The purpose of this site is to provide a balanced up-to-date review of scientific studies on circumcision that have been published mainly in reputable international medical and scientific journals after a formal, critical refereeing process by experts in the field. 329 References are cited. Most can be found by the reader in any medical library. The message they convey is quite clear. Unfortunately, the topic of circumcision has been made unnecessarily controversial because of emotive propaganda and opinions placed on the internet by extremist anti-circumcision organizations. It is the intention of the present overview to provide sound information that should be of assistance to parents, medical professionals and others who wish to be informed. The author is a full professor in the medical faculty of a major university and has over 33 years of scientific research experience.

**WHAT IS CIRCUMCISION?**

Circumcision is the removal of a simple fold of skin (the 'foreskin' or 'prepuce') that covers the head (glans) of the un-erect penis. The amount of this skin varies from virtually none to a considerable amount that droops down from the end of the flaccid penis. Thus, in some men, during an erection, the head of the penis peeks out from the loose foreskin that surrounds it, but in men with a lot of foreskin the head of the penis remains covered, either partially or completely. A recent questionnaire-based survey conducted by Badger in Sydney, Australia found that among men with a foreskin, in 67% the foreskin not only covered the glans of the penis when flaccid, but there was extra skin hanging off the end, in 15% it just covered the glans, in another 15% it half covered the glans, and in 4% the glans was bare. In the erect state these numbers were 15% extra skin, 22% still covered, 32% half covered, and 41% glans bare. Racial differences exist. For
example, in Malaysia, New Guinea, Sri Lanka and southern India the foreskin is very long and ends in a narrow extension that acts like a muzzle. This is an impediment to sexual intercourse, so that circumcision facilitates procreation for these men. A short prepuce that rarely covers the glans completely is seen in Whites of the northern Mediterranean and many Asians (Chinese and Japanese). In uncircumcised males the head of the penis is pink. This becomes more apparent when the head of the penis emerges during an erection, giving the overall penis a "two-toned" look. In male babies the foreskin is lightly attached to the penis underneath it, much like the skin on an orange, and comes free over the course of the first few years of life. A variety of methods are, moreover, used to remove the foreskin, and the amount eliminated also varies. More on this later.

WHO IN THE WORLD GETS CIRCUMCISED?

Circumcision is one of the most common medical procedures in the world. It is also one of the oldest [78, 174], and one of the simplest, with 25 circumcisions performed every minute worldwide [117]. The fact that it is still popular must mean that there is something in it! In the USA, which has the greatest medical knowledge and medical expertise in the world, 65-90% of males are circumcised (more than 1.2 million newborns per year [195, 274]. Those who are not circumcised are mainly from cultures in which it is unfamiliar (e.g., Hispanic, as well as many European and Asian). Globally approx. 25% of men are circumcised [190]. Such a high rate for elective surgery involving the genitalia suggests important net benefits. Moreover, in most western countries circumcision, where practiced, tends to be a family tradition that has nothing to do with religion. With the rise in information from medical research in recent years, informed parents are learning more and more of the lifelong benefits that circumcision can convey to the health and well-being of their children, and are insisting on this simple procedure. In majority populations of the Middle East and in peoples derived from there, such as Jews and Muslims, circumcision is a mandatory part of their religion. However, on the other side of the world in Australia, aboriginals also practice circumcision, as do Pacific Islanders. So did the Aztecs. Why is this? A common theme in each case is that these diverse races and cultures have traditionally inhabited a hot and sometimes arid sandy environment, where the heat, sweat and, often, sand getting under the foreskin would be expected to cause considerable irritation. Ritual removal has been the outcome, irrespective of whether this was a "command from God" or just plain common sense, that when embedded in the religion or culture over millennia lost its original health-related significance. Interestingly, in some places, such as Madagascar, circumcision is 100% regardless of religion, and the reason is actually dictated by the women, who maintain that circumcised sex is "longer, stronger and cleaner". All of this is good "dinner party" conversation. However, sociology is a muddy area to trek in to, so this review tries to steer clear of issues like this, as well as religion, as far as possible.

THE CIRCUMCISION DEBATE

Historically circumcision has been a topic of emotive and often irrational debate. At least part of the reason is that a sex organ is involved. (Compare, for example, ear piercing.) In the USA circumcision has always been common amongst the majority Anglo-Celtic Whites and also amongst Afro-American Blacks. Australia similarly once conducted routine circumcision of all newborn boys. In both countries a down-turn took place after the mid-1970s, but is now rising again in each as the medical and health benefits are becoming better known.

The misinformation that produced the downtrend years ago is still embedded in the consciousness of some medical practitioners who hail from the 70s, and their proteges. In fact there have even been reports of harassment by medical professionals (such as less well-informed midwives, nurses and doctors) of new mothers, especially those that can be more readily identified because they belong to religious groups that practice circumcision, in an attempt to stop them having this procedure carried out. There has been a trend by pediatric bodies to skirt the truth in favor of what could be viewed as 'New-Age political correctness', spurious "human rights" rhetoric, or perhaps fear of litigation stemming from the rare surgical mishap. The policy statements of professional
pediatric bodies have been misused by others as part of an "appeal to authority" fallacy [108], which is often used as a substitute for supplying an actual argument. The bodies themselves also see a trend and copy it so that the statements of one of them can be seen to trigger a "bandwagon" response. Those who write the policy statements are often physicians with little or no academic expertise. Not surprisingly they have been criticized by academic experts, as discussed below.

POSITION STATEMENTS BY NATIONAL PEDIATRIC BODIES

Through the 1990s and into the new millenium a reversal of the downtrend began. In the light of an increasing volume of medical scientific evidence pointing to the benefits of neonatal circumcision, the pediatric professional bodies of various countries have been forced to review the evidence and formulated recent policy statements. The reports have to be read in their entirety to be fully comprehended. Isolated quotes taken from these by anti-circ groups can be a problem. What is stated in the details of the various reports is much like what is presented in the present review of the medical literature. However, it is important to note that vital facts have been distorted, watered down or omitted from the various reports of pediatric bodies, whereas the present review is very much more comprehensive and balanced. Moreover, no medical body has advocated prohibition of circumcision and arguments by opponents are weak and specious [294]. The latest statements of the American Association of Pediatrics in 1999 [168], the Canadian Paediatric Society in 1996 [87] and the Royal Australian College of Physicians, Divisions of Paediatrics and Child Health in 2002 [242] provide information on the benefits and possibility of rare or minor risks. These suffer, however, from falling short of drawing the obvious conclusion from the evidence they present, i.e., that circumcision is the best choice for lifetime health and sexual well-being. The hesitancy is undoubtedly a consequence of the sensitivity of this issue, as well as medico-legal caution and the recognition of the hysteria that this subject can provoke because of the diversity of opinion in the community, where anti-circ groups tend to bombard such professional bodies in an attempt to "win" their political cause. More on this can be found in the section "Anti-circumcision lobby groups". The British Medical Association has not even attempted to review the medical literature, producing instead a pompous, head-in-the-sand, paternalistic and legalistic statement in 2003 [37, 38].

By and large the statements of most of these professional bodies tend to recommend that medical practitioners fully inform parents of the benefits and minor, rare risks of having their male children circumcised. Thus publicly most give the impression that the benefits and harms are very evenly balanced [87]. Indeed, professional societies have carefully avoided taking sides in the polarized debate, by making noncommittal guidelines and leaving it to the medical practitioner to discuss the matter with the parents [93]. While such bland tolerance has accommodated a broad range of strong and conflicting opinions, the medical profession is now faced with a growing knowledge-base that indicates a wide range of health benefits of circumcision, meaning that the time is fast approaching when affirmative statements cannot be avoided [93]. Indeed, Prof Roger Short states "If we believe in evidence based medicine, then there can be no debate about male circumcision; it has become a desirable option for the whole world" [268]. Of course, well-informed medical practitioners only have to read the present statements of pediatric bodies in full to be able to draw their own conclusion. In a deplorable ploy, the Royal Australasian College of Physicians (RACP) 2002 Policy Statement sidestepped making a conclusion by instead substituting the words there 'is no medical indication for routine infant male circumcision', i.e., that the foreskin as it presents at birth lacks any medical indication that would mandate its removal. This tactic is to be condemned as inexcusably irresponsible, especially in the current era of preventative medicine and medical knowledge of the benefits of circumcision. Recognized authoritative figures in the USA in particular strongly advocate circumcision of all newborn boys. More details of what they have said appear later.
WHY THE FORESKIN INCREASES INFECTION RISK

As a prelude to this, one needs to first understand the anatomy. The foreskin is composed of an outer layer that is keratinized, i.e., as is skin generally, and an inner layer that is a mucosal surface. The inner lining thus resembles other mucosal epithelia such as line the cervix, nasal passages and rectum. It had been suggested that the foreskin protected the glans from drying out and becoming keratinized. However, histological examination has shown the same amount of keratin in the skin of the head of the penis irrespective of circumcision status [279]. The inner layer lines a 'preputial sac', which becomes a repository for shed cells, secretions and urinary residue that accumulates [54, 212]. It is also a hospitable environment for the growth of bacteria and other microorganisms. During an erection the head and shaft of the penis extend so that the inner layer becomes exteriorized along the distal half of the shaft. This exposes it to infectious agents during sexual intercourse. It has been speculated that the prepuce is a source of secretions, pheromones, etc, but given the dubious authorship of these reports and the absence of any research support, such suggestions should be regarded as fanciful.

It has been suggested [43] that the increased risk of infection in the uncircumcised may be a consequence of the following:

- The foreskin presents the penis with a larger surface area.
- The moist inner lining of the foreskin represents a thinner epidermal barrier than the more cornified outer surface of the foreskin and the rest of the penis, including the glans of both circumcised and uncircumcised penises, which have been found to have the same amount of keratin (i.e., similar skin thickness and protection from invasion of microorganisms) [279]. This means that the inner lining is a potential entry point into the body for viruses and bacteria. (A photograph of a histological section illustrates this later, in the section on the AIDS virus.)
- The presence of a prepuce is likely to result in greater microtrauma during sexual intercourse, thereby permitting an entry point into the bloodstream for infectious agents.
- The warm, moist mucosal environment under the foreskin favours growth of micro-organisms (discussed in detail later). The preputial sac has even been referred to by Dr Gerald Weiss, an American surgeon, as a 'cesspool for infection' [302], as its unfortunate anatomy wrapped around the end of the penis results in the accumulation of secretions, excretions (urine), dead cells and growths of bacteria as referred to above. Parents are told not to retract the foreskin of male infants, which makes cleaning difficult. Even if optimal cleansing is performed there is no evidence that it confers protection [317, 318].

HISTORY AND RECENT TRENDS

Circumcision pre-dates recorded history. Egyptian mummies and wall carvings record the practice of circumcision over 6000 years ago [6]. Along with Columbus’ 'discovery' of North America he noted that many of the natives there were circumcised [99]. In fact circumcision is seen in diverse people all over the world, ranging from African, the Middle East, parts of Asia, Australian aboriginals, Pacific Islanders and native Americans, both North and South. Whether this indicates a very ancient origin that was part of human practice as our species colonized the globe, or whether it arose independently in different regions of the world will probably never be known. There is evidence to suggest that hygiene may be one reason, as appears to be the case for elite classes in ancient Egypt and the Aztec peoples [234]. Ritualistic circumcision has been practiced in West Africa for more than 5000 years and in the Middle East for over 3000 [190, 299]. It is virtually universal in the Jewish and Muslim religions.

In the late 19th century circumcision became routine as a result of pronouncements in publications by various physicians most notably Remondino [6, 107, 234]. The procedure rapidly gained popularity and became routine. Although most of the claims in Victorian times were absurd, some have nevertheless stood the test of time, including prevention of penile cancer, syphilis, balanoposthitis and phimosis.
A trend not to circumcise started in the UK in 1948 when Britain adopted a nationalized healthcare system and removed procedures in which it considered cost exceeded benefit. Circumcision also dropped rapidly across Europe after a (misguided) paper by Gairdner in 1949 [99]. It was not until the early 1970s that a similar fall happened in Australia and Canada, in response to statements by the pediatric bodies in each country [16, 57]. Curiously a similar statement by the American Academy of Paediatrics (AAP) Committee for the Newborn in 1971 that there are "no valid medical indications for circumcision" [56] had only a slight effect. In 1975 this was modified to "no absolute valid ..." [287], which remained in the 1983 statement, but in 1989 it changed significantly to "New evidence has suggested possible medical benefits" [8]. However, in the 1999 Statement [168] the AAP went backwards. Although the literature review was academically weak, this did, nevertheless, mention the vast array of benefits. Its major flaw was that it fell short of stating the obvious, if it had used a more balanced literature survey, in recommending circumcision. As mentioned above this is quite understandable, given medico-legal worries in the face of very hostile, politically active anti-circ groups. Interestingly, a joint response by the previous Chair of the AAP Taskforce and others more expert than those on the recent Taskforce rebutted the 1999 statement [260, 261]. Others also levelled valid criticisms [28, 160]. The various statements highlight the information that follows in the present much more comprehensive and better balanced web review. It is clear that providing a scientific and balanced statement by a pediatric body is difficult in the face of minority lobby groups whose agenda tends to be a political one rather than medical or scientific. This is not to detract from the clear scientific weaknesses in the 1999 AAP Statement and their pamphlet [28, 260].

Dr Edgar Schoen, Chairman of the 1989 Task Force on Circumcision of the American Academy of Pediatrics, has stated that the benefits of routine circumcision of newborns as a preventative health measure far exceed the risks of the procedure [256]. He has continued to this day to campaign for public education of the benefits of circumcision. During the period 1985-92 there was an increase in the frequency of post-newborn circumcision (to over 80% in one study [322]) and during that same time Schoen points out that the association of lack of circumcision and urinary tract infection (UTI) has moved from "suggestive" to "conclusive" [256]. Moreover, this period heralded the finding of associations with other infectious agents, including HIV. In fact he goes on to say that "Current newborn circumcision may be considered a preventative health measure analogous to immunization in that side effects and complications are immediate and usually minor, but benefits accrue for a lifetime" [256].

Some of the health benefits are:

- Decrease in physical problems involving a tight foreskin [201].
- Lower incidence of inflammation of the head of the penis [79, 82,85].
- Fewer urinary tract infections.
- Fewer problems with erections, especially at puberty.
- Decrease in certain sexually transmitted diseases (STDs) such as HIV.
- Almost complete elimination of invasive penile cancer.
- Decrease in urological problems generally [reviewed in 6, 8, 17, 87, 162, 246, 254] to cite just a few. More details appear in specific sections to follow)

Therefore the benefits are different as the human male progresses through life. Each of these benefits will be reviewed in more detail in this website.

**DIFFERENT SPECIALISTS SEE DIFFERENT THINGS**

Neonatologists see only newborns and thus only see the problems of the operation itself performed on infants. In fact such problems occur in only a minor proportion of baby boys, and generally because of poor technique by an inexperienced operator. However, urologists who see and have to treat the problems of uncircumcised males of all ages cannot understand why all newborns are not circumcised [254, 256]. Other health care workers in hospitals and aged care
homes also have adverse comments concerning the uncircumcised penises they see and have to deal with, problems with catheters for urinary drainage, and the deranged reactions of elderly men with dementia when attempts are made to wash the genital area. The demand for circumcision later in childhood has increased, but, with age, there is an inevitable increase in worry to the boy or man in the lead-up to having this done, usually a more visible scar is left, and the cost can be 10-times as great. Such considerations, coupled with the advantages of early circumcision, led Schoen to state "Current evidence concerning the life-time medical benefit of newborn circumcision favours an affirmative choice" [256].

