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Review Article

Effects of Circumcision on Urinary Tract Infection and Sexually Transmitted Disease

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Abstract

Circumcision is one of the oldest surgical procedures in the world. Despite its history, the medical benefits and risks of circumcision remain controversial. Although neonatal circumcision reduces the development and recurrence rates of urinary tract infection (UTI) in children, routine circumcision is only recommended in children with high risk of UTI. Further large-scale studies are required to prove if topical steroid hormones are an alternative therapy to circumcision in the prevention of pediatric UTI. In men, it is well-established that circumcision can reduce the risks of transmitting sexually transmitted diseases (STDs), including human immunodeficiency virus (HIV), human papilloma virus, type 2 herpes simplex virus, and syphilis. The World Health Organization and the United Nations Program on HIV/AIDS has recommended promotion of circumcision in areas with a high prevalence of heterosexually transmitted HIV. Since circumcision only partially prevents STD, opponents worry that risk compensation (not using a condom and increased sexual partners) may overwhelmingly reduce the protective effects of circumcision. Parents and patients need to weigh the benefits and risks of male circumcision to make well-informed decisions about this procedure. (*Tzu Chi Med J* 2009;21(3):185–189)

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1. Introduction

Since circumcision may be performed for religious, social, and medical reasons, its prevalence varies widely among different ethnicities and cultures. The reported neonatal circumcision rate is 65.3% in the United States (1), but less than 2% in Scandinavian countries (2). In Taiwan, the prevalence of neonatal circumcision is low, ranging from 0% to 1.4% (3). As boys get older, the prevalence of circumcision increases, from 7.2% at age 7, to 8.7% at age 13 (3).

Despite the long history of circumcision, the medical benefits and risks remain debatable. Herein, we review recent meta-analyses and clinical trials of the role of phimosis in pediatric urinary tract infection (UTI), and adult sexually transmitted disease (STD). The complications of circumcision are summarized. Finally, a brief review of circumcision and sexual function is provided.

2. Circumcision and pediatric UTI

UTI is one of the most commonly observed bacterial infections leading to hospitalization in children. UTIs may reoccur in up to 30% of children; this can result in renal scarring, leading to hypertension [4]. Before the age of 1 year, boys are more susceptible to UTI than girls [5]. The trends of susceptibility in sex reverse after that time. Phimosis is thought to be one of major factors leading to UTI in boys. Hiraoka et al [5] evaluated boys with febrile UTIs and found that the meatus of boys aged 0–6 months among their study subjects was significantly more tightly covered than that in healthy neonates. In Israel [6], boys receive neonatal circumcision routinely at 1 week. The incidence of UTI in Israeli boys peaks 2–4 weeks post-circumcision and then decreases later. As such, the incidence of UTI in Israeli boys is lower than girls after the age of 8 weeks. In boys with acute pyelonephritis under the age of 6 months, a non-retractile prepuce was the most important risk factor for recurrent UTI [7]. In conclusion, phimosis plays an important role in both the development and recurrence of UTI in boys.

A recent systemic review and meta-analysis [8] evaluated the relationships between neonatal circumcision and UTI in boys and concluded that neonatal circumcision may only be beneficial in boys at high risk of UTI. Although circumcision may reduce 90% of UTI in boys, a total of over 195 circumcision procedures are needed to prevent one hospital admission due to UTI. Since 1–2% of boys experienced UTI in the first 10 years of life, which is equal to the 2% complication rate from circumcision, the benefits of circumcision did not outweigh the risks. However, this research has been criticized because the authors may have overestimated the complication rate of neonatal circumcision, and ignored the potential role of neonatal circumcision in the prevention of STD when the children became adults [9]. In addition, the cost of neonatal circumcision is much lower than that performed in childhood and adults.

An alternative therapy to circumcision is topical application of steroids for non-retractile prepuce [10]. In children with UTI, topical steroid treatment reduced the recurrence rate of UTI from 29.7% to 7.1% [11]. However, only a small group of patients was enrolled in that study and further studies are needed to confirm these findings. Topical steroids may not be able to replace the role of circumcision in the reduction of STD transmission in men.

