

# SCIENTIFIC SECTION

## Review Article

### Benefits and risks of circumcision

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Circumcisions are performed either prophylactically in the neonatal period or therapeutically at a later age. About 10% of males not circumcised at birth will eventually require circumcision. The present neonatal circumcision rate is about 80% in the United States and 40% in Canada. The single most important determinant of whether a newborn male will be circumcised is the attitude of the attending physician.

The literature was reviewed to determine the proven benefits of circumcision and to compare these with the known risks. Circumcising the newborn facilitates penile hygiene, prevents cancer of the penis and decreases the incidence of genital herpes in later life. Whether it decreases the incidence of cancer of the cervix is still uncertain. More important, neonatal circumcision is associated with much lower morbidity and mortality and with lower costs than therapeutic circumcision. Thus, prophylactic circumcision is recommended for the male population as a whole.

La circoncision est pratiquée soit dans un but prophylactique durant la période néonatale, soit dans un but thérapeutique plus tard dans la vie. Environ 10% des hommes qui n'ont pas été circoncis à la naissance doivent éventuellement l'être. Le taux de circoncision néonatale est présentement de 80% aux États-Unis et de 40% au Canada. Le plus important facteur qui va déterminer si un nouveau-né sera circoncis est l'attitude du médecin traitant qui préside à l'accouchement.

On a procédé à une revue de la littérature afin de mettre en évidence les bénéfices démontrés de la circoncision et de les comparer aux risques connus. La circoncision du nouveau-né facilite l'hygiène, prévient le cancer du pénis et abaisse l'incidence de l'herpès génital plus tard dans la vie. Il n'est pas encore sûr qu'elle puisse réduire l'incidence du cancer du col. Ce qui est encore plus important est que la circoncision néonatale entraîne une morbidité et une mortalité beaucoup plus faibles que la circoncision thérapeutique, et ceci à un coût plus faible. En conséquence, la circoncision prophylactique est recommandée pour l'ensemble de la population mâle.

Few topics in the medical literature have aroused as much rhetoric and passion as the practice of the most common operation in North America, the nonritual circumcision of newborn males. Viewpoints range from the extreme opposition expressed by writers such as Morgan in his articles "Penile plunder"<sup>1</sup> and "The rape of the phallus"<sup>2</sup> to the staunch support of Dagher and associates,<sup>3</sup> who claimed the crusade against circumcision is merely a superimposition of current anti-establishment trends in society on humanity's primordial anxiety over genital injury and castration. No wonder Wilson,<sup>4</sup> in a letter to this journal, asked for "more light and less heat" in discussions regarding circumcision. Since the publication of Gairdner's classic paper in 1949,<sup>5</sup> which first brought the appropriateness of "routine circumcision" into question, numerous attempts have been made to apply the scientific method to the study of circumcision.

In general, the results of studies and the recommendations of panels have not supported the practice of nonritual circumcision and yet have had little or no influence on rates of circumcision, at least in North America. In 1971 the committee on the fetus and newborn of the American Academy of Pediatrics stated that "there are no valid medical indications for circumcision in the newborn period."<sup>6</sup> In 1974, however, the proportion of newborns being circumcised in the United States was still greater than 80%,<sup>7</sup> a rate that showed there had been essentially no decline in frequency since the 1971 statement. Although the committee reaffirmed its position in 1975,<sup>8</sup> and despite a similar stance taken by the bureau of epidemiology of the Center for Disease Control of the United States Department of Health, Education, and Welfare,<sup>9</sup> the rate of circumcision has not dropped and controversy still rages among neonatal health care professionals.

Although the decision to circumcise a newborn infant is ultimately taken by the parents, the single most important factor affecting this decision is the attitude of the attending physician. Patel<sup>10</sup> showed that in Canada circumcisions were performed in 20% of cases in which physicians opposed it and in 100% of cases in which physicians favoured it. He also found that par-

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ents who specifically requested circumcision were in the minority; those who did usually made this request because of their particular social and cultural values, which were often based on erroneous information, rather than because of medical advice. Typical reasons given included beliefs that circumcision would prevent excessive crying, that it was necessary for fertility, that it would prevent masturbation or that it would make the penis aesthetically more pleasing (although Michelangelo chose to leave his statue of David uncircumcised). While one might expect mothers to decide on the circumcision of their sons on the basis of the status of the child's father, in fact many mothers had no idea whether the father was circumcised. Colletti,<sup>11</sup> on the other hand, reported that almost all the prospective mothers in his practice over the past year had decided in favour of circumcision, and had done so without seeking medical advice.