**BENEFITS OUTWEIGH THE RISKS**

Dr Tom Wiswell, a respected authority in the USA was a strong opponent, but then switched camps as a result of his own research findings and the findings of others. This is what he has to say: "As a pediatrician and neonatologist, I am a child advocate and try to do what is best for children. For many years I was an outspoken opponent of circumcision ... I have gradually changed my opinion" [314, 315]. This ability to keep an open mind on the issue and to make a sound judgement on the balance of all available information is to his credit ... he did change his mind!

Wiswell looked at the complication rates of having or not having circumcision performed in a study of 136,000 boys born in US army hospitals between 1980 and 1985. 100,000 were circumcised and 193 (0.19%) had complications, mostly minor, with no deaths, but of the 36,000 who were not circumcised the problems were more than ten-times higher and there were 2 deaths [322]. A study by others found that of the 11,000 circumcisions performed at New York's Sloane Hospital in 1989, only 6 led to complications, none of which were fatal [246]. An early survey saw only one death amongst 566,483 baby boys circumcised in New York between 1939 and 1951 [195]. (There are no deaths today in developed countries.)

Problems involving the penis are encountered relatively frequently in pediatric practice [167]. A retrospective study of boys aged 4 months to 12 years found uncircumcised boys exhibited significantly greater frequency of penile problems (14% vs 6%; P less than 0.001) and medical visits for penile problems (10% vs 5%; P less than 0.05) compared with those who were circumcised. In infants born in Washington State from 1987-96, 0.2% had a complication arising from their circumcision, i.e., 1 in every 476 circumcisions [50]. It was concluded that 6 urinary tract infections could be prevented for every circumcision complication, and 2 complications can be expected for every penile cancer prevented [50].

**PAIN AND MEMORY**

No adverse psychological aftermath has been demonstrated [251]. A longitudinal study in the UK, beginning in 1946, involving over 5000 individuals followed from birth to age 27 found no difference in developmental and behavioural indices between circumcised and uncircumcised males [44]. Long term psychological, emotional, and sexual impediments from circumcision are anecdotal [190, 311] and can be discounted. It must be recognized that there are many painful experiences encountered by the child before, during and after birth [186]. Circumcision, if performed without anaesthetic is one of these. Cortisol levels, heart rate and respiration have registered an increase during and shortly after the procedure [211, 213], indicating that the baby is not unaware of having had something painful done in instances when circumcision has been carried out without anesthesia. It is therefore generally advised that local anesthetic be used for all circumcisions on infants (more on anesthesia later). The response is variable and, even without anesthetic, some babies show no signs of distress at all. Most do, however, and this may be contributed by the restraining procedure, as well as the surgery itself. In the past doctors and parents had to weigh up the need to inflict this short-term pain in the context of a lifetime of gain from prevention or reduction of subsequent problems. Use of anesthetic for circumcision makes it virtually pain-free.
PENILE HYGIENE

The proponents of not circumcising nevertheless stress that lifelong penile hygiene is required. This acknowledges that something harmful or unpleasant is happening under the prepuce. Studies of middle class British [140] and Scandanavian [207] schoolboys concluded that penile hygiene, as such, is at best poor and at worst non-existent. Furthermore, Dr Terry Russell, an Australian medical practitioner and circumcision expert states "What man after a night of passion is going to perform penile hygiene before rolling over and snoring the night away (with pathogenic organisms multiplying in the warm moist environment under the prepuce)" [246]. The bacteria start multiplying again immediately after washing and contribute, along with skin secretions, to the whitish film, termed 'smegma', that is found under the foreskin. Bacteria give off an offensive odour. Men differ in their sensitivity to this smell and some shower several times a day as a result (See section 'What men say'). Some uncircumcised men, and/or their partners, find the stench so unpleasant that the smell has caused these men to seek a circumcision on this basis alone. Penile hygiene is often difficult to achieve and attempting a very high degree of hygiene in uncircumcised men can result in new dermatological problems. For mothers and fathers, it is far easier to maintain cleanliness of their son's penis if it is circumcised. If their son is not circumcised the messages are confusing: should they clean under the foreskin or leave it alone?

Anti-circ activists make unusual claims about the smegma and even claim there are glands under the foreskin that secrete pheromones important in sexual attraction. There is no support for such claims and all of their statements should be regarded as fantasies unless proved otherwise by credible scientific evidence. The wet tip of an uncircumcised penis could permit quicker penetration. However, the requirements of the modern woman generally differ somewhat from this kind of sex, which might have had some benefit for primitive humans who may have wanted to complete the sex act quickly to minimize the time they were vulnerable to predators.

WHAT MOTIVATES PARENTS TO GET THEIR BABY BOY CIRCUMCISED

The reasons for circumcision, at least in a survey carried out as part of a study at Sydney Hospital, were: 3% for religious reasons, 1-2% for medical, with the remainder suggested by the researchers as "to be like dad" or a preference of one or both parents for whatever reason [73]. The main reason may have more to do with hygiene and appearance, as will be discussed later in the section on socio-sexual aspects.

RATES OF CIRCUMCISION

USA: In the USA the rate of circumcision has always been high, although differs in different regions. The rates are recorded by the Centre for Disease Control's National Center for Health Statistics (NCHS) [195]. Since only those circumcisions recorded are included in the statistics, these are minimum estimates, and are more useful for determining trends rather than absolute rates. The most recent rate given is 65.3%. For Whites there was no change (65.8 vs 65.5%). For Blacks it rose from 57.9% to 64.4%. The rates recorded in the north-east region were steady at 70%, while rates rose in the mid-west (80%) and South (70%). For the western region rates have been falling due to the influx of Hispanics (50% of all births, so diluting out the overall rate in California to 35%). Since Whites were not subdivided into Non-Hispanic and Hispanic the overall statistics show an increase in circumcision rate for Non-Hispanic Whites. In the West individual hospital data shows the rate for Non-Hispanic Whites is in fact 75-80%, confirmed by physical
examination of adolescents as 82% [70]. Interestingly, for the next generation of Hispanics, 29% of boys are circumcised (San Francisco General Hospital data). Importantly, as noted, the actual rates are higher than indicated by this data. Since these data represent only the numbers reported, whereas not all are: under-reporting being more than 10% in one large study [104]. Even when they are supposed to be, they are often not listed on the medical record face sheet used in NCHS surveys, so that after the oversights were corrected in one study, infant circumcision rate increased from 75% to 89% [198]. The rates differ for different ethnic groups. Whites of Anglo-Celtic derivation have high rates, as do Blacks. In Hispanics the rate is quite low, circumcision not being a part of their culture. Thus high Hispanic populations will contribute to an overall lower rate for a particular region. In La Canada Hospital, Los Angeles, in which 71% of patients are upper-income whites, 83% of parents chose circumcision for their sons [2]. In comparison the Children's Hospital, LA, which serves primarily Hispanics, reported only 16% being circumcised [2]. Amongst 1508 poor adolescents in Texas rate was 82% in whites, 58% in Blacks and 22% in Hispanics, by direct physical examination [70]. The lower rates amongst non-Jewish European immigrants also contributes to a reduction in the overall rate for the entire USA. Interestingly, no difference has been found between families with and without private health insurance to cover the costs [226].

Canada:

The rate in that country varies markedly between different regions. Even in the same province, Ontario, for example, the rate between different districts ranges from 2% to 70%, with a mean of around 50% . (Data from Ontario Ministry of Health and Statistics Canada, and Institute for Clinical Evaluative Sciences.)

Australia:

In the study in Sydney referred to earlier [73] the proportion of men who were circumcised when examined at this clinic was 62%. Of those studied, 95% were white, with younger men just as likely to be circumcised as older men. In Adelaide, South Australia, a similar proportion has been noted, except that the rate in younger men (55%) was slightly lower [120]. Medicare statistics, which relate only to rebate claims for circumcision, and are thus underestimates, show a rate of 17% Australia-wide [199], implying an actual rate of at least 20%, and probably higher to accord with the rates seen in adults. For boys aged less than 6 months the rate has risen over the past decade from 10.6% in 1994 to 12.7% in 2004 [199]. In the largest state, New South Wales, the rate rose from 11.3% to 16.3%. In the next biggest state, Queensland, it increased from 16.3% to a current steady rate of 19.5-20.8% over the past few years [199]. Again, to emphasize, the actual number circumcised is upwards of this lower limit. They do not include circumcisions paid for privately or covered by Veterans insurance, nor do they cover circumcisions done by hospital doctors to public patients in public hospitals. In this regard, different states have different public hospital policies, it being apparently easier to get a public patient circumcised by a hospital doctor in a public hospital in Western Australia, for example. This could explain the lower reported Medicare rates in this state and others, such as Victoria, especially when one compares rates in the neighbouring states of South Australia and New South Wales. The influence of ritual circumcisions in Jews would be small as the Australian Jewish community is less than 0.4% of the population. Another group in which the males are circumcised are the Muslims, but these make up only approx. 1% of Australians. In regards the current overall rate, it would seem that a new survey is needed to determine the proportion of the total male population that is circumcised to see if it is rising or falling from the level of approx. 50% seen in the surveys conducted in the early 1990s.

Britain:

In the UK, the following rates have been reported: 7-10% for boys aged less than 15 years in one study [237], 12.5% for males aged 16-24 years, 15.9% for 25-34 year-olds, and 26.4% for the 35-44 year age group (n = 1,874, 2,111 and 2,049, respectively) in another [306], 48% in 305 London
males aged 4-93 (av. 42 years of age) [178], and in the 2000 British National Survey of Sexual Attitudes and Lifestyle 15.8% of 16-44 year-olds were circumcised, the rate being 19.9% in those aged 40-44 and 11.7% in the 16-19 year age group [65]. In Scotland figures from the NHS, which offers circumcision routinely, give an annual rate in 0-13 year-olds of 4% in 2000 [225]. Newborn circumcision was dropped by the British NHS in 1949 in response to the famous physician Douglas Gairdner who was opposed to it, noting 16 deaths annually, although these were from the general anesthetics employed back then, NOT the circumcision itself.

Africa, Middle-East, Asia, India, Pakistan:

In these regions the rates vary according to religion and culture, with rates approaching 100% amongst Muslims, Jews and certain tribes, and low rates amongst some other groups and nations. Hindus for example do not usually circumcise. For Christians, advocacy differs amongst different groups or denominations.

RECORDED incidence of NEWBORN circumcision in different COUNTRIES [6]:

- USA: 65%: Ethnic breakdown: White 65-81%, Black 64-65%, Hispanic 54-64%) [170, 195]. Regional breakdown: Northeast 65.4%, Midwest 81.4%, South 64.1%, West 36.7% [195]
- Canada: 35% [174]
- Australia: 13% [199]
- England: 6% [236]
- Scandinavia: 2% [96]
- Europe, Russia, China, Japan: Low (no published studies)
- South Korea: 5-10% (rising to greater than 90% by age 18; av. age 12) [211]

RELIGIONS:
- Judaism: greater than 95%
- Islam: 15% (rising to greater than 95% by adulthood; average age 6) [247]

PHYSICAL PROBLEMS

These are more than twice as frequent in uncircumcised boys [98]

**Phimosis:** This is generally regarded as narrowing of the foreskin orifice so as to prevent retraction of the foreskin over the glans. Phimosis is normal in very young boys, but is gone by age 3 in 90%. If still present after age 6 it is regarded as a problem. Phimosis affects at least 10% of uncircumcised males, the reported rates being: 20%, as seen by Gairdner in 5-13 year-olds [99], 8% at age 8 in Danish boys [207], 14% in British soldiers [206], and 9% in German youths [248] and men [253]. Although a rate of 50% in men in Japan [202] and Bali [35] has been reported, a more recent study found that by age 11-15, 77% had a retractable prepuce [135]. There is also the condition of pathological phimosis from secondary cicatrization of the foreskin orifice arising from balanitis xerotica obliterans and which has a rate of 1% [236]. The narrow foreskin opening causes urinary obstruction that can be partial or complete. Backward pressure to the kidney may impede its function and lead to high blood pressure, which is associated with increased risk of heart attack and stroke. Phimosis also increases risk of penile cancer (discussed later) and treatment by complete circumcision to prevent this outcome is advocated [14]. It can be treated with topical steroid creams, but these need to be applied for at least a month, are not completely successful and offer no benefit to other conditions associated having a foreskin.

**Paraphimosis:** This is when the retracted foreskin cannot be brought back again over the glans and is a very painful problem, relieved by circumcision or slitting the dorsal surface of the foreskin.

**Zipper injury** In uncircumcised boys the foreskin can become accidentally entrapped in zippers, resulting in pain, trauma, swelling and scarring of this appendage. Foreskin accidents in men can also occur.
Elderly men In elderly men, infections and pain from balanoposthitis (see below), phimosis and paraphimosis are seen and carers report problems in achieving optimal hygiene in uncircumcised men. The need for an appliance for urinary drainage in quadraplegics and in senile men is facilitated if they are circumcised. Nursing home staff have particular difficulty performing their duty of washing the genital area of uncircumcised elderly men, particularly with the onset of dementia. Such men can react violently towards staff or family during attempts to wash under the foreskin. This is an under-recognized problem and far from the mind of a parent or neonatologist when considering circumcision for an infant and information on the gerontological perspective should also be given [94].

Bathroom 'splatter' Boys and men who are not circumcised can be a source of irritation if they do not retract the foreskin when they urinate, as 'splatter' will occur. Although not a medical problem, it is a source of annoyance for other people (such as a parent or partner) if it is they who have the job of cleaning the bathroom.

The foreskin problems referred to above also mean intercourse is painful.

Frenular chordee This results from an unusually thick and often tight frenulum and prevents the foreskin from fully retracting, being present in a quarter of all uncircumcised males [110]. The frenulum then tears during intercourse or masturbation. Since scar tissue is generally more fragile and less elastic than normal tissue, the tear often re-occurs causing pain, bleeding and is an impediment to sexual activity. This problem can be solved by excising the frenulum during a circumcision. Frenoplasty (removing just the tight frenulum) is also possible.

Psychological sequelae Follow-up 5 years later of 117 boys circumcised for phimosis, balanitis scarring of the prepuce, or ballooning when urinating found that 95% expressed complete satisfaction and the only psychological effect was slight shyness in the school change-room in 9% of boys in this Swedish study [275, 276]. The study showed that parents had nothing to fear for their son's psychological well-being from circumcision.

INFLAMMATORY DERMATOSES

Balanitis and posthitis: To paediatric surgeons, the most obvious medical reasons for circumcision are balanitis (inflammation of the glans) and posthitis (inflammation of the foreskin). Both are very painful conditions. The latter is limited to uncircumcised males. Balanitis is seen in 11-13% of uncircumcised men, but in only 2% of those who are circumcised [85, 155]. In uncircumcised diabetic men it is 35% [155]. In boys the incidence of balanitis is twice as high in those who are uncircumcised [97, 126]. In babies, balanitis is caused by soiled diapers, playing and sitting in dirty areas, antibiotic therapy, as well as yeast and other micro-organisms. Balanitis caused by the group A haemolytic variety of Streptococcus is present exclusively in uncircumcised boys [204].