3. Circumcision and STD

3.1. Circumcision and ulcerative STD

A number of observational studies have revealed a significantly lower risk of ulcerative STD in circumcised men [12]. A recent meta-analysis by Weiss et al [12] showed that male circumcision may reduce the risk of syphilis and chancroid infection. The reduced risk of herpes simplex virus type 2 (HSV2) infection was of borderline statistical significance. Male circumcision provided a 33% reduction in the risk of syphilis (relative risk [RR], 0.67; 95% confidence interval [CI], 0.54–0.83), and a 12% reduction in the risk of HSV2 (RR, 0.88; 95% CI, 0.77–1.01). Protective effects against chancroid were noted in six of seven studies (individual study RRs, 0.12–1.11). In 2009, a large scale (n=5534), prospective, randomized study was performed in Uganda evaluating circumcision of adolescents and men in the prevention of HSV2, human papilloma virus (HPV) and syphilis. They found that circumcision provided a 28% reduction in risk of HSV2 (RR, 0.72; 95% CI, 0.56–0.92; p=0.008), with no significant protective role for syphilis (RR, 1.10; 95% CI, 0.75–1.65; p=0.44) [13].

3.2. Circumcision and non-ulcerative STD

Non-ulcerative STD, including *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, and *Trichomonas vaginalis*, pose a threat to public health due to high prevalence and possible serious complications [14,15]. Previous observational studies have revealed conflicting relationships between non-ulcerative STD and circumcision [16–21]. Recently, two large-scale prospective randomized studies evaluated the relationships between adult male circumcision and non-ulcerative STD, and revealed no protective effects of circumcision. One study performed in South Africa revealed that the risk ratios for male circumcision against *N. gonorrhoeae*, *C. trachomatis* and *T. vaginalis* were 0.97 (p=0.84), 0.58 (p=0.065) and 0.54 (p=0.062), respectively [22]. The protective effect against *T. vaginalis* became statistically significant (RR, 0.49; p=0.03) only in the as-treated analysis. The results from a study in Kenya revealed no protective effects of male circumcision on non-ulcerative STD [18]. From multivariate analysis, significant risk factors for non-ulcerative STD were multiple sex partners within <30 days, and sexual intercourse during menses in the previous 6 months. The results confirmed that condom use was the only protective factor while not circumcised. In summary, circumcision yielded no or weak protective effects on non-ulcerative STD.

3.3. Circumcision and HPV infection

HPV infection is related to genital warts, penile cancer in men, and warts and cancer of the cervix, vulva, and vagina in women [23]. The prevalence of high-risk HPV has been estimated to account for 99.7% of cervical cancer [24]. An observational study found

that circumcised men had lower prevalence rates of HPV than uncircumcised men (19.6% *vs.* 5.5%) [25]. Furthermore, partners of circumcised men had lower rates of cervical cancer than partners of uncircumcised men (odds ratio, 0.42; 95% CI, 0.23–0.79). A meta-analysis of observational studies confirmed that male circumcision is associated with a statistically significantly reduced risk of penile HPV and related lesions (RR, 0.56; 95% CI, 0.39–0.82) [26]. Two large-scale prospective randomized interventional studies have been published recently [27,28]. One was performed at Orange Farm in South Africa with 1260 men randomized to the circumcision or control group [27]. In the 1-year follow-up, 14.8% of circumcised men and 22.3% of uncircumcised men had HPV infections. In total, circumcision reduced HPV infection by 34% (RR, 0.66; 95% CI, 0.51–0.86). Another study enrolled 3393 human immunodeficiency virus (HIV)-negative, HSV2-negative, uncircumcised men (age range, 15–49 years) randomized to receive immediate or delayed circumcision at 24 months. They found that circumcision provided a 35% reduction in the risk of HPV infection (0.65; 95% CI, 0.46–0.90) with the prevalence of high-risk HPV genotypes being 18.0% in the intervention group and 27.9% in the control group [28].

3.4. Circumcision and HIV infection

The protective role of circumcision against HIV infection was first proposed in 1986 [29]. Since then, a large number of observational studies have revealed these protective effects [30,31]. From 2002 to 2006, three large-scale, prospective randomized controlled trials were conducted in South Africa [32], Uganda [33], and Kenya [34]. They evaluated the protective effects of circumcision against HIV in adult males. Based on the findings in these three trials [32–34], a recent Cochrane review concluded that medical male circumcision significantly reduces the acquisition of HIV in heterosexual men by between 38% and 66% over 24 months [35]. The reported complication rates were low and circumcision was reported to be quite safe. Inclusion of male circumcision into current HIV prevention policy and guidelines is suggested but further research on cost-effectiveness and feasibility is warranted [35]. A study by Williams et al published in 2006 hypothesized that male circumcision could prevent 2.0 million new HIV infections and 300,000 deaths over the next 10 years in Sub-Saharan Africa [36]. However, there are criticisms that the study ignored the fact that the circumcision has only partial protective effects and risk compensation may eventually hamper the protective effects. The major limitations of circumcision in the prevention of STD is risk compensation, i.e. men who have undergone circumcision then increase risky behavior, such as not using condoms and increasing the number of sexual partners [37]. In the South African trial [32], circumcised men reported higher numbers of sexual acts. The study in Kenya [34] did not report significant changes in behavior.