A review article published in 1978 presented the conclusion that the existing medical literature did not provide a basis for a firm stand for or against neonatal circumcision and that long-term, prospective, randomized studies were necessary.<sup>9</sup> However, there is much that is known about the benefits and risks of removing the foreskin of the newborn. The purpose of this article is to review the literature and current opinion on this subject, and to present a risk-benefit analysis that will enable physicians and parents to share in an informed decision on circumcision based on current scientific evidence.

## History and prevalence

The origins of circumcision are surrounded by controversy. A bas-relief on the tomb of the Egyptian King Ankh-Mahn (c. 3000 BC) depicts the practice.<sup>12</sup> Some historians claim circumcision was a religious rite performed on royalty, while others are convinced it was used as a mark of slavery.<sup>13</sup> The latter view is the basis for the theory that the Jews, having undergone compulsory circumcision while they were slaves in Egypt, adopted the procedure as a ritual and later incorporated its practice into the Old Testament (Genesis 17: 10-14) as a symbol of a covenant between God and man.<sup>14</sup> The first written account of circumcision signals its introduction into Western civilization, and Jews continue to circumcise their sons on the eighth day of life as commanded in the Old Testament. Moslems wait until the child is 10 to 12 years old, a practice that may also be based on scripture even though circumcision is never mentioned in the Koran; Abraham's eldest son, Ishmael, from whom Moslems claim to be descended, was circumcised at puberty. One of the many problems the evangelist Paul faced in converting gentiles to his new religion was convincing them that they need not be circumcised to enter the Heavenly Kingdom (I Corinthians 7: 18-19). Circumcision continued to be popular among some Christians, however, and there is a 17th-century painting that shows circumcision as a religious ritual performed by a bishop.<sup>15</sup>

What is perhaps more fascinating is that circumci-

sion sprang up independently in so many parts of the world. It was practised by West African tribes over 5000 years ago, and its beginnings there may even predate its practice in Egypt. Australian aborigines, North and South American Indian tribes (Columbus was supposedly greeted by circumcised natives) and several African tribes practised neonatal circumcision.<sup>14</sup> In other communities it was performed as a puberty rite and sometimes immediately before marriage. The reasons for circumcision, whether symbolic, practical or both, are probably as varied as the people who practise it, and include the beliefs that it is a test of a man's ability to withstand pain and that it will increase fertility, to mention only two. In anthropologic terms its most basic function appears to be its use as a rite of initiation.<sup>14</sup>

Today circumcision is still practised by one sixth to one seventh of the world's population.<sup>15</sup> The likelihood that a particular individual will be circumcised depends on his nationality, race, religion, social class and age. Circumcision is uncommon in Central and South America, China and some other far eastern countries and in most European countries, including Scandinavia.<sup>16</sup> That it is not common in Scandinavia is an advantage to epidemiologic studies, in that these countries can provide data on a useful control group of uncircumcised Caucasian men of relatively high socioeconomic status. In Britain circumcision is now performed on only 6% of all males and is almost never done in the neonatal period.<sup>17</sup> Canada and Australia have the second highest rates of neonatal circumcision among English-speaking countries, about 40%, but this figure is considerably lower than the rate of over 80% in the United States, despite the fact that factors that influence the practice of circumcision are common to the hospitals in all three countries.<sup>7</sup> Indeed, in the United States circumcision is the commonest operation performed.<sup>9</sup> In all countries where it is practised the rate is generally higher in higher socioeconomic groups.<sup>10</sup>

Within Canada the rate of neonatal circumcision varies widely among the provinces. Disregarding the Northwest Territories, for which figures are not available, the highest rate, about 70%, is in the Yukon Territory. In the four western provinces, Ontario and Prince Edward Island the rate is about 50%, in New Brunswick and Nova Scotia almost 30%, in Quebec about 13% and in Newfoundland about 2%.<sup>18</sup> These differences can probably be ascribed to social or cultural factors. The low rate in Quebec may be related to the different ethnic composition of that province's population: "routine" circumcision is not practised in France. This idea could be tested by comparing hospitals that treat predominantly French-speaking patients with those that serve the English-speaking in Quebec and elsewhere in Canada. The Newfoundland statistics are not surprising because this province has often been described as culturally distinct. The reasons for Newfoundland's low rate, however, are difficult to trace. It should also be mentioned that there is no simple correlation between the circumcision rate and

the amount paid by each provincial health insurance plan for this procedure (J.L. Wirth: unpublished data, 1980).