Penile skin diseases also include psoriasis, those arising from penile infections, lichen planus, schorrheic dermatitis, and Zoon balanitis. The various conditions have been extensively reviewed [80, 155] and are either much more common in, or totally confined to, uncircumcised males. For example, all patients with plasma cell (Zoon) balanitis, Bowenoid papulosis, and non-specific balanoposthitis were uncircumcised [178]. Mycobacterium smegmatis has been implicated Zoon balanitis [80]. Typical symptoms of the latter include erythrema (in 100%), swelling (in 91%), discharge (in 73%), dysuria (in 13%), bleeding (in 2%) and ulceration (in 1%) [155].

Balanoposthitis (inflammation of the foreskin and glans) is common in uncircumcised diabetic men, owing to a weakened shrunken penis [85] and such men also have more intercourse problems. Diabetes is common, inherited and rising in incidence, so this, especially when there is
a family history of diabetes may add to considerations about whether to circumcise an infant at birth.

Most cases of inflammatory dermatoses are diagnosed in uncircumcised men (overall odds ratio 3.2). Thus circumcision is protective [178]. The disorders include psoriasis, penile infections, lichen sclerosus, lichen planus, schorrheic dermatitis, and Zoon balanitis (referred to above). All patients with Zoon balanitis, bowenoid papulosis, and nonspecific balanoposthitis were uncircumcised. Lichen sclerosis is found in 4-19% of all foreskins [75]. In older patients progressive Lichen sclerosis or other inflammatory changes lead to phimosis [21]. For a more extensive account on diseases of the penis see the references: [80, 155]

URINARY TRACT INFECTIONS

Infections of the urinary tract (UTI) are regarded as being common in the pediatric population [157]. The highest prevalence and greatest severity of UTIs is prior to 6 months of age [258, 317]. The association of UTI with lack of circumcision is unequivocal. Most of the evidence has emerged over the past 20 years or so.

In 1982 it was reported that 95% of UTIs in boys aged 5 days to 8 months were in uncircumcised infants [105]. This was confirmed by Wiswell [324] and a few years later Wiswell and colleagues found that in 5261 infants born at one US Army hospital, 4% of UTI cases were in uncircumcised males, but only 0.2% in those who were circumcised [325]. This relatively captive population in Hawaii was said to be more reliable than the rate reported for hospital admissions [319]. Wiswell then went on to examine the records for 427,698 infants (219,755 boys) born in US Armed Forces hospitals from 1975-79 and found that the uncircumcised had an 11-fold higher incidence of UTIs [321]. During this decade the frequency of circumcision in the USA decreased from 84% to 74% and this decrease was associated with an increase in rate of UTI [320]. Reviews by others in the mid-80s concluded there was a lower incidence in circumcised boys [175, 239]. The rate in girls was stable during the period it was increasing in boys, in whom circumcision was in a decline. In a 1993 study by Wiswell of 209,399 infants born between 1985 and 1990 in US Army hospitals worldwide, 1046 (496 boys) got UTI in their first year of life [322]. The number was equal for boys and girls, but was 10 times higher for uncircumcised boys. Among the uncircumcised boys younger than 3 months, 23% had bacteremia, caused by the same organism responsible for the UTI.

In a study of 14,893 male infants aged less than 1 year who had been delivered during 1996 at Kaiser Permanente hospitals in Northern California, with 65% circumcised, 86% of the UTIs occurred in the uncircumcised boys [258, 260]. The mean cost of management in the boys was US$1111, being twice that of girls (US$542), reflecting a higher rate of hospital admission in uncircumcised males with UTI (27%) compared with females (7.5%). Mean age at admission also differed: 2.5 months for uncircumcised boys vs 6.5 months for girls. Total cost was 10-times higher for uncircumcised boys vs girls ($155,628 vs $15,466). There were 132 episodes of UTI in uncircumcised males, but only 22 in those who had been circumcised. Hospital admissions were 38 vs 4, respectively. Incidence during the first year of life was 2.2% in uncircumcised boys and just 0.22% in circumcised (odds ratio = 9:1). The incidence in the girls was 2%. In a commentary to this article, Wiswell points out that half of infants with acute pyelonephritis get renal scarring that then goes on to predispose to serious, life-threatening conditions later in life, meaning also a large, ongoing costs [319]. Unlike adults, children, especially the very young are more likely to develop such renal injury and scarring. In fact imaging studies have shown that 50-86% of children with febrile UTI and presumed pyelonephritis have renal parenchymal defects [243], which persist. In a 27-year follow-up study risk of hypertension in these was 10-20%, and 10% were at risk of end-stage renal disease [136]. UTIs are thus far from benign disorders of infancy. Moreover, the AAP Subcommittee on Urinary Tract Infections recommends a urine culture for any child under 2 with unexplained fever.
It should be noted that these studies gave figures for infants admitted to hospital for UTI, so that the actual rate would undoubtedly have been higher. Moreover, many fevers for which infants are admitted could have an undiagnosed UTI as the basis. The rate of UTI in uncircumcised boys may thus be higher than 2%.

The infection can travel up the urinary tract to affect the kidney, so explaining the higher rate of problems such as pyelonephritis and renal scarring (seen in 7.5% [231]) in uncircumcised children [244, 277]. Moreover, as reported in Science in 2003, the E. coli responsible for UTI form impenetrable, protective "pods" on the walls of the bladder, so explaining the well-known ability of the bacteria responsible for UTI to persist in the face of robust host defences and antibiotic administration [12].

These and other reports [e.g., 62, 105, 125, 244, 265, 277] all point to the benefits of circumcision in reducing UTI. Because UTIs are associated with long-term morbidity and potential mortality [157], prevention by measures such as infant male circumcision is highly desirable.

Wiswell performed a meta-analysis of all 9 studies that had been published up until 1992 and found that every one had observed an increase in UTI in the uncircumcised [322]. The average was 12-fold higher and the range was 5- to 89-fold, with 95% confidence intervals of 11-14 [322]. Meta-analyses by others have reached similar conclusions.

A large study in Canada of equal numbers of neonatally circumcised and uncircumcised boys saw rates of UTI and hospital admissions for UTI that were 4-fold higher in the uncircumcised [288]. In Australia, a relatively small study in Sydney involving boys under 5 years of age (mean 6 months) found that 6% of uncircumcised boys got a UTI, but only 1% of circumcised [61].

The benefit appears to extend beyond childhood and into adult life. In a study of men aged, on average, 30 years, and matched for race, age and sexual activity, the circumcised had a lower rate of UTI [272].

The fact that fimbriated strains of the bacterium Escherichia coli which are pathogenic to the urinary tract and pyelonephritogenic, have been shown to be capable of adhering to the foreskin, satisfies one of the criteria for causality [98, 106, 141, 142, 277, 320, 323]. In a prospective study of 25 boys who underwent circumcision for medical reasons, specimens of periurethral bacterial flora were taken prior to as well as 3 weeks after surgery [310]. Before circumcision, 52% harboured uropathogenic organisms (E. coli and other coliforms 93%, Enterococcus spp 9%, Proteus spp 8%, Pseudomonas spp 4%, and Klebsiella spp 2%), but after circumcision, none of the boys had uropathogens. It was postulated that circumcision converts a 'cul-de-sac' that is a reservoir of organisms capable of causing ascending UTI into a surface colonized by natural skin organisms. This study supports the idea that circumcision protects against UTI. In another study in 2004 pathogenic bacteria were reported to be present in the peri-urethral region of 64% of boys (without phimosis) prior to circumcision, but in only 10% four weeks after circumcision [113]. For the glanular sulcus these figures were 68% and 8%, respectively, and the bacteria were similar in each location. This study concluded that the origin of periurethral flora is the deeper preputial regions and also emphasized the beneficial role of circumcision [113]. Thus in infancy and childhood the prepuce becomes colonized with bacteria. Fimbriated strains of Proteus mirabilis, non-fimbriated Pseudomonas, as well as species of Klebsiella and Serratia also bind closely to the mucosal surface of the foreskin within the first few days of life [98, 106, 320]. Circumcision prevents such colonization and subsequent ascending infection of the urinary tract [329].

Swabs taken of the periurethral area (the region of the penis where urine is discharged) in 46 circumcised and 125 uncircumcised healthy males (mean age = 27; range = 2 to 54 years) showed a predominance of Gram positive cocci in both groups, facultative Gram negative rods in 17% of uncircumcised males, but in only 4% of circumcised (P = 0.01) [264]. Streptococci, strict anaerobes (bacteria that can grow without oxygen) and genital mycoplasms (bacteria that lack a cell wall) were found almost exclusively in uncircumcised males over the age of 15 years (82% of
the study group) [264]. Since these organisms are common inhabitants of the female genital tract, acquisition via sexual transmission was suggested. These latter categories of bacteria, unlike the Gram positive cocci, are potential pathogens capable of causing UTIs. It was speculated that when Gram negative organisms are the only colonizers of the preputial space they achieve higher concentrations and that the quantitative difference may contribute to the development of UTI. The findings of this study provide a microbiological basis for the observed higher risk of UTI in uncircumcised adult men. The authors also concluded that their results pointed to a role for the prepuce as a reservoir for sexually transmitted organisms [264]. Another study, conducted in Dublin, involving swabs from the periurethral area, found that antibiotic prophylaxis in boys with vesicoureteral reflux was not effective in reducing the bacterial colonization of the prepuce, and recommended circumcision to reduce UTIs [47]. Vesicoureteral reflux increases risk of UTI, putting those boys in great danger from renal damage [91]. Salmonella typhimurium has also been found (in a 10 month old boy) and circumcision not only prevented further UTI, but also the spread of this organism to the general public [271].

Since the absolute risk of UTI in uncircumcised boys is approx. 1 in 25 (0.05) and in circumcised boys is 1 in 500 (0.002), the absolute risk reduction is 0.048. Thus 20 to 50 baby boys need to be circumcised to prevent one UTI. However, the potential seriousness and pain of UTI, which can in rare cases even lead to death, should weigh heavily on the minds of parents. Obtaining a midstream urine sample for culture from a circumcised boy is easy [27]. However, valid urine samples from uncircumcised boys requires invasive techniques such as transurethral catheterization and suprapubic bladder aspiration [11, 27, 157]. The complications of UTI that can lead to death are: kidney failure, meningitis and infection of bone marrow. The data thus show that much suffering has resulted from leaving the foreskin intact. Lifelong genital hygiene in an attempt to reduce such infections is also part of the price that would have to be paid if the foreskin were to be retained. However, given the difficulty in keeping bacteria at bay in this part of the body [207, 256], not performing circumcision would appear to be far less effective than having it done in the first instance [244]. Moreover, the effectiveness of newborn circumcision in preventing UTI (greater than 90%) means it has a similar protective effect as many vaccines given to children to prevent diseases [26 0]. Thus, just as for immunization, in the era of preventative medicine circumcision should be vigorously promoted in an effort to prevent the tens of thousands of boys that are afflicted with this painful condition that can also have lifelong cardio-renal health implications.

SEXUALLY-TRANSMITTED INFECTIONS

Ulcerative STIs (chancroid, syphilis) are associated with lack of circumcision, as seen in over 11 studies (for review see [190]). There are no studies to the contrary [190]. For other STDs the overall picture indicates greater prevalence in uncircumcised men, although some more recent studies have shown no difference (reviewed in [190]).

The possible protection afforded by circumcision against syphilis, genital herpes and urethritis was recognized over a century ago [234]. Subsequently, in 1947, a study involving 1,300 consecutive patients in a Canadian Army unit showed that being uncircumcised was associated with a 9-fold higher risk of syphilis and 3-times higher gonorrhea [313]. Then, in the mid-70s work by the London Hospital showed higher chancroid (an infectious venereal ulcer), syphilis, papillomavirus and herpes in uncircumcised men [285]. Subsequent to this, a study in 1983 at the University of Western Australia showed twice as much herpes and gonorrhea, 5-times more candidiasis and 5-fold greater incidence of syphilis [213]. In South Australia, a study in 1992 showed that uncircumcised men had more chlamydia (odds ratio 1.3) and gonococcal infections (odds ratio 2.1) [121]. Others have reported higher rates of nongonococcal urethritis in uncircumcised men [270].

In 1988 a study in Seattle of 2,776 heterosexual men reported higher syphilis and gonorrhea in uncircumcised men, but no difference in herpes, chlamydia and non-specific urethritis (NSU) [58].
Like this report, a study in 1994 in the USA, found higher gonorrhea and syphilis, but no difference in other common STDs. An earlier (1987) study of 9514 sexually transmitted infection patients from a US military base found higher nongonococcal, but not gonococcal, urethritis in those who were circumcised [270]. In 1994, Dr Basil Donovan and associates reported the results of a study of 300 consecutive heterosexual male patients attending Sydney STD Centre at Sydney Hospital [73]. They found no difference in NSU, genital herpes (24% having a history [31]) or seropositivity for HSV-2 (65% [31]) and genital warts (i.e., the benign, so-called 'low-risk' human papillomavirus types 6 and 11, which are visible on physical examination, unlike the 'high-risk' types 16 and 18, which are not). As mentioned earlier, 62% were circumcised and the two groups had a similar age, number of partners and education. Gonorrhea, syphilis and hepatitis B were too uncommon in this Sydney study for them to conclude anything about these other STIs. Similar findings were obtained in the National Health and Social Life Survey in the USA, which asked about gonorrhea, syphilis, chlamidia, nongonococcal urethritis, herpes and HIV (a virus more often acquired intravenously in heterosexual i.v. drug-using men in the USA) [169], although some under-reporting by uncircumcised men was likely as they tended to be less educated. Also, circumcision at birth was assumed, so that the number who sought circumcision later in life for problems, such as STIs and/or other infections, and therefore had switched group, was not taken into account. In a cross-sectional and cohort study from a multicentre controlled trial involving 2021 men in the USA from 1993 to 1996, and using multiple logistic regression to compare STI risk among circumcised and uncircumcised men adjusted for potentially confounding factors, uncircumcised men were significantly more likely to have gonorrhea in the multivariate analysis adjusted for age, race and site (odds ratio 1.3 and 1.6 for each respective study) [71]. This was also the case for syphilis (odds ratios 1.4 and 1.5), but not chlamydia.

Design aspects of a number of the studies have been criticized. As a result there is still no overwhelming agreement. Nevertheless, on the bulk of evidence, it would seem that at least some STIs could be more common in the uncircumcised. This conclusion is, however, by no means absolute in Western settings, and the incidence may be influenced by factors such as the degree of genital hygiene, availability of running water and socioeconomic group being studied. In some more recent studies in developed nations, in which hygiene is good, little difference was apparent in the more common STIs.

