, in the study by Ginsburg and McCracken [1], among the 62 male infants with UTIs, 95% of whom were uncircumcised, there were 29 whose UTI emerged between 7 and 29 days of life. The UTI cases among these neonates occurred with an even time distribution over the 3 week period. By contrast, the clustering of UTI cases between days 1 and 9 after ritual circumcision was performed on the neonates in our study points to the procedure as the likely culprit.

Fever in neonates is a relatively common event and may herald a serious bacterial infection such as UTI. As seen in our study, UTI in a very young infant may be particularly dangerous due to the possibility of resultant bacteremia and meningitis.

The incidence of bacteremia associated with post-circumcision UTI among the different studies in Table 2 varies between 7% and 38%. Though meningitis was not reported in the other studies, it is a known, albeit relatively rare complication of neonatal UTI [2,17] and is almost always associated with bacteremia. The potential for these two life-threatening complications associated with neonatal UTI further emphasizes the importance of early diagnosis and treatment of this condition.

A particular limitation of this retrospective study is the potential for error in recall by parents who were contacted in the telephone survey, since in some cases several years had elapsed since the child's circumcision. Nonetheless, even with the passage of time, it would be expected that Jewish parents would correctly remember the day of life on which their son was circumcised, and if the circumcision was performed by a mohel or physician. Other limitations are the lack of a control group of non-circumcised neonates, which we have previously addressed, as well as the lack of a control group of neonates circumcised by a physician. The study has a relatively small number of subjects, though combined with those presented in other similar studies adds further strength to the association between ritual circumcision and neonatal UTI.

Clinical practice guidelines have long recommended empiric intravenous antibiotic treatment and hospitalization for all febrile neonates [18,19]. However, a recent study performed in another region of Israel concluded that in well-appearing febrile neonates who fulfill specific “low risk” criteria, this may not be necessary since the rate of serious bacterial infection, including UTI, is extremely low [20]. We suggest that particularly for febrile male neonates who have undergone ritual circumcision, the significantly increased risk for UTI mandates a high index of suspicion and empiric intravenous antimicrobial therapy in the hospital. Further, the medical community should attempt to change the hemostasis technique used after ritual circumcision. It is likely that this would significantly reduce the incidence of a preventable serious bacterial infection in male neonates.

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