### *Temporal trends*

The literature does not explain how in Western society neonatal circumcision was transformed from a religious ritual practised by a small minority to a prophylactic or therapeutic procedure firmly entrenched in medical practice. At the end of the 19th century several authors championed the procedure on the basis of completely undocumented claims that it prevented a host of evils.<sup>19</sup> Even among those who challenged these claims many apparently felt that the nonretractable foreskin of the infant was a barrier to proper hygiene that could easily and safely be removed by circumcision. Over the first half of the 20th century the circumcision rate rose until the procedure became "routine" in many hospitals. The outcry against the practice in the past 30 years has had a varied effect on the circumcision rate, depending on the country considered.

In the 1930s approximately one third of British males were circumcised at birth. Since then the rate has steadily declined, and by 1975 it had dropped to 6%. The practice in Britain may have been affected by Gairdner's paper, published in 1949,<sup>5</sup> which showed that the proportion of boys with a nonretractable foreskin was higher among infants than among those of school age. Such data have led British physicians to perform circumcisions only for specific indications rather than as a prophylactic measure for hygiene. Thus, there has been a shift towards circumcision at a later age, with only one third performed before the age of 5 years.<sup>17</sup>

In the United States, unlike Britain, there has been no correlation between the number of circumcisions performed and professional criticism of the procedure. In United States Air Force hospitals in 1974 there was a neonatal circumcision rate of 97.7%.<sup>20</sup> These hospitals serve people of many cultural and geographic origins and are staffed by relatively young physicians. Apparently the 1971 recommendation of the American Academy of Pediatrics had no effect on the practices of these younger physicians.

In Australia, where criticism of circumcision by some, such as Morgan,<sup>1</sup> has been particularly harsh, the neonatal circumcision rate has dropped from about 60% in the late 1960s to 50% in 1973 and to 43% in 1976.<sup>7</sup> This is still rather high considering that reports published there denounced the procedure as not only worthless but also damaging.<sup>1,21</sup>

The circumcision rate in Canada is somewhere between that in the United States and that in Great Britain, and is actually most similar to that in Australia. The overall neonatal circumcision rate declined from 50% in 1971 to 40% in 1977.<sup>18</sup> As with the actual rate, however, the rate of decrease has varied among the provinces. There has been no decrease at all in Saskatchewan and the Yukon, and a less marked decrease in Ontario than elsewhere; all three

of these provinces still have a relatively high rate. So far there has been no apparent increase in the rate of circumcising older infants and children in the provinces that show a drop in the neonatal circumcision rate.<sup>18</sup>

### **Anatomy and development of the prepuce**

The prepuce appears at about 8 weeks' gestation as a thickened ring of epidermis proximal to the glans penis. By 16 weeks the prepuce has grown forward toward the tip of the glans. At this time the squamous epithelium of the deep surface of the prepuce is continuous with that of the glans. Whorls of epithelial cells, or rests, form and then degenerate, leaving spaces. As these spaces link up and enlarge, the preputial sac is formed. At birth this process is usually not completed and the foreskin is not retractable.<sup>5</sup> In 1949 Gairdner<sup>5</sup> reported that the foreskin was still not retractable by 6 months of age in 80% of boys, by 1 year in 50%, by 2 years in 20% and by 3 years in 10%; the prepuce was still not retractable in 6% of children aged 5 to 13 years and could be only partially retracted in 14%. In the older children retraction of a previously unretracted prepuce revealed a collection of malodorous smegma. Gairdner recommended that until age 3 years a nonretractable prepuce be considered normal, but that after this age the situation be corrected.

### **Methods of circumcision**

A detailed discussion of the various methods of circumcision can be found in several surgical texts. In the neonatal period anesthesia is not usually used, though some discuss the use of a dorsal nerve block.<sup>22</sup> Devices such as the Gomco (Yellen) clamp or the Plastibell (Hollister Inc., Chicago) are commonly used to safely define the surgical field. The Gomco device has a metal cone that protects the glans and a clamp that holds the foreskin tightly in position and effects hemostasis before an incision is made. The Plastibell method involves the use of plastic cap and ligatures rather than a clamp. The distal foreskin is cut off and the distal portion of the cap removed, allowing that part of the foreskin strangulated by ligatures to necrose and fall off with the remaining ring of the cap. Use of the former device involves a slightly higher risk of hemorrhage, and use of the latter entails a greater risk of infection, as the device must be left in place for a week.<sup>23</sup>

### **Conditions that affect the decision to circumcise**

A therapeutic circumcision must be performed for the following conditions:

- Phimosis.<sup>13</sup>
- Paraphimosis.<sup>13</sup>
- Recurrent balanitis.<sup>13</sup>
- Dyspareunia due to a short frenulum.<sup>24</sup>
- A foreskin opening so narrow that it obstructs urination (very rare).<sup>25</sup>

In infants posthitis (inflammation of the prepuce) is actually a contraindication to circumcision because it is usually caused by irritation from ammonia liberated by urea-splitting bacteria in the urine, and the circumcision would merely expose the delicate glans and meatus to the same pathogenic process, perhaps inducing a meatal ulcer that would be much more difficult to cure.<sup>5</sup> In adults with posthitis, circumcision is indicated only if the causative factors are removed; otherwise the operation will induce balanitis.<sup>13</sup>

As none of the above conditions except urinary obstruction by the foreskin, which is very rare, occur in the newborn infant, it is apparent that circumcision at birth is almost invariably a prophylactic procedure.

A prophylactic circumcision should not be performed in the following circumstances:

- Prematurity. An otherwise healthy premature infant is much more prone to septicemia after circumcision.<sup>14,26</sup>

- Neonatal illness.<sup>8</sup>

- Congenital anomalies. Although the presence of any anomaly is a relative contraindication, the contraindication becomes absolute for such conditions as hypospadias (the foreskin is necessary for later reconstruction), ambiguous genitalia, umbilical artery anomalies (the latter are often associated with genitourinary abnormalities)<sup>14</sup> and neurologic abnormalities (an incontinent child is more easily fitted with an external collecting device if the prepuce is intact).<sup>8</sup>

- Bleeding problems.<sup>8</sup>

- Presence of any rash — especially pustules. A rash can be an early sign of the staphylococcal scalded skin syndrome.<sup>27</sup>

- Outbreaks of staphylococcal infection in the nursery.<sup>27</sup>

- Low Apgar score.<sup>14</sup>

- History of pneumothorax and pneumomediastinum.<sup>28</sup>

- The infant is less than 24 hours old. A circumcision should not be performed in the first day of life because it takes time to assess the infant for the conditions that contraindicate this procedure and because the infant has to be uncovered and thus is exposed to too much stress from cold.<sup>8,26</sup>

Burger and Guthrie<sup>14</sup> made the valid point that the term "routine circumcision", which appears so frequently in the literature, should never be used for a procedure with so many contraindications.

### Risk-benefit analysis

Table I summarizes the possible benefits and recognized risks of neonatal circumcision.

#### *Cancer of the prostate*

The results of several studies suggesting a significantly higher incidence of prostatic cancer in gentiles than in Jews have been interpreted as evidence that circumcision protects against this disease. In a study cited by Apt,<sup>16</sup> Ravich found that 2% of Jews undergoing prostatectomy had cancer of the prostate, as

compared with 20% of gentiles. Apt found that the age-adjusted incidence of cancer of the prostate in Sweden (where circumcision is rarely performed) was 2.3 times higher than in Israel. The attempt by Preston<sup>29</sup> to discount this study may be invalid because of inappropriate calculations. However, although the findings of Kaplan and O'Connor<sup>30</sup> resembled those of Ravich as to the observed rates of cancer of the prostate in Jews and gentiles, Kaplan and O'Connor also observed that in the gentiles there was no relation between circumcision status and the incidence of cancer of the prostate. In their discussion they discounted Ravich's postulate that smegma contains a carcinogen that migrates up the urethra by pointing out that cancer usually arises in the posterior lobe of the prostate. They concluded that a genetic predilection for cancer of the prostate is probably responsible for its increased incidence in gentiles.

#### *Cancer of the cervix*

The relation between cancer of the cervix and the circumcision status of the woman's sexual partner has long been debated. Some have attributed the low incidence of cancer of the cervix in Jewish women to the fact that most Jewish men are circumcised.<sup>31,32</sup> Handley<sup>33</sup> drew attention to the fact that the incidence of cervical cancer among the partners of circumcised Fijians was one tenth that among the partners of Indians in the same islands, who generally were uncircumcised.