**CANCER OF THE PENIS**

**Incidence**

The predicted lifetime risk of penile cancer for an uncircumcised man has been estimated as 1 in 600 in the USA and 1 in 900 in Denmark [154]. Penile cancer accounts for approx. 0.2% of all malignancies in men in the USA and 0.1% of cancer deaths, the 5-year survival rate being 50% [9]. Mortality rate is 25-33% [154, 177]. The annual incidence of cancer of the penis in the USA is approx. 1 per 100,000 men per year [9, 63] (In comparison cervical cancer is 10 times higher [see below], prostate cancer is 100 times higher, and fatal heart attack is 200 times higher.) Statistics on the American Cancer Society web page point to 1,570 new cases of penile cancer in 2004 and an estimated 270 deaths [9]. Neonatal circumcision virtually abolishes the risk [168, 189]. The rate data in the USA has to be viewed in the context of the high proportion of circumcised men in the USA, especially in older age groups, and the age group affected (mean age at presentation = 60 years), where older men represent only a portion of the total male population. Thus the incidence of 1 in 100,000 men per year of life translates to 75 in 100,000 during each man's lifetime (assuming an average life expectancy of 75 years). However, penile cancer occurs almost entirely in uncircumcised men. If we assume that these represent 30% of males in the USA, the chance an uncircumcised man will get it would be (very approximately) 75 per 30,000 = 1 in 400. Perhaps not surprisingly this accords with the incidence that is actually seen (as stated at the beginning of this paragraph).
In 5 major series in the USA, starting in 1932 [326], not one man with invasive penile cancer had been circumcised neonatally [177], i.e., this disease is almost completely confined to uncircumcised men. In fact penile cancer is so rare in a man who has been circumcised in infancy, that when it does occur it can even be the subject of a published case report [143]. The finite residual risk appears to be greater in those circumcised after the newborn period, but is still less than in the uncircumcised [177, 259, 260].

Lifetime risk in the total population of circumcised men is only 1 in 50,000 to 1 in 12,000,000 [316, 317]. In a study of 213 cases in California only 2 of 89 men with invasive penile cancer were circumcised in infancy, so that uncircumcised men were stated to have 22 times the risk [259, 260]. Of 118 with the localized, and thus more easily curable, variety of penile cancer, namely carcinoma in situ (which is not lethal), only 16 had been circumcised as newborns, i.e., incidence was 3-fold higher in the uncircumcised [177, 259, 260].

Overall there were 50,000 cases of penile cancer in the USA from 1930 to 1990 and these resulted in 10,000 deaths. Only 10 of these cases were in circumcised men [255], and these had been circumcised later in life. In Denmark (circumcision rate = 2%), penile cancer has been decreasing steadily [96] in parallel with an increase in indoor bathrooms. Urban unmarried men were more likely to get it. Since the rate of penile cancer in Denmark is lower than in the USA other factors besides circumcision are also at work in these climatically, genetically and culturally different countries. The statistics for Denmark have been used by anti-circ advocates to draw a sweeping and fallacious conclusion about lack of circumcision per se in penile cancer. The Danish themselves have concluded that although their uncircumcised men are at lower risk, this is only 1 in 900 as opposed to 1 in 600 in the USA, as stated above [154]. A study in Spain concluded that "circumcision should be performed in childhood [as a] prophylactic [to penile cancer] [249].

In underdeveloped countries the incidence is higher: approx. 3-10 cases per 100,000 per year [154]. In those underdeveloped countries where circumcision is not routinely practiced, such as South America and parts of Africa, it can be ten times more common than in developed countries, representing 10-22% of all male cancers [9, 112, 194]. In Uganda and some other African countries it is the most common malignancy in males, leading to calls for greater circumcision in that country [72]. Enormous differences are, moreover, seen in third world nations such as Nigeria (circumcised: low rate) when compared with Uganda, Puerto Rico [328] and Brazil [295], where most males are uncircumcised.

In Australia there were 78 cases in the year 2000, and over the decade to this year cases averaged approx. 60 per year [19]. Of these, 4% were in their 30s, 14% in their 40s, 15% in their 50s, 22% in their 60s, 31% in their 70s, and was 12% in those aged over 80 [19]. One in four died as a result, the rate being higher in older men. The incidence figures were 0.8 per 100,000 population [19], i.e., was similar to the USA, and was also similar in each state of Australia. Lifetime (age 0-74) risk was estimated as 1 in 1,574 males [19]. As in the USA, the majority of older men in Australia are circumcised, so any decline in proportion of uncircumcised males in the Australian population will be expected to be accompanied by an escalation in the rate of penile cancer.

As a comparison, the rate of cervical cancer is 10 times higher, with 745 cases in Australia in 2000 (incidence 7.6 per 100,000) and 265 deaths [19].

In Israel, where almost all males are circumcised, the rate of penile cancer is extremely low: 0.1 per 100,000, i.e., is 1/10th that of Denmark [328].
Cause

Cancer of the penis presents as carcinoma in situ or invasive penile cancer. The proportion of each of these is roughly equal. The latter is lethal, whereas carcinoma in situ is not. Human papillomavirus (HPV) is present in most basaloid and warty carcinomas which comprise 50% of cases [112]. Similarly, in women, half of all vulvar carcinomas are HPV-positive (cf. the close to 100% positivity for high-risk HPVs in cervical cancer). High-risk HPV is found more frequently in verrucous carcinomas than giant condylomas (which are caused by low-risk HPV) and keratinizing and verrucous carcinomas are HPV positive in one-third of cases [112]. Thus high risk HPV (types 16, 18 and a large number of rarer types) are found in a large proportion of cases and there is good reason to suspect that they are involved in the causation of penile cancer [185], i.e. the same virus is responsible as is the case for virtually all cases of cervical cancer in women (see below). The distribution of HPV on the penis has been reported as 28% foreskin, 24% shaft, 17% scrotum, 16% glans and 6% urine [300]. HPVs, notably high-risk types, are more common in uncircumcised males [48, 155, 196]. In a recent large study published in the New England Journal of Medicine HPV was detected in 19.6% of 847 uncircumcised men, but only 5.5% of 292 circumcised men (overall odds ratio after adjusting for potential confounding factors = 0.37) [48]. The high-risk types of HPV produce flat warts that are normally only visible by application of dilute acetic acid (vinegar) to the penis. The majority of infections are subclinical, being more prevalent in uncircumcised men with balanoposthitis [155]. The data on high-risk HPVs should not be confused with the incidence figures for genital warts, which are large and readily visible, and are caused by the relatively benign HPV types 6 and 11 [147]. Smegma (found only under the foreskin) was implicated in an early study [223]. It is not clear, however, what component was responsible, and could have been HPV present in the smegma. Interestingly, 93% of men whose female partner was positive for early signs of cervical cancer (cervical intra-epithelial neoplasia, CIN) had the male equivalent, penile intra-epithelial neoplasia (PIN) [20]. This reflects the fact that the disease, via HPV, is sexually transmitted. Oncogenic HPV was present in 75% of patients with PIN grade I, 93% with PIN grade II and 100% of PIN grade III, which is one step before penile cancer itself [20]. Moreover, the rate of PIN was 10% in uncircumcised men cf. only 6% in circumcised men [20]. Phimosis is strongly associated with invasive penile carcinoma (adjusted odds ratio = 16) [290]. Other factors, such as smoking, poor hygiene and other STDs have also been suspected as contributing to penile cancer as well [28, 177], but it would seem that lack of circumcision is the primary prerequisite, with such other factors adding to the risk in the uncircumcised man. Indeed, there is no scientific evidence that improved penile hygiene is effective in reducing the risk in an uncircumcised man [190].
Treatment

Complete or partial surgical amputation of the penis is the traditional treatment. Radiation is an alternative (or additional) therapy and in early-stage disease can preserve function of the organ. In a retrospective study in Switzerland of 41 consecutive patients with non-metastatic invasive carcinoma of the penis 44% underwent surgery (to remove all or part of the penis, as well as lymph nodes in one third), followed by radiation therapy (in three-quarters) and the rest (56%) had just radiation therapy [329]. Over the median 70 months of follow-up 63% relapsed. For all patients 5-year survival rate was 57% and 10-year survival was 38%. Local relapse rate was lower in those who underwent surgery. However, there was no difference in survival when compared with radiation therapy, either alone, or in conjunction with salvage surgery.

The psychosexual implications to a man are, understandably, not inconsequential [203]. The fact that, as is the case for breast cancer, the sex-related organ is often surgically removed, adds to the devastating physical and emotional impact of penile cancer. But the 5-year survival rate is lower [233]. It would be cold comfort to a man so afflicted to know that his disease could almost certainly have been prevented had he been circumcised in infancy.

Cost

Financial considerations are, moreover, not inconsiderable. In the USA it was estimated that the cost for treatment and lost earnings in a man of 50 with cancer, even back in 1980, was $103,000 [122]. The amount today is very much higher.

Deaths from penile cancer vs. circumcision

In Australia between 1960 and 1966 there were 78 deaths from cancer of the penis and 2 from circumcision. (Circumcision fatalities today are virtually unknown.) At the Peter McCallum Cancer Institute 102 cases of penile cancer were seen between 1954 and 1984, with twice as many in the latter decade compared with the first [250]. Moreover, several authors have linked the rising incidence of penile cancer to a decrease in the number of neonatal circumcisions [64, 250]. It would thus seem that "prevention by circumcision in infancy is the best policy". Indeed it would be an unusual parent who did not want to ensure their child was completely protected by this simple procedure.

PROSTATE CANCER

Prostate cancer accounts for one quarter of all new cancers in males and 7% of deaths [19]. Uncircumcised men have twice the incidence of prostate cancer compared with circumcised [14, 84], and this cancer is rare amongst Jews [7]. No association has been seen between rate of prostate cancer and rate of cervical cancer in different geographic localities [241]. However, in a study of 20,243 men in Finland, infection with HPV18 was associated with a 2.6-fold increase in risk of prostate cancer (P less than 0.005) [69]. For HPV16 the increased risk was 2.4-fold.

CERVICAL CANCER IN FEMALE PARTNERS OF UNCIRCUMCISED MEN

A number of studies have documented higher rates of cervical cancer in women who have had one or more male sexual partners who were uncircumcised. The earlier studies have to be looked at critically to see to what extent cultural and other influences might be contributing within groups that have different circumcision practices. Of interest in studies conducted in India and Pakistan, premarital sex is uncommon in the various religious groups in these and surrounding countries, where in general Muslims are circumcised and Hindus are not. In a study of 5000 cervical and 300 penile cancer cases in Madras between 1982 and 1990 the incidence was low amongst Muslim women, when compared with Hindu and Christian, and was not seen at all in Muslim men [100]. In a case-control study of 1107 Indian women with cervical cancer, sex with uncircumcised men or
those circumcised after the age of 1 year was reported in 1993 to be associated with a 4-fold higher risk of cervical cancer [3]. This figure was, moreover, obtained after controlling for factors such as age, age of first intercourse and education. Another study published in 1993 concerning various types of cancer in the Valley of Kashmir concluded that universal male circumcision in the majority community was responsible for the low rate of cervical cancer compared with the rest of India [67]. In Israel, a 1994 report of 4 groups of women aged 17-60 found that Moshav residents with no gynaecological complaints had no HPV 16/18 and healthy Kibbutz residents had a 1.8% incidence [134]. Amongst those who had a gynaecological complaint HPV 16/18 was found in 9% of Jewish and 12% of non-Jewish women. Thus the causative agent (high-risk HPV) can be found in Jewish women, where the lifestyle and contact with non-Jewish men (some of whom may be uncircumcised) would likely have been higher in the Kibbutz dwellers. The source of this (circumcised vs. uncircumcised partners) was not explored.

So-called 'high-risk' HPV types 16, 18 and some rarer forms are responsible for virtually every case of cervical cancer [218, 296, 297]. These same high-risk HPVs also cause penile intra-epithelial neoplasia (PIN), which is the precursor to penile cancer and is the male equivalent of cervical intra-epithelial neoplasia (CIN), which is the precursor to cervical cancer. In a study published in the New England Journal of Medicine in 1987 it was found that women with cervical cancer were more likely to have partners with PIN [29]. A study in 1994 found that in women with CIN, PIN was present in the male partner in 93% of cases [20]. This is consistent with the known sexual transmission of this cancer-causing virus. The abnormality termed CIN may progress to cancer or, more often, it will go away. Thus co-factors are suspected. Interestingly, smegma (the film of bacteria, secretions and other material under the foreskin), obtained from human and horse was shown to be capable of producing cervical cancer in mice in one study [220], but not in another [232]. Differences in exposure time in each study could have contributed to this difference.

In 2002, a large, well-designed multinational study by the International Agency for Research on Cancer published in the New England Journal of Medicine has irrefutably implicated the foreskin in cervical cancer [48]. This involved 1913 couples in 5 global locations in Europe, Asia and South America. Penile HPV was found in 20% of uncircumcised, but only 5% of circumcised men (odds ratio = 0.37). The women were more 5.6 times more likely to have cervical cancer if their partner was uncircumcised. Penile HPV infection was associated with a 4-fold increase in the risk of cervical HPV infection in the female partner, and cervical HPV infection was associated with a 77-fold increase in the risk of cervical cancer. In an accompanying editorial it was suggested that "reduction in risk among female partners of circumcised as compared with uncircumcised men may well be more substantial than reported" in this study [1]. This may be because skin-to-skin contact that does not extend to sexual intercourse with the uncircumcised penis could infect the woman. Indeed, condom use had NO significant protective effect! - the odds ratio between condom users (0.83) was not significantly different from non-users (0.67) [48]. Genital HPV types are highly infectious and can infect skin throughout the genital region. Interestingly, the uncircumcised men washed their genitals more often after intercourse, but the circumcised men had better penile hygiene, when examined by a physician. So why are uncircumcised men much more highly infected? One suggested reason was that the more delicate, easily-infected, mucosal lining of their foreskin is pulled back during intercourse, and so is wholly exposed to vaginal secretions of an infected woman, so infecting them, and increasing risk of infection to any future woman the uncircumcised man has sex with.

Thus the epidemic of cervical cancer worldwide would appear to be contributed, at least in part, by the uncircumcised male. In countries that have experienced a downturn in circumcision rate one might therefore expect to see the incidence of cervical cancer get even worse. This could apply particularly in regions where neonatal circumcision decreased in the late 1970s and 1980s, meaning men that were born then and not circumcised will now have reached sexual maturity and be increasingly putting at risk women today. Although vaccine development is in progress, it should be noted that there are 200 types of HPV, 50 of which have been described in the anogenital region. Although vaccination against the two most common types (HPV 16 and 18) could
prevent two-thirds of cervical cancers [X Castellsague , personal communication], this falls short of 100% protection. It is, moreover, premature to speculate on date of implementation, cost, or participation, noting that like the anti-circ movement there are also vigorous anti-immunization lobby groups in our society. Also a finding that HPV vaccines can increase tumor invasiveness [156] suggests that their use may still be some way off.

HERPES SIMPLEX VIRUS TYPE 2 IN WOMEN

Just as described above for HPV, a history of sexual intercourse with an uncircumcised man (ever) was reported in 2003 to be a risk factor for herpes simplex virus type 2 (HSV-2) infection in women. After multivariate logistic regression an analysis odds ratio was 2.2 (95% CI 1.4-3.6) [49]. This study was conducted in Pittsburgh, Pennsylvania amongst 1207 women aged 18-30 years whose overall HSV-2 seroprevalence rate was 25%. The high rate of HSV-2 worldwide highlights the need for amelioration of risk factors. Circumcision should therefore also help reduce HSV-2 transmission and prevalence.

HIV: THE AIDS VIRUS

HIV infection is via the foreskin

Over 60 million people have been infected with HIV (15,000 each day; 4.3 million in 2003), with 37.8 million currently living with HIV, and 25 million having died as a result, leading to greater than 15 million children being orphaned [www.unaids.org] [219]. By 2050 there could be one billion infected [114]! Half of HIV cases are men, most of whom have been infected through their penises [155], the foreskin being implicated as early as 1986 [88]. Over 80% of these infections have arisen from vaginal intercourse [139]. How then does HIV enter a man's body in this way? Epidemiological data from more than 40 studies (discussed below) shows that HIV is much more common in uncircumcised, as opposed to circumcised, heterosexual men [91]. A wealth of evidence indicates that male circumcision protects against HIV infection, as acknowledged in the major journals Science [138] and Nature [305], and its promotion in HIV prevention is advocated [76].