Since circumcision did not provide a completely protective effect against STD, circumcised men who increase risky behavior may eventually have an equal or higher rate of STD infection. In addition, HIV-infected circumcised men did not have a lower transmission rate of HIV to their sex partners, and risk compensation may increase the infection rate of partners [37].

3.5. Rationale for prevention of STD

There are several theories that explain why circumcision may prevent men from contracting STD [30]. The first is that coverage of the prepuce provides a warm, moist area that makes replication of virus and bacteria easier. The second theory is that uncircumcised men easily sustain micro-abrasions on the skin during intercourse which gives an access to infection. Another plausible explanation is that the inner surface of the prepuce is abundant in CD4+ cells, macrophages, and dendritic cells (the target cells of HIV) without the protection of a keratinized surface. After removal of the inner surface during circumcision, the susceptibility of hosts to HIV may decrease. Both ulcerative and non-ulcerative STDs have been shown to facilitate the transmission of HIV in numerous studies [38]. Circumcision protects the hosts from ulcerative STD infection which may cause small wounds on the penis, and thus provides additional protective effects. According to a study by Fleming and Wasserheit, other STDs were associated with a two- to five-fold increase in HIV transmission rate in countries with different circumcision rates [39]. Although the exact role of these HIV cofactors is still unknown [40], it has been hypothesized that HSV2 and syphilis may enhance HIV acquisition by causing small lesions over the mucosa that permit HIV entry while simultaneously recruiting HIV-susceptible cells to the mucosa [41]. The mechanisms responsible for the synergistic association of HSV2 and syphilis have recently been further elucidated—demonstrating that both syphilitic and HSV2-infected tissue have increased numbers of CCR5-expressing T cells, theoretically increasing HIV susceptibility in active ulcerative STD [40].

3.6. Complications of circumcision

Generally, circumcision is a safe procedure with a reported complication rate ranging from 0.2% to 0.3% [42]. The rate of complication decreases as the surgeon's experience increases. In a study performed in Uganda in which 3011 men were circumcised,

the mean operative time required to complete surgery was approximately 40 minutes for the first 100 procedures, declining to 25 minutes for the subsequent 100 circumcisions [43]. The rate of moderate and severe adverse events was 8.8% (10/114) for the first 19 unsupervised procedures after training, 4.0% for the next 20–99 (13/328) and 2.0% for the last 100 (p=0.003) [43]. The reported complications included death, bleeding, suture sinus tracts, infection, phimosis and concealed penis, adhesions, meatitis, meatal stenosis, chordee, urethrocutaneous fistula, amputations, and hypospadias [42].

3.7. Sexual function and circumcision

The function of the prepuce in human sexual response continues to be debated. A significant number of circumcised men experienced worsened erectile function and decreased penile sensitivity with improved satisfaction because of curing of underlying phimosis and balanoposthitis [44]. However, in two studies performed in Africa, adult male circumcision was not associated with sexual dysfunction [45,46]. Circumcised men reported increased penile sensitivity and enhanced ease of reaching orgasm. Regarding the satisfaction of female partners, O'Hara and O'Hara [44] surveyed women who had experience of sex with both circumcised and uncircumcised partners. A significant number of women reported greater likelihood of experiencing vaginal orgasm, less discomfort, and greater intimacy with an uncircumcised partner. However, another large prospective study [47] in South Africa recently showed that only 2.9% of women reported less sexual satisfaction after their partners were circumcised. The overwhelming majority of women (97.1%) report either no change or improved sexual satisfaction after their male partner was circumcised.

4. Conclusions

Circumcision lowers the rate of pediatric UTI and adult STD. Since circumcision is not without complication and does not completely avoid the risk of STD, routine circumcision is not recommended for infants and adults. Circumcision for medical reasons is suggested in children with repeated balanoposthitis and a high risk of UTI, and in adults living in areas with a high prevalence of STD.

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