During heterosexual intercourse the foreskin is pulled back down the shaft of the penis, meaning that the whole of its inner surface is exposed to vaginal secretions [279]. An early suggestion that attempted to explain the higher HIV infection in uncircumcised men was that the foreskin could physically trap HIV-infected vaginal secretions and provide a more hospitable environment for the infectious inoculum [45]. It was also suggested that the increased surface area, traumatic physical disruption during intercourse and inflammation of the glans penis (balanitis) could aid in recruitment of target cells for HIV-1. Initial thoughts were that the port of entry could potentially be the glans, sub-prepuce and/or urethra. It was suggested that in a circumcised penis the drier,
more keratinized skin covering the penis may prevent entry. However, more recent studies showed that the glans of the circumcised and uncircumcised penis were in fact identical in histological appearance, having exactly the same amount of protective keratin [279]. In contrast, the inner lining of the foreskin is a mucosal epithelium and lacks a protective keratin layer [24] (see picture below taken, with permission, from [24]. The foreskin’s inner epithelium thus resembles histologically the lining of the nasal passages and vagina. All such mucosal epithelia are major targets for infection by micro-organisms (colds, flu, STDs, etc). Added to this is the fact that the uncircumcised penis is more susceptible to minor trauma and ulcerative disease, and the preputial sac could harbor pathogenic organisms in a pool of smegma [6]. The mucosal inner lining of the adult foreskin is rich in Langerhans cells and other immune-system cells (22.4, 11.5 and 2.4% of total cell population is represented by CD4+ T cells, Langerhans cells and macrophages) [214]. (This contrasts with the neonate, where the foreskin is deficient in such cells [301], the proportion being instead 4.9, 6.2 and 0.3%, respectively [214]). The respective percentages for immune-system cells in the cervical mucosa are: 6.2, 1.5 and 1.4% [214]. In the external layer of the foreskin, which is like the rest of the penis, the proportions are very much lower: 2.1, 1.3 and 0.7%, respectively [214]. Although the urethra is also a mucosal surface, it lacks Langerhans cells, so is not likely to be a common site of HIV infection. The immune cells of the inner lining of the foreskin help fight bacteria and viruses that accumulate under it. However, in the case of HIV, they act as a ‘Trojan horse’ and in fact serve as portals for uptake of HIV into the body, where HIV entry generally requires CD4 receptors and cofactors such as chemokine receptors CCR5 and CXCR4 present in high density on the surface of the Langerhans cells [6]. Moreover, the selective entry of HIV via the inner foreskin has been shown by direct experimentation [24, 32, 214]. Punch biopsies were taken from fresh foreskin obtained immediately after circumcision of an adult male. Cultures were made of cells from the external surface (which resembles the rest of the penis) and from the inner mucosal surface of the foreskin. Live HIV tagged with a fluorescent marker was then applied. Within minutes the HIV entered the Langerhans cells [see picture above - obtained, with permission, from 17 (similar images can be seen in [214]). No uptake occurred for cultured epithelium of the keratinized outer surface of the foreskin, i.e., the part that resembles the skin of the circumcised penis. The mean number of HIV copies per 1000 cells (determined by quantitative PCR) one day after infection was 301 for the mucosal inner foreskin, but was undetectable in the outer, external, foreskin [214]. For cervical biopsies mean HIV copy number was 30, showing that the mucosal inner foreskin is 10-times more susceptible to HIV infection than the cervix [214]. Also, the HIV receptor CCR5 was especially prevalent on foreskin tissue cells [214]. This biological work thus nicely confirms the epidemiological evidence below. It is furthermore supported by experiments in which SIV (the monkey equivalent of HIV) has been applied to foreskin of monkeys, that then became infected [188]. The monkey work also showed infected Langerhans cells. Antigen presenting cells in the mucosa of the inner foreskin [133] are a primary target for HIV infection in men [279]. The foreskin is thus the weak point that allows HIV to infect men during heterosexual intercourse with an infected partner. A circumcised man with a healthy penis is thus very unlikely to get infected. However, ulcerations or abrasions on the penis will allow infection and a circumcised man with these will continue to be at risk of HIV, as well as some other STIs. Thus condom use is strongly advocated in an attempt to make absolutely sure that infection will not occur. Condoms are not, however, a panacea, and a man with a foreskin can still be infected even if using a condom during intercourse, if infected fluids come into contact with the inner foreskin, for example during foreplay.
Risk per exposure

In the USA the overall estimated risk of HIV infection per heterosexual exposure, when HIV status is unknown, is less than 1 in 100,000 [43. 210]. Based on data from Kenya, if one partner is HIV positive and otherwise healthy then a single act of unprotected vaginal sex carries a 1 in 300 risk for a woman and as low as a 1 in 1000 risk for a man [43]. (The rates are very much higher for unprotected anal sex and intravenous injection.) This data does not take into account circumcision status.

In Europe (13 centres from 9 countries) the rate is higher: 3 in 10,000 [75].

In Nairobi, Africa the rate is 1 in 1000 in the absence [123] and 1 in 6 in the presence [45] of genital ulcers.

In Asia, a study of young military conscripts in Northern Thailand, a country with low circumcision rates, and where the men were having regular contact with female sex workers the rate was 1 in 18 to 1 in 32 [181].

A recent overview of all of these various studies found that in developing countries the rate of female-to-male HIV transmission was 341 times higher than in developed countries [200]. (This compared with a male-to-female rate 2.9-fold higher in developing countries.) Among couples in the West, female-to-male transmission was 11% [182]. For male-to-female it was 23%. In Africa, however, female-to-male was 73% [127] and male-to-female was 60% [127, 169]. In another study, in rural Uganda, female-to-male transmission (12 per 100 person years) was identical to male-to-female transmission [227]. After consideration of all of the factors, lack of circumcision was highlighted as a major driving force behind the AIDS epidemic [200].

Epidemiological research

Africa:

Sub-Saharan Africa would appear to be where HIV first appeared in the human species. This region has 75% of HIV infections in the world [291]. Of 44 sub-Saharan countries, in only 4 is the prevalence less than 1%. Of the 16 in which it is greater than 10%, in 7 it is greater than 20%. In South Africa 25% of adults are infected and in Botswana 40%. Mortality in those infected is elevated 50-500% [www.who.int/ emc-hiv]. Sexual transmission continues to be by far the major mode of spread of HIV in Africa [252]. The male, who is more likely to be promiscuous than the female, is the major source of infection in the majority of women, who only have that one partner [92]. They may then pass on the virus to their children during pregnancy and breastfeeding. Men should therefore be the target for intervention strategies aimed at combating the disease.
There have now been over 50 studies of the role of circumcision in HIV incidence. One of the earliest key studies of the risk of HIV infection imposed by having a foreskin was that by Cameron, Plummer and associates published as a large article in Lancet in 1989 [45]. It was conducted in Nairobi. Rather than look at the existing infection rate in each group, these workers followed HIV negative men until they became infected. The men were visiting prostitutes, numbering approx. 1000, amongst whom there had been an explosive increase in the incidence of HIV from 4% in 1981 to 85% in 1986. These men were thus at high risk of exposure to HIV, as well as other STDs. From March to December 1987, 422 men were enrolled into the study. Of these, 51% had presented with genital ulcer disease (89% chancroid, 4% syphilis, 5% herpes) and the other 49% with urethritis (68% being gonorrhea). 12% were initially positive for HIV-1. Amongst the whole group, 27% were not circumcised. The men were followed up each 2 weeks for 3 months and then monthly until March 1988. During this time 8% of 293 men seroconverted (i.e., 24 men), the mean time being 8 weeks. These displayed greater prostitute contact per month (risk ratio = 3), more presented with genital ulcers (risk ratio = 8; P less than 0.001) and more were uncircumcised (risk ratio = 10; P less than 0.001). Logistic regression analysis indicated that the risk of seroconversion was independently associated with being uncircumcised (risk ratio = 8.2; P less than 0.0001), genital ulcers (risk ratio = 4.7; P = 0.02) and regular prostitute contact (risk ratio = 3.2; P = 0.02). The cumulative frequency of seroconversion was 18% and was only 2% for men with no risk factors, compared to 53% for men with both risk factors. Only one circumcised man with no ulcer seroconverted. Thus 98% of seroconversion was associated with either or both cofactors. In 65% there appeared to be additive synergy, the reason being that ulcers increase infectivity for HIV. This involves increased viral shedding in the female genital tract of women with ulcers, where HIV-1 has been isolated from surface ulcers in the genital tract of HIV-1 infected women. In this African study the rate of transmission of HIV following a single exposure was 13% (i.e., very much higher than in the USA). It was suggested that concomitant STDs, particularly chancroid [43], may be a big risk factor, but there could be other explanations as well. In uncircumcised males the highly vascular frenulum is particularly susceptible to tearing or other damage during intercourse, and is also a frequent site of lesions produced by other STDs [279]. The risk of HIV infection is thus further reduced by circumcision, which therefore reduces the synergy that normally exists between HIV and other STDs [279].

An earlier study in Nairobi was the first to notice that among 340 men being treated for STDs there was a 3-fold higher rate of positivity for HIV if they had genital ulcers or were uncircumcised (11% of these men had HIV) [269]. Subsequently another report showed that amongst 409 African ethnic groups spread over 37 countries the geographical distribution of circumcision practices indicated a correlation of lack of circumcision and high incidence of AIDS [34]. In 1990 Moses in the International Journal of Epidemiology reported that amongst 700 African societies involving 140 locations and 41 countries there was a considerably lower incidence of HIV in those localities where circumcision was practiced [191, 192]. Truck drivers, who generally exhibit more frequent prostitute contact, have shown a higher rate of HIV if uncircumcised [230]. Interestingly, in a West African setting, men who were circumcised but had residual foreskin were more likely to be HIV-2 positive than those in whom circumcision was complete [216]. Of 33 cross-sectional studies to the mid 1990s, 22 reported statistically significant association [e.g., 66, 68, 132, 137, 224, 292], by uni-variate and multi-variate analysis, between the presence of the foreskin and HIV infection (4 of these 33 were from the USA). Five reported a trend (including 1 of the studies in the USA) [189, 192]. Of the 6 that saw no difference 4 were from Rwanda and 2 from Tanzania. In an editorial review in 1994 of 26 studies it was pointed out that more work was needed in order to reduce potential biases in some of the previous data [66]. Studies since then that did control for such potential confounding factors, have confirmed that there was indeed a significantly lower HIV prevalence among circumcised men [171, 292]. Hazard rate ratio for being uncircumcised in one of these was 4.0 [171]. Many of the earlier studies have now been re-evaluated and those that were negative are now consistent with the majority of studies, i.e., ALL studies show lower HIV in circumcised populations. In this large systematic meta-analysis published in 2000 [304], 27 studies were examined, with 21 showing reduced risk in circumcised men. In 15 that were adjusted for potential confounding factors the association with circumcision was 0.42 (i.e., uncircumcised were
2.4 fold higher). The difference was highest in men at high risk, circumcised being 0.27 vs uncircumcised (i.e., was 3.7 fold higher for uncircumcised). The authors concluded that safe services for circumcision should be provided as an AIDS prevention strategy in parts of Africa where men are not traditionally circumcised.

In addition to the many case-control studies there have been a number of prospective studies, including ones in Kenya and Tanzania reporting statistically significant association with lack of circumcision. The increased risk in the significant studies ranged from 1.5 to 9.6. Later adjustment of the data for other factors showed all studies were significant in demonstrating higher HIV in uncircumcised men [304]. Women are at higher risk if their partner is uncircumcised. A study in Dar es Salaam, Tanzania, where most men are circumcised, noted that married women, with one sex partner, had a 4-fold higher relative risk of HIV if their husband was uncircumcised [144]. In most of these studies circumcision status was self-reported. However, physical examination in one study showed that 33% of men who said they were circumcised were in fact not circumcised [197]. Amongst Muslims, 26% were not circumcised. In the meta-analysis by Weiss et al. [304], only one study actually verified the circumcision status by physical examination [292]. Agreement between self-reported and actual was only about 81% in a study in a small geographic area of Kenya [40]. This study also found many had only a partial circumcision due to enormous variation in operative technique used. Moreover, clinical reports of circumcision status can also be inaccurate, especially if the clinician was a woman, as reported in a US study of White, Black and Hispanic males that showed a disagreement of 16% [70]. A study of racially mixed adolescent males (mean age 15) in Houston, Texas found that only 69% of those who were circumcised knew this, with 7% thinking they weren't and 23% unsure [238]. Thus the residual HIV infection amongst so-called circumcised groups could quite likely be to a large extent from this residue of uncircumcised men, i.e., the estimated protective effect from being circumcised could really be far greater than the statistics above. The conclusive findings emerging from the large number of studies have, moreover, led various workers, Moses and Caldwell included, to propose that circumcision be used as an important intervention strategy in order to reduce AIDS [43, 89, 115, 132, 151, 179, 191, 192]. Such advice has been taken up, with newspaper advertisements from clinics in Tanzania, western Kenya, Rwanda, Uganda and other parts of Africa offering this service to protect against AIDS [115]. Young men are opting for circumcision and tribal elders are changing the edicts of their culture by now allowing circumcision in order to prevent AIDS [115, 197]. In traditionally noncircumcising cultures, circumcision rate has increased to 23% overall with a mean age of having it done of 17.4 years, and the rate is even higher (57%) in those who had at least 8 years of education [197]. Health was cited as the reason. This work in Tanzania [197], as well as all other studies such as in Kenya [25], Botswana [149] and South Africa [163, 229], show the majority of population groups would be willing to accept circumcision to reduce HIV. Thus circumcision can be readily adapted into a culture. However, this must be accompanied by education that makes it clear that circumcision reduces, but does not eliminate the risk. Moreover, although earlier studies also appeared to show that circumcision is most effective as a preventative measure against HIV infection if it is performed prior to puberty [150], more recent work suggests a benefit at any age [4].

The possibility of an absolute protective effect of circumcision in an otherwise healthy penis was suggested by a large study published in the prestigious New England Journal of Medicine in 2000 [227]. This involved 415 heterosexual couples in which only one partner (228 men and 187 women) was HIV-positive. It followed them prospectively for 30 months. The incidence of seroconversion was 17 per 100 person-years among the 137 uncircumcised male partners. However, among the 50 circumcised men with a HIV-infected female partner, not one seroconverted, i.e., none became infected , even though they were having regular unprotected sex with an infected woman. The effect was apparent in circumcised non-Muslim men as well as Muslims (who wash after intercourse), suggesting behaviors arising from religion were not involved [109]. Moreover, the protection was seen only when circumcision had been performed prior to puberty [109]. A commentary to this article highlighted the need to explore circumcision in reducing the spread of AIDS [52].
A study reported in 2004 in which fastidious matching of uncircumcised and circumcised groups was carried out has continued to show a higher rate of HIV infection in uncircumcised men [4]. The study involved 845 Luo men in a single ethnic community in rural Kenya in which circumcision was dictated by their particular African-instituted Christian religious denomination, and involved 9 churches of each persuasion. In an accompanying Commentary on this article it was mentioned that 'careful (even obsessive) statistical analysis has zealously controlled for every possible confounder', meaning that 'the quality of the science informing the debate has just moved up a notch.'

Frequency of sexual intercourse has also been excluded. In a study of 188 circumcised and 177 uncircumcised men in Mbale, Uganda, non-Muslim circumcised men engaged in more risk-taking behaviors, such as drinking alcohol in conjunction with sex, sex with women on the first day of meeting, sex in exchange for money or gifts, pain on urination, penile discharge, earlier sexual debut (16 vs 17), more extramarital sex partners in the previous year (1.1 vs 0.6), and more nonwet sex [26]. (The latter, which is also practiced in Haiti, the Dominican Republic and to a certain extent in the USA, in an uncircumcised man can cause bleeding of the foreskin and frenulum, so increasing infection risk [116].) Muslims had a lower risk profile regarding all of these factors, except for being less likely to have used a condom ever or during the previous sexual encounter (odds ratio 0.3). This highlights the fact that the foreskin itself confers an increased risk of HIV infection. Overall, rough estimates are that circumcision has prevented more than 10 million HIV infections so far in Africa and Asia [91]. Worldwide this figure will obviously be greater.

At present 3 large randomized clinical trials are in progress (Kenya, Uganda, South Africa's Guateng Province) involving thousands of subjects. The results in 2005 to 2006 should reinforce recommendations about male circumcision in prophylaxis against HIV.

India:

A prospective study published in the Lancet in 2004 of 2,298 men initially not infected with HIV found that circumcision was strongly protective against HIV-1 infection with a 6.7-fold reduction in adjusted relative risk (0.14; P = 0.0089 ) [235]. The data led them to conclude that biological rather than behavioural differences were responsible and that the foreskin has an important role in sexual transmission of HIV. India, Central Asia, as well as Eastern Europe, are experiencing an alarming increase in HIV infections, with a 46% rise in the number of people living with HIV between 2001 and 2003 [219]. Men, such as Hindus, who are not circumcised will be at increased risk.

Asia:

Like Africa there are regional and ethnic differences in circumcision practice. Again, like Africa, HIV prevalence follows the foreskin. Rate is low where circumcision is high: e.g., Philippines (0.06% of adults), Bangladesh (0.03%), Indonesia (0.05%). In contrast the rate is 10-50 times higher in countries where most males are uncircumcised: e.g., Thailand (2.2%), India (1.8%) and Cambodia (2.4%) [115]. Large increases in infections are expected in such Asian countries over time [115]. Moreover the outbreak of HIV in central China in 2000 arising from use of contaminated needles to buy and on-sell blood from people there allowed entry of HIV which could then spread via heterosexual transmission. The leadership of this, the biggest country in the world, is well placed by its political ideology to reduce such a disaster by institution of a circumcision policy.

USA:

Studies in the USA have not been as conclusive. Some studies have shown a higher incidence in uncircumcised men [309]. In one study in New York City, however, no significant correlation was found, but the patients were mainly intravenous drug users and homosexuals, so that any existing
effect may have been obscured. A study in Miami of heterosexual couples did find a higher incidence in men who were uncircumcised. In studies of heterosexual men risk ratios of 2.9 and 3.5 were reported [146, 190, 286]. A study in Seattle of homosexual men found they were twice as likely to be HIV positive if uncircumcised [158].

**Rapidity of spread**

The sorts of health problems faced by the 'third-world', coupled with a lack of circumcision may account for the rapid spread of HIV through Asia [308]. The reason for the big difference in apparent rate of transmission of HIV in Africa and Asia, where heterosexual exposure has led to a rapid spread through these populations and is the main method of transmission, compared with the very slow rate of penetration into the heterosexual community in the USA and Australia, could be related at least in part to a difference in the type of HIV-1 itself [159]. In 1995 an article in *Nature Medicine* discussed findings concerning marked differences in the properties of different HIV-1 subtypes in different geographical locations [205]. A class of HIV-1 termed 'clade E' is prevalent in Asia and differs from the 'clade B' found in developed countries in being more highly capable of infecting Langerhans cells found in the foreskin, so accounting for its ready transmission across mucosal membranes. The Langerhans cells are part of the immune system and in turn carry the HIV to the T-cells, whose numbers are then severely depleted by the virus as a key feature of AIDS. The arrival of the Asian strain in Australia was reported in Nov 1995 and has the potential to utilize the uncircumcised male as a vehicle. More vigorous promotion of circumcision should help curtail any potential epidemic.

**Condoms**

Sexual transmission of HIV and other STIs should be reduced by use of barrier protection such as condoms. A feared AIDS epidemic resulted in media campaigns starting in the 1980s aimed at increased condom use. In a 1996 survey of American college students only 60% had used condoms in the previous 6 months and less than 50% definitely intended to use them in the next month [33]. Amongst a general US population sample, 62% of adults in 1996 reported using condoms at previous intercourse outside of an ongoing relationship [13]. In a review in the *Lancet* condom use was similarly reported as 55% [74]. Thus half of the sexually-active population of western countries are not using condoms. Indeed, the message of condom campaigns can easily be forgotten, especially in the young, in whom passion will over-ride compliance on occasions. Young people represent the most sexually promiscuous, at-risk group. They are at an age when risk-taking behaviour is prevalent (cf. smoking in young people vis-a-vis the anti-smoking campaign, dangerous driving, alcohol and drug taking, etc). In the case of HIV too, this will have tragic consequences. Many young people do not use condoms and openly scoff at the idea, despite the health warnings. Indeed it may be a sign of machismo to the young adult. Indeed the well-known 3 "I"s are represented in their behavior of being "infertile", "immortal", and "immune". Thus education is only part of the answer and where an additional simple procedure is available to reduce the risk, then logic dictates that it should be used. The result will be many lives saved.

Even when used, the method of condom use if often incorrect. Condoms may break during intercourse. There can also be strong cultural and esthetic objections to their use. Also, application of a condom to a circumcised penis is easier than to a penis with a foreskin.

In the prospective study referred to earlier of circumcised and uncircumcised men whose female partner was infected condoms were made available continuously [227]. However, in discussing this study it was pointed out that 89% of the men never used condoms and condom use did not appear to influence the overall rate of transmission of HIV [279]. Only circumcision status did. Circumcision removes the tissue that is the entry point for HIV. Unless a condom is used during all sex play then the risk remains of contact between the inner lining of the foreskin and HIV-laden secretions, sperm (in the case of homosexual sex), cells or tissues of an infected sex partner.
Thus condom use is far from a panacea for HIV prevention, since exposure of the vulnerable foreskin to infected biological fluids could take place during foreplay prior to application of the condom. Homosexual men who engage in mutual masturbation [267], also known as 'docking', a sexual practice that requires the foreskin, are placing themselves at risk, often not knowing of the danger this puts them in if their partner is infected. Heterosexual transmission was the initial, and remains the major, mode of transmission worldwide, lack of circumcision is a major contributing factor to the AIDS epidemic. Even though other modes of transmission are prevalent in developed countries, heterosexual transmission remains and may be especially relevant for men who visit counties with high HIV. Moreover, in some studies [109, 150], but not in a more recent one [4], the effectiveness of circumcision in AIDS risk reduction was greater when performed prior to puberty.

SOCIO-SEXUAL ASPECTS

Perhaps the first, albeit small and restricted, but interesting survey of circumcised vs uncircumcised men and their partners was conducted by Sydney scientist James Badger [22, 23] (who regards himself as neutral on the issue of circumcision). It involved responses to a questionnaire placed in clinics of the Family Planning Association in Sydney. This led to 180 participants (79 male, 101 female) who were aged 15-60. The women were mainly (50%) in the 20-30 year-old age group cf. 25% of the men, more of whom (33%) were aged 30-40. It found that:

- 18% of uncircumcised males underwent circumcision later in life anyway.
- 21% of uncircumcised men who didn't, nevertheless wished they were circumcised. (There were also almost as many men who wished they hadn't been circumcised and it could be that at least some men of either category may have been seeking a scapegoat for their sexual or other problems. In addition, this would no doubt be yet another thing children could "blame" their parents for, whatever the decision was when their child was born.)
- No difference in sexual performance (consistent with Masters & Johnson).
- Slightly higher sexual activity in circumcised men.
- No difference in frequency of sexual intercourse for older uncircumcised vs. circumcised men.
- Men who were circumcised as adults were very pleased with the result. The local pain when they awoke from the anaesthetic was quickly relieved by pain killers (needed only for one day), and all had returned to normal sexual relations within 2 weeks, with no decrease in sensitivity of the penis and claims of "better sex". (Badger's findings are, moreover, consistent with every discussion the author has ever had with men circumcised as adults, as well as an enormous number of email messages received from many such men. The only cases to the contrary were a testimonial in a letter sent to the author from a member of UNCIRC and a very brief email message that didn't say why.)
- Women with circumcised lovers were more likely to reach a simultaneous climax - 29% vs. 17% of the study population grouped across the orgasmic spectrum of boxes for ticking labelled 'together', 'man first', 'man after' and 'never come'; some ticked more than one box. (Could this involve psychological factors? ... Could it be that more circumcised men have a better technique? ... Or could other factors be involved?)
- Women who failed to reach an orgasm were 3 times more likely to have an uncircumcised lover. (These data could, however, possibly reflect behaviours of uncircumcised males that might belong to lower socio-economic classes and/or ethnic groups whose attitudes concerning sex and women may differ from the better-educated groups in whom circumcision is more common.)
- A circumcised penis was favoured by women for appearance and hygiene. (Furthermore, some women were nauseated by the smell of the uncircumcised penis, where, as mentioned earlier, bacteria and other micro-organisms proliferate under the foreskin.)
- An uncircumcised penis was found by women to be easier to elicit orgasm by hand.
- An circumcised penis was favoured by women for oral sex (fellatio).

A survey of 5000 men aged 16-49 (78% circumcised, 19% not, 3% "don't know") was subsequently conducted by Badger. This was open to all, and so included men who were anti-circumcision activists and those who were not. Circumcision had been performed at birth in 72%,
before puberty in 12% and after puberty in 16%. Of those who said someone else decided for them that they should be circumcised, only 16% said they were unhappy to be circumcised; 46% were happy and 38% didn't care. Overall only 11% said they would not circumcise any son(s).

These findings are consistent with later studies. In a survey of new mothers in the USA, hygiene and appearance were the two major reasons for choosing to have their newborn son circumcised [312]. There was a strong correlation between their son's circumcision status and the woman's ideal male partner's circumcision status for intercourse. Thus by being circumcised they thought that their sons would likewise be more attractive to a future sexual partner (with the implication that they would be at an advantage in passing on their, and therefore the mother's, genes to the subsequent generation). Their own preference thus affected their choice for their sons. 92% said the circumcised penis was cleaner, 90% said it looked 'sexier', 85% it felt nicer to touch and 55% smelled more pleasant. Even women who had only ever had uncircumcised partners preferred the look of the circumcised penis. Only 2% preferred an uncircumcised penis for fellatio, with 82% preferring the circumcised variety. Preference for intercourse for circ. vs uncirc. was 71% vs 6%, respectively; manual stimulation, 75% vs 5%; visual appeal, 76% vs 4%. What then is sexier about a circumcised penis? Quite likely it is that the glans is exposed in both the erect and un-erect state.

In Africa, women preferred men who were circumcised because they considered they were at less risk of STI [197]. The foreskin was also regarded as a source of a bad smell and men too thought it was cleaner. Increased sexual pleasure to both partners has also been stated [197]. For example, women from tribes that do not practice circumcision report deriving greater sexual pleasure from circumcised men [190].

Many surveys have been carried out by women's and men's magazines over the years and all report a preference by women for a man with a circumcised penis. One in Sydney by 'Men's Health' (July 2001 issue) found that only 16% of women preferred the uncircumcised penis. 46% preferred the circumcised, 31% didn't care (6% had never seen an uncircumcised penis and 1% had not seen a circumcised penis).

A survey by anti-circ activists of female members of their anti-circumcision organization, not surprisingly, found the opposite. Moreover, apart from the fact that it was not published in a proper scientific journal, bias arising from the seriously flawed study design causes it to lack credibility.

In the visual arts, for scenes involving the naked male it is quite plausible that American producers of erotic films and publishers of photographic works choose circumcised men, or at least uncircumcised men whose foreskin is smooth and free from loose, wrinkled skin, as the latter lacks visual appeal, especially to those who are not used to seeing an uncircumcised penis. Societal attitudes, at least in the USA, are reflected in the entertainment industry, such as TV shows. With apologies for introducing anecdotal material, a few examples are nonetheless potentially illuminating. For example, the character 'Elaine', in an episode of the TV sitcom 'Seinfeld' stated that "[the uncircumcised penis] looks like an alien!" Similarly in an episode of 'Sex in the City', also set in New York, one character recoiled in shock on seeing her new boyfriend was uncircumcised. It was clear that the quite sexually experienced 30-something women in this show were unused to the foreskin, describing it as resembling a Shar Pei (a dog breed with excessive rolls of skin). The new boyfriend's status had been bothering him anyway so he got circumcised, and liked his new look and sex so much he dumped the new girlfriend so he "could take the doggy for a walk", i.e., to try it out on other women around town. The moral: "You can take the Shar Pei out of the penis, but you can't take the dog out of the man". In the TV cartoon series 'South Park' the boys were alarmed to hear a new baby was going to be circumcised, thinking the penis was going to be cut off. Later when told it made the penis bigger they all wanted it. (Being set in America's heartland it is certain they already were circumcised (and didn't know what it was) - that is if one can apply this kind of rationale to cartoon characters)
illustrations involve of course actors or characters who are following a script, and is therefore not scientific by any means, but do reflect thinking and behaviors in these US settings.

As far as performance during sex is concerned, the National Health and Social Life Survey (NHSLS) of over 1400 men in the USA found that uncircumcised men were more likely to experience sexual dysfunctions [170]. This was slight at younger ages, but became quite significant later in life and included finding it twice as difficult to achieve or maintain an erection. It was also discovered that circumcised men engaged in a more elaborate set of sexual practices, i.e., enjoyed a more elaborate sexual lifestyle, and their female partners were more pleased with the esthetics of a circumcised penis over an uncircumcised one. Not surprisingly, in view of the findings above, circumcised men received more fellatio. However, they also masturbated more, a finding that, ironically, contradicts the apparent wisdom in Victorian times that circumcision would reduce the urge to masturbate. (Contrary to anti-circ. propaganda, circumcision may not have been used so much to reduce masturbation in that era, but rather to prevent smegma and itching, so stopping males scratching their genitalia, which would have offended polite Victorian sensitivities, and where such genital touching sometimes led to arousal) As noted in other studies, circumcision rates were greatest among whites and those who were better educated, reflecting their exposure to and ability to evaluate and respond to scientific information about circumcision [170]. There was little difference between different religious groups. The study also found that the men's female partners found the circumcised penis to have greater esthetic appeal.

Masters & Johnson undertook clinical and neurological testing of the ventral and dorsal surfaces, as well as the glans, and detected no difference in penile sensitivity between circumcised and uncircumcised men [180]. Sexual pleasure also appears to be about the same.

Two US studies published in 2002 both found similar or greater sexual satisfaction in men after circumcision as adults [55, 90]. The mean age of the men in each study was 37 and 42, respectively. In the smaller survey [55] there was no difference in sexual drive, erection, ejaculation, problem assessment or satisfaction compared with what the men recalled sex being like prior to foreskin removal. Penile sensitivity was the same. The Collins paper stated that their study was prompted by reports by proponents of "foreskin restoration", in particular the "disparity between the mythology and medical reality of circumcision regarding male sexuality" [55]. In the Fink study of 123 men [90], 62% said they were satisfied with having been circumcised (they liked their new look) and 50% reported benefits. There was no change in sexual activity. Penile sensitivity, although not tested directly, was thought by some of the men in this study to be slightly lower (but not statistically so), which may have contributed to their claims of better sex. Although there was no change in sexual activity, some of the men thought erectile function was slightly less (category scores: 12.3 vs 11.1, P = 0.05), which is the opposite of the very much larger National Health and Social Life Survey [170]. The authors point out that this would, however, have to be confirmed by duplex Doppler ultrasound before a definitive conclusion could be made. Furthermore, the outcome of this study could have been affected by the fact that 93% of the men had been circumcised for a medical problem. Both the men and their partners preferred the appearance of the penis after it had been circumcised. As in other studies [170] oral sex became more frequent, but there was no change in anal sex or masturbation [90]. Their partners were also more likely to initiate sex with them.

A report in 2004 of men circumcised for non-medical reasons showed an increase in ejaculatory latency time, consistent with decreased sensitivity, but this was considered an advantage in that they could prolong intercourse [263].

The foreskin contains sensory nerve receptors as are prevalent over the rest of the penis. There is no scientific evidence that the extra complement of these in uncircumcised men leads to greater sexual pleasure. Uncircumcised men often complain that their penis is too sensitive, leading to pain, and seek circumcision to relieve this. Diminishing sensitivity is in fact desired by many men and women in order to prolong the sex act by preventing premature ejaculation [41]. Orgasm, the
culmination of the sex act, is not related to the foreskin. It should also be added that anecdote needs to be translated into science, however, which can only be clarified by further research. Fanciful speculation by anti-circ proponents must be disregarded.

In Britain a class distinction is associated with circumcision. Circumcision traditionally indicated that a doctor had attended the birth (an indicator of family wealth) rather than a midwife (more likely to be used instead by poorer people). The Royal Family and the upper classes are circumcised and the lower classes less so. Queen Victoria believed her family descended from King David (of the Biblical Old Testament) and sanctioned circumcision. Prince Charles was circumcised by a mohel (a rabbi who specializes in circumcision). Princess Diana decided that Princes William and Harry would go uncircumcised. The NHSLS in the USA saw greatest rates among whites and the better educated. There was little difference between different religious groups. Some ancient cultures and some even today practice infibulation (drawing a ring or similar device through the prepuce or otherwise occluding it for the principal purpose of making coition impossible) [262]. This is the opposite of circumcision. It was, moreover, espoused in Europe and Britain in previous centuries as a way of reducing population growth amongst the poor and to prevent masturbation [262]. Ancient Greece was similarly faced with severe overpopulation, putting pressure on food and other resources. Infibulation was one method used to address this. Not to circumcise then became embedded in Greek cultural practice.

THE PROCEDURE ITSELF

Circumcision of the neonate

There is no evidence of any long-term psychological harm arising from circumcision. The risk of damage to the penis is extremely rare and avoidable by using a competent, experienced doctor. Unfortunately, because it is such a simple, low-risk procedure, it had once been the practice to assign this job to junior medical staff, with occasional devastating results. Parents or patients need to have some re-assurance about the competence of the operator. Also the teaching of circumcision to medical students and practitioners needs to be given greater attention because it is performed so commonly and needs to be done well. A model to teach interns has, moreover, been produced [81]. Surgical methods often use a procedure that protects the penis during excision of the foreskin. The most commonly used devices are the GOMCO clamp (67%), MOGEN clamp (10%) and PlastiBell (19%) [274]. Pictures of these can be found in refs [6, 167], and the latter in particular discusses the procedure, as well as contraindications. The Plastibell (Hollister Inc, USA) provides a no scalpel circumcision. In this method, the foreskin is stretched over a protective plastic cap which covers the glans, and a ligature is tied around the base of the foreskin. The compression against the underlying plastic shield causes the foreskin tissue to necrose and the foreskin and Plastibell then get sloughed off within a week, thus eliminating the need to actually cut the foreskin off [103, 129]. Cosmetic results have met with unanimous parental acceptance [77]. An 18 minute video entitled "No scalpel circumcision" that teaches the Russell method [245] using a Plastibell device was produced in Australia in 2004 for use in Botswana, which has a very high rate of HIV (terry@russellmedical.com.au). Moreover, since this simple plastic device is now off patent it can be produced at very low cost to help reduce AIDS in poor countries [268]. More on the Russell protocol can be found in the next section. The Gomco and Mogen clamps serve to protect the penis when excising the prepuce. The type of clamp used affects the time taken for the procedure, being on average 81 seconds for the Mogen clamp and 209 seconds for the Gomco clamp [161]. In a head-to-head trial of length of procedure the Mogen took 12 minutes, compared with 20 minutes for the PlastiBell [284]. Although simpler to use and more pain-free than the other two [148, 161, 284], the Mogen removes less foreskin. The Gomco is the oldest, having been invented in 1935, and is the most refined instrument [298]. Since some of these more elaborate methods take up to 30 min to perform they therefore expose the baby to a greater period of discomfort. In contrast, a circumcision can be completed in 15-30 seconds by a competent practitioner using methods that are part of traditional cultures. Interestingly, strict sterile conditions were reported not to be necessary to prevent infection in ritual neonatal circumcision in
Israel [193]. Also, rather than tightly strapping the baby down, swaddling and a pacifier has been suggested [124, 316-318]. A special padded, 'physiological' restraint chair has moreover been devised and shown to reduce distress scores by more than 50% [273]. Dr Tom Wiswell and other experts strongly advocate the neonatal period as being the best time to perform circumcision, pointing out that the child will not need ligatures or general anaesthesia, nor additional hospitalization [316-318]. Without an anaesthetic the child experiences pain and pain is also present for from a few up to a maximum of 12-24 hours afterwards. The child does not, however, have any long-term memory of having been circumcised. A greater responsiveness to subsequent injection for routine immunization may suggest, however, that the baby could remember for a short time [283]. Anesthesia is therefore advocated (see below). Complication rate is very low (0.2%), as is cost (discussed later).

Children

For children aged 4 months to 15 years a general anaesthetic is generally used and this carries a small risk. Also, ligatures are usually needed, although use of a tissue glue has proven to be an effective alternative [278]. Excellent cosmetic results were reported for all of 346 patients aged 14 to 38 months using electro-surgery, which presents a bloodless operative field [217]. Metal of any kind (such as the Gomco clamp) has to of course be avoided in this procedure. Even better, gentle tissue dissection with simultaneous hemostasis was achieved using an ultrasound dissection scalpel for circumcision [86]. Circumcision later obviously requires a separate (occasionally overnight) visit to hospital. Rate of complications is also greater, but still low (1.7%). The incidence of penile adhesions decreases with age, however, but at any age they resolve spontaneously [221]. Pain sometimes can last for days afterwards and those older than 1-2 years may remember. Cost is also much greater than for neonatal circumcision.

Adults

In adults circumcision is more expensive, but can be performed on an outpatient basis (so reducing costs), sometimes with local anesthetic (so reducing anesthetists charges), and pain can last for up to a week or so, during which time absence from work is required. Some however report no pain, just minor discomfort from the stitches. Vasectomy by men previously circumcised as adults (and who can thus attest to the difference) is said to be much more painful.

Thus when considering when is the best time, it would appear that circumcision in the newborn period is safe and technically easy. It is also cheap, as discussed in the next section, as well as providing the maximum lifetime benefit.

ANESTHESIA

In the past, anesthesia was not advocated for infant circumcision. The reasons included: (1) unfamiliarity with use and side effects of anesthetics in infants, (2) belief that the procedure caused little or no pain in this age group, and (3) belief that pain from injection of anesthetic was as bad as the pain of the surgery [307]. It is now known, however, that infants do experience pain [222], and anaesthesia for circumcision is recommended [184, 228]. It is nevertheless a fact that neonates exhibit low pain scores compared with older infants [293]. Indeed, a baby must be quite resilient to endure the pain of passing through the narrow birth canal during parturition. Dorsal penile nerve block [108] represents 85% of anaesthetic use in the USA [299] and is effective [131], even in low birth weight infants [128]. It involves injection of local anesthetic at the 10 and 2 o'clock positions at the base of the penis, where the dorsal penile nerve is situated. Ring block, which had initially been used for post-circumcision analgesia [39], is simpler, and extremely effective [118, 164, 183]. It involves injection of a local anesthetic around the circumference of the penis at the mid-shaft level. In fact this method may be the best. Further technical information can be found in ref [240]. Pain from the infiltration of a local anesthetic is short-lived and significantly less than the pain from an un-anesthetized circumcision [165]. EMLA cream (5%
lidocaine/prilocaine; AstraZeneca) [283, 315-318] reduces pain during circumcision [281, 283], and blood sampling in newborn babies [231], but is less effective than the others [42, 164]. Rises in met-hemoglobin 3.5 to 13 hours after application of EMLA cream are well below potentially harmful levels [36, 172]. Epicutaneous 5% lidocaine-prilocaine is more effective than 30% lidocaine [327]. Pacifiers, especially with glucose or sucrose, are also effective (pain score = 1 as opposed to 7 with placebo) [46]. Infants circumcised with the Mogen clamp and combined anesthesia (lidocaine dorsal penile nerve block, lidocaine-prilocaine, acetaminophen, and sugar-coated gauze dipped in grape juice), with 55 seconds taken for the procedure, showed substantially less pain than those circumcised with the Gomco clamp and EMLA cream, which took 577 seconds for the procedure [282]. Tetracaine gel is another topical agent and is as effective as EMLA cream, but can be applied for only 30 min, compared with 60 min, prior to circumcision [280]. As mentioned above a simple, effective procedure has been described by Russell in Brisbane, Australia [245] and is the subject of a teaching video. The technique involves applying EMLA cream thickly to the distal penis 2 hours prior to the procedure. The penis is wrapped in cling-wrap to keep the cream in contact with the penis, but with the end left open to allow for urination. The Plastibell device is then used. The baby did not cry. In those aged less than 7 months 99% fed immediately afterwards, 96% settled rapidly, 97% had no disturbance of sleep pattern, 93% had little or no apparent pain, and 96% had no pain or difficulty when urinating. None required stronger post-operative analgesia than paracetemol. Postponing circumcision until the child is suitable for general anesthesia was strongly rejected [245]. Total pain control can of course be achieved by a general anaesthetic. This can be given routinely for very young children, and if done in a children’s hospital there is virtually no risk. However, because the operation is so trivial technically, local anaesthesia is all that is required.

For a minority of people the way the circumcision is performed will obviously be dictated by their cultural or religious beliefs. It is, moreover, acknowledged that for Jews the traditional bris might be less traumatic than common institutional approaches [165]. Jewish Mohelim take 10 seconds, with 1 second for excision, and 60 seconds on average for crying; since there is no crushing of tissue the pain is claimed to be not as severe as techniques used by doctors [266].

Despite the benefits and proven safety of anesthesia, many male newborn circumcisions in North America do not involve anaesthetics and this can be as much as 64-96% in some regions [289, 307]. "Given the overwhelming evidence that neonatal circumcision is painful and the evidence of safe and effective anesthesia/analgesia methods, residency training in neonatal circumcision should include instruction of pain relief techniques" [130]. In the USA 84% of pediatric, 80% of family practice and 60% of obstetric programs do indeed teach anaesthesia/analgesia techniques [130]. It is thus surprising that 71% of pediatricians, 56% of family practitioners, and only 25% of obstetricians use analgesia/anaesthesia [274].

COST

Circumcision is amongst the 40 most frequently performed surgical procedures, occurring more commonly than tooth extraction [15]. For example, in the year to Feb 2004, 16,311 neonatal circumcisions were performed in Australia at a cost to Medicare of A$623,080. Interestingly, in 1985 the Federal Minister for Health removed the rebate for newborn circumcision from the Medical Benefits Schedule in response to the (now outmoded) 1983 recommendations of the National Health & Medical Research Council (NHMRC) of Australia. It was then quickly restored after a public outcry. The scheduled fee for a neonatal circumcision in 2004 = A$38.20 (~US$26) [18]. Many doctors consider that the fee in Australia should be higher, as such a low rebate has the potential to cause some doctors to discourage it because of the low financial return relative to other procedures. For age 6 months to 10 years the fee = $89.85 in 2004, and in those over 10 years = $124.45 or $154.30 (for GP vs specialist). The overall cost to Medicare for circumcisions in the year to Feb 2004 was thus A$623,080 + $275,210 + ($298,880 or $369,086) = $928,170 to $998,375. Given the benefits, this is money well spent.
In the USA, a neonatal circumcision will generally cost US$89-204, being cheaper in the mid-west and more expensive on the east coast. On average the amount per circumcision across all ages versus mean lifetime medical costs in those not circumcised has been estimated to work out about the same [53, 101, 173]. In one of these analyses it was stated that if the rate of surgical complications from circumcision was less than 0.6% or if risk of penile problems in uncircumcised males exceeded 17% (cf. the then current baseline of 14%) then circumcision would be preferred on a cost and lifespan basis [173]. However, these analyses, now a little dated, did not consider a variety of other conditions such as cervical cancer, genital herpes, inflammatory dermatoses, physical, as well as sexual and other problems in uncircumcised men and their partners. When these conditions are factored in, then the cost of non-circumcision would greatly exceed that of circumcision.

Everyone has a right to ensure a healthy penis. Many who seek a doctor to circumcise them or their child may be doing so because of a medical problem. However, most merely want what is best, be it prevention of future problems or esthetics. These are all valid reasons for requesting circumcision. A medical complaint, even if minor, should help reduce the overall cost by providing a return on a claim to a health insurance provider, if not covered by the health system of the country in which it is done.

**HOW DO I FIND SOMEONE TO DO IT?**

For neonates, most obstetricians will perform a circumcision as part of the overall service to their patient, the mother. Failing that, there are many pediatric surgeons who do circumcisions. There are also clinics where circumcision is one of the major, if not the exclusive, activity. Many other doctors, including general practitioners will do it. However, level of expertise and practice (frequency of carrying out the procedure) should be an important consideration by parents in seeking someone good. Circumcision is very simple technically, but despite this has to be done by someone who knows what they are doing.

In the USA, 54% of doctors involved in the delivery or care of infants perform circumcisions [274]. The breakdown is: obstetricians 46%, family practitioners 29% and pediatricians 25%.

For adults a urological surgeon will often be the person to consult with, or a general surgeon. You will need a referral from any local doctor. Again, being so simple, there may be other doctors who are not surgeons who can do it. So to find someone, think about who you might ask first from your own knowledge and contacts. It could be your local doctor. There are also men's health centres/clinics that specialize in such male-specific matters, and are used to handling enormous numbers of enquiries from men who want to get circumcised. So if you are an uncircumcised male and think this is what you want, don't be shy! ... Ask!

**WHOSE RESPONSIBILITY?**

It is argued by opponents of circumcision that the male himself should be allowed to make the decision about whether he does or does not want to be circumcised. However, there are problems with this argument, not the least of which is the fact that the greatest benefits accrue the earlier in life the procedure is performed. If left till later ages the individual has already been exposed to the risk of urinary tract infections, the physical problems, and carries a residual risk, albeit reduced compared with no circumcision, of penile cancer and possibly HIV infection. Moreover, it would take a very 'street-wise', outgoing, adolescent male to make this decision and undertake the process of ensuring that it was done. Most males in the late teens and 20s, not to mention many men of any age, are reticent to confront such issues, even if they hold private convictions and preferences about their penis. Moreover, despite having problems with this part of their anatomy, many will suffer in silence rather than seek medical advice or treatment. Thus to argue that circumcision be delayed until the male can make his own decision is specious. By the teen or later years the procedure is no longer as fast, simple, cheap or as pain-free, and a general, as opposed
to a local, anesthetic is usually employed. Really though parental responsibility must over-ride arguments based on 'the rights of the child'. Think what would happen if we allowed children to reach the age of legal consent in relation to, for example, immunization, whether they should or should not be educated, etc, etc. A period of great benefit would have been lost, to the potential detriment of the person concerned. In fact of all the many decisions a parent or legal guardian must make for their growing child over the years until they are legally considered adults, there are many that will likely have a more profound effect on them than the presence or absence of a foreskin [6]. Parents have the legal right to authorize surgical procedures in the best interests of their children [10, 83, 294]. For them to make this decision medical practitioners are obliged to disclose to them fully and objectively ALL information relating to circumcision. This includes benefits and risks, prognosis and alternative methods. Unfortunately, in a recent survey in California 40% of parents believed they had not been provided with enough information [2]. Parents of those children who were left uncircumcised said that no medical provider discussed circumcision with them, as opposed to 15% of parents of children who were circumcised. Twice as many parents (27% of uncircumcised vs 14% of circumcised boys) were unhappy with their initial decision, i.e., twice as many in retrospect would have wanted their child to have been circumcised had they known more.

RISKS

Having described the benefits, let’s look at the risks. Surgical complications for large published series range from 0.2% to 0.6% [50, 254, 321]. Higher rates of 2-10% have been reported in much older and smaller studies [95, 111, 145]. One, conducted in US Army hospitals from 1980 to 1985, found that for 100,157 boys who were circumcised in the first month of life, there were 193 complications (0.19%) [321]. These included 62 local infections, 83 of hemorrhage (31 requiring ligature and 3 requiring transfusion), 25 instances of surgical trauma, 20 urinary tract infections (cf. 88 UTIs in the 35,929 boys in this study who had not been circumcised), and 8 cases of bacteremia (cf. 32 in the uncircumcised). There were no deaths or reported losses of the glans or entire penis. However, in the uncircumcised boys, 3 developed meningitis, 2 got renal failure and 2 died. The largest study, of 354,297 male infants born in Washington State from 1987-1996, noted a complication rate in the 130,475 who were circumcised during their newborn hospital stay of only 0.21% (1 in 476) [50]. It was then calculated that 6 UTIs could be prevented for every circumcision complication and 1 penile cancer prevented for every 2 complications. In a small study of 500 New Zealand boys over a longer period, namely from birth to 8 years of age, the rate of penile problems was 2-fold higher in those who were not circumcised (19% vs 11%), the inclusion of both minor and more serious problems leading to an overall higher rate than would otherwise have been the case [97]. Preliminary data such as this needs to be extended to very large studies, such as those conducted in the USA for infants, before a conclusion can be reached.

As listed in [6, 315-317], the various complications of circumcision in infancy and the rates of each are:

- Excessive bleeding: Occurs in 1 in 1000. This is treated with pressure or locally-acting agents, but 1 in 4000 may require a ligature and 1 in 20,000 need a blood transfusion because they have a previously unrecognized bleeding disorder. Hemophilia in the family is of course a contra-indication for circumcision.
- Infection: Local infections occur in 1 in 100-1000 and are easily treated with local antibiotics. Systemic infections may appear in 1 in 4,000 and require intravenous or intramuscular injection of antibiotics.
- Subsequent surgery: Needed for 1 in 1000 because of skin bridges, or removal of too much or too little foreskin. Repair of injury to penis or glans required for 1 in 15,000. Loss of entire penis: 1 in 1,000,000, and is avoidable by ensuring the practitioner performing the procedure is competent. Injuries (rare) can be repaired [30] and in the infinitely remote instance of loss of the
penis it can be reattached surgically [209]. (Successful reattachment can also follow adult self-inflicted amputation [166].)

- **Local anaesthetic:** The only risk is when the type of anaesthetic used is a dorsal penile nerve block, with 1 in 4 having a small bruise at the injection site. This will disappear.

- **Death:** Data in the records show that between 1954 and 1989, during which time 50,000,000 circumcisions were performed in the USA there were only 3 deaths, but during this period there were 11,000 from penile cancer, a disease essentially confined to the uncircumcised [317]. In the study by Wiswell referred to above there were 2 deaths in those not circumcised, but none in the 3 times as many who were circumcised [321].

In Jewish ritual circumcision tightly wrapped gauze is used to stop minor bleeding (as compared to use of local pressure in hospitals), and it is thought that this can cause urinary retention and hence UTI [119]. Not surprisingly, complication rates are higher when circumcision is carried out by individuals who are not medically trained [208].

Although very rare, complications from use of the Plastibell have been reported and include a higher rate of infection [103], proximal migration and tissue strangulation if the one chosen is too large [51], pressure necrosis of the glans if one is used that is too small [51], urinary retention [187], distended bladder [176] and sepsis [152]. To illustrate the rarity of these, in a study of 2000 neonates there were no serious sequelae at all [5]. In the case of the Gomco clamp excessive removal of foreskin tissue can occur [103].

It should be stressed that there are contraindications to circumcision in the case of prematurity, family history of bleeding disorders (hemophilia), penile abnormalities (hypospadias, epispadias, micropenis, ambiguous genitalia, megalourethra, webbed penis) in which the foreskin may be required to reconstruct the penis at a later date [6]. Not surprisingly, nonmedical, co-called 'community circumcision' is associated with higher risk of complications [59].

**WHY ARE HUMAN MALES BORN WITH A FORESKIN?**

One function of the foreskin was probably to protect the head of the penis from long grass, shrubbery, etc when humans wore no clothes, where evolutionarily our basic physiology and psychology are little different than our savannah-wandering or cave-dwelling ancestors tens to hundreds of thousands of years ago. Also, the moist tip would facilitate quick penetration of a female, where lengthy foreplay and intercourse would be a survival disadvantage, since the risk to the copulators from predators and human enemies would be greater the longer they were engaged in sex.

Dr Guy Cox from The University of Sydney has suggested that the foreskin could in fact be the male equivalent of the hymen, and served as an impediment to sexual intercourse in adolescent primeval humans before the advent in our species of civilization and cultures [60]. Way back then Cox says the foreskin would have reduced 'successful' sexual acts in those too young to adequately care for any offspring that might arise. With civilization, control of the sexual behaviour of the young by society made the physical mechanism redundant and society introduced circumcision to free the individual from the impediment of having a foreskin. Interestingly, the physical difficulties experienced by the uncircumcised may explain why the word for uncircumcised in Hebrew means 'obstruction' or 'to impede', so explaining the Biblical term 'uncircumcised heart' when referring to obstructionism.

**WHAT CAUSED MANY CULTURES TO RITUALLY REMOVE IT?**

There are several theories and each may have elements of truth. As mentioned above, according to Cox, the ritual removal of the foreskin in diverse human traditional cultures, ranging from Muslims to Aboriginal Australians could be a sign of civilization in that human society acquired the ability to control, through education and religion, the age at which sexual intercourse could begin.
Another compelling explanation involves the ritualization of circumcision's prophylactic effects, especially as many different human groups and cultures that live in desert or other hot environments have adopted it as part of their customs. Infections, initiated by the aggravation of dirt and sand, are not uncommon under such conditions and have even crippled whole armies, where it is difficult to achieve sanitation during prolonged battle. A US Army report stated that in World War II 150,000 soldiers were hospitalized for foreskin problems due to inadequate hygiene, leading to the statements: "Time and money could have been saved had prophylactic circumcision been performed before the men were shipped overseas" and "Because keeping the foreskin clean was very difficult in the field, many soldiers with only a minimal tendency toward phimosis were likely to develop balanoposthitis" [215]. In the Vietnam War men requested circumcision to avoid "jungle rot". Similarly sand was a problem for uncircumcised men in the Gulf War [102]. Thus, historically it was not uncommon for soldiers to be circumcised in preparation for active service. The Judeo-Muslim practice of circumcision quite likely had its origin in Egyptian civilization, where there is evidence of a circumcised mummy at the time the Hebrews inhabited Egypt, as well as illustrations of the operation itself and of circumcised Pharoahs, dating back to 3000 BC [302]. One possible reason the Egyptians could have circumcised themselves and their slaves might have been to prevent schistosomal infection [302, 303]. Urinary tract obstruction and hematuria are common in localities such as the Nile Valley that are inhabited by the blood fluke, Schistosoma haematobium. The foreskin would undoubtedly possess the adverse ability of being able to hold water infected with the cercaria stage of the life cycle of this parasite and so facilitate its entry into the body. The perpetuation of the procedure by the Jews may have subsequently been driven by a desire to maintain cleanliness in an arid, sandy desert environment. Such considerations could also explain why it is practiced in multiple other cultures that live in such conditions. In each instance, the original practical reason became lost as the ritual persisted as a religious rite in many of the various cultures of the world. In the Muslim religion circumcision is performed over a wide range of ages in childhood.

Below and in the 'About the Author' page are photographs of a group of Masai boys in their early teens that the author came across in Kenya in 1989 dressed in their dark circumcision robes, with white feathers as headwear, and white painted facial decoration that stood out against their very black skin. Each wore a pendant that was the razor blade used in their circumcision. The ceremony that they had gone through is a special part of their tribal culture and was very important to these boys, who were proud to show that they were now 'men'. (Of course, use of a razor and lack of sterile procedure, etc is far from ideal and is not to be encouraged.)

In other cultures circumcision is associated with preparation for marriage and as a sign of entry into manhood. Australian Aboriginals circumcise a boy when he reaches puberty in a ceremony that is part of 'men's business'. In Southern East Timor, men are traditionally circumcised at 20 or so years of age in preparation for marriage, but the man is then expected to have sex with at least 3 or 4 women before getting married. In Tonga, boys are circumcised at age 7-9 in hospital without anesthetic, pain being seen as part of transition to manhood. This is fully funded by the government of Tonga. Other Pacific Islands cultures traditionally practice circumcision. In some, such as the islands of New Caledonia, the ritual for the boy entering manhood also includes the 'bungee jump', and is where this 'sport' began. In the Philippines circumcision, generally carried out at age 12-14, is part of a coming-of-age ritual, again without anesthetic. In Madagascar, where all men are circumcised regardless of religion, the reason is that women say that sex with a
circumcised man is longer, stronger, better for them and cleaner, so the men are very much more likely to get sex by being circumcised.

In China many men are circumcised as adults because of problems with their foreskin. In SE Asians such as Japanese, Chinese and Vietnamese the foreskin tends to be short and the custom is to wear it pulled back after puberty. As a result the head is drier and less prone to problems in hot, humid conditions. This may explain why circumcision is not common. Other cultures living in a hot climate, including those of the Incas and Aztecs of Central and South America, practiced circumcision. Because scar tissue is more visible on Asian skin than Caucasian, Chinese and Japanese doctors make a cut around the base of the penis rather than the foreskin itself. The skin is pulled back to expose the glans, then stitched into place.

Interestingly, in Japan, circumcision has become a fashion amongst young men. The procedure is promoted by way of articles and advertisements in the vast array of 'girlie', sex magazines read by young males. The message is that it improves hygiene and attractiveness to women.

There are many fascinating historical aspects involving circumcision or lack thereof. For example, some argue that the latter may have precipitated the French Revolution. Marie Antoinette, 12th daughter of the Emperor and Empress of Austria, much hated by France, married the future Louis XVI in 1770 at the age of 14. By 18, still immature and lacking in intellectual interests, she became queen. Louis XVI suffered from phimosis (tight foreskin) that prevented successful intercourse. As a result Antoinette was deprived of the responsibilities of motherhood, which might have matured her. She indulged in lavish amusements, balls, plays and receptions that pandered to her childish fantasies, even building a model dairy farm "dolls house" at Trianon. Her enemies accused her of bankrupting France. In a secret visit to France her brother, Emperor Joseph II, reprimanded her and also persuaded Louis to get circumcised. This was 8 years after their marriage. Although she subsequently bore 3 children, the damage had been done. The rest is history, the Revolution took place, and both were executed in 1793.

TO SUMMARIZE:

Lack of circumcision:

- Confers a higher risk of death in the first year of life (from complications of urinary tract infections: viz. kidney failure, meningitis and infection of bone marrow).
- One in ~400-900 uncircumcised men will get cancer of the penis. A quarter of these will die from it and the rest will require at least partial penile amputation as a result. (In contrast, invasive penile cancer never occurs or is infinitesimally rare in men circumcised at birth.) (Data from studies in the USA, Denmark and Australia, which are not to be confused with the often quoted, but misleading, annual incidence figures of 1 in 100,000).
- Is associated with balanitis (inflammation of the glans), posthitis (inflammation of the foreskin), phimosis (inability to retract the foreskin) and paraphimosis (constriction of the penis by a tight foreskin). Up to 18% of uncircumcised boys will develop one of these by 8 years of age, whereas all are unknown in the circumcised. Risk of balanoposthitis = 1 in 6. Obstruction to urine flow = 1 in 10-50.
- Means increased risk of problems that may necessitate circumcision later in life. Also, the cost can be 10 times higher for an adult.
- Is the biggest risk factor for heterosexually-acquired AIDS virus infection in men. 8-times higher risk by itself, and even higher when lesions from STDs are added in. Risk per exposure = 1 in 300.
- Is associated with higher incidence of cervical cancer in the female partners of uncircumcised men.
Getting circumcised will result in:

- Having to go through a very minor surgical procedure that carries with it small risks.
- Improved hygiene.
- Much lower risk of urinary tract infections.
- Much lower chance of acquiring AIDS heterosexually.
- Virtually complete elimination of the risk of invasive penile cancer.
- More favourable hygiene for the man and his sexual partner.
- Better sexual function on average.
- A penis that is regarded by most as being more attractive.

If all 2,000,000 boys born in the USA annually were circumcised, the following would be prevented during their lifetimes:

- > 7,000 cases of HIV
- > 10,000 cases of syphilis
- > 20,000 episodes of pyelonephritis:
  - 2,000 with concurrent bacteremia
  - 1,500 cases hypertension
  - 150 cases of end stage renal disease
- 2,000 cases of penile cancer
- 200,000 cases of phimosis
- 250,000-500,000 cases of balanoposthitis

Data apply to the 2 million boys circumcised in the USA annually. (Kindly provided by Dr Tom Wiswell, USA)

CONCLUSION

It is hoped that this review will prove informative to medical practitioners and health workers, thereby enhancing the quality of information that is conveyed to parents of male children and to adult men. It should also prove to have educational value to others, especially the parents of boys, but also adult men, whether circumcised or not. It is hoped that as a result of reading the information presented here the choice that has to be made concerning circumcision, especially of infants, will be a much more informed one. Although there are benefits to be had at any age, they are greater the younger the male. Issues of 'informed consent' may be analogous to those parents have to consider for other medical procedures, such as whether or not to immunize their child. The question to be answered is 'do the benefits outweigh the risks'. When considering each factor in isolation there could be some difficulty in choosing. However, when viewed as a whole the answer to whether to circumcise a male baby must surely be 'YES'. Nevertheless, everybody needs to weigh up all of the pros and cons for themselves and make their own best decision. Hopefully the information provided here will help in the decision-making process.