These findings parallel those of studies done among Moslems, who circumcise their young before puberty.<sup>34-36</sup> In 1954 Wynder and associates<sup>37</sup> analysed a number of factors, such as syphilis in the woman, the circumcision status of the man, the age at first coitus for the woman, age at the first and last pregnancy and

Table I—Possible benefits and recognized risks of neonatal circumcision

<b>Benefits</b>	
<b>Controversial</b>	
	Decreases incidence of cancer of the prostate
	Decreases incidence of cancer of the cervix
	Increases sexual satisfaction
<b>Accepted</b>	
	Facilitates penile hygiene
	Prevents cancer of the penis
	Decreases the incidence of sexually transmitted disease
	Prevents phimosis
	Prevents paraphimosis
	Prevents balanitis
	Avoids the pain and possible psychologic effects of late circumcision
	Avoids risk associated with anesthesia for late circumcision
	Avoids the cost of late circumcision
<b>Risks</b>	
<b>Early complications</b>	
	Hemorrhage
	Infection
	Local
	Systemic
	Surgical trauma
<b>Late complications</b>	
	Meatitis
	Meatal stenosis
	Death

at the onset of menses, the number of partners for the woman and the contraceptive measures used by either partner for their relation to cancer of the cervix. They found statistically significant positive associations with an early age at first coitus, with more than one partner for the women and with having an uncircumcised man as a partner. In 1973 Terris and colleagues<sup>38</sup> also studied the question but found no statistically significant relation between cancer of the cervix and lack of circumcision of the woman's partner. They did, however, admit that the low rate of cervical cancer among Jewish women was convincing and that the matter required further study. Although Dodge and associates<sup>39</sup> found a decreased incidence of cancer of the penis among circumcised African tribes, they found no such decrease for cancer of the cervix among the women of these tribes. Aitken-Swan and Baird<sup>40</sup> also found no significant association between circumcision status and cancer of the cervix.

The authors of one retrospective study discovered that both being circumcised and using barrier methods of contraception were associated with a decreased incidence of herpes genitalis.<sup>41</sup> Other authors have linked barrier methods of contraception with a decreased incidence of cancer of the cervix.<sup>40</sup> This might lead to the speculation that the herpes simplex virus could be the link between cancer of the cervix and circumcision status. Some authors, who have discovered a higher-than-expected incidence of genital cancer in the wives of patients with cancer of the penis, have suggested a mutual environmental factor, such as a chemical or a virus, or an agent transmitted through sexual contact, as being responsible for the malignant disease in both partners.<sup>42</sup> The greater protection against cancer of the penis afforded by neonatal, rather than late, circumcision may be a manifestation of the same factor that is responsible for the lower incidence of cancer of the cervix among Jewish women than among Moslem women, whose partners are circumcised later than those of Jewish women. These observations are presented not as evidence that specific relations have been proven but as evidence that there is a need for further investigation of the relation between circumcision status and the occurrence of cancer of the cervix.

### *Sexual satisfaction*

Harnes<sup>43</sup> has written a tongue-in-cheek summary of his fruitless attempts to study this issue scientifically. It is generally well accepted that circumcision, by permanently exposing the glans, causes epithelial changes that decrease its sensitivity.<sup>14,29</sup> Whether this is an advantage or a disadvantage is the subject of controversy. According to Morgan,<sup>1</sup> coitus without a foreskin "is like viewing a Renoir or a Van Gogh while colourblind". Others argue that this decreased glandular sensitivity diminishes the incidence of the very common problem of premature ejaculation.<sup>14,29</sup> This notion can be countered, however, with evidence that premature ejaculation is a psychologic rather than an organic problem.<sup>1</sup>

In one retrospective study of causes for circumcising

adults, the second commonest indication after phimosis (the cause in 20% of cases) was dyspareunia because of a short frenulum (the mucous membrane on the ventral surface) that restricted the foreskin and caused chordee during intercourse. This problem is unlikely in a circumcised man. In addition, phimosis and poor hygiene are the commonest physical causes of dyspareunia in men, and both of these conditions can be alleviated by circumcision.<sup>24</sup> On the other hand, it has been argued that the foreskin decreases the likelihood of dyspareunia by lubricating the glans and easing penetration.<sup>1</sup>

### *Hygiene*

We grant that regular retraction and cleansing could do as much to keep the preputial sac free of smegma and bacteria. However, in 10% of boys the foreskin is still not retractable at 3 years of age. Gairdner<sup>5</sup> recommended that at this age some procedure be performed to allow cleansing because smegma tended to collect beyond this age. Thus, 10% of 3-year-old boys would require a procedure ranging from simple manipulation to circumcision if the practice of neonatal circumcision was abandoned in all cases.

From Kalcev's study<sup>44</sup> we learn that of 50 boys aged 4 to 5 years who had completely retractable foreskins only 27 actually practised personal hygiene in this area. Indeed, in a group aged 14 to 15 years only 19 of the 69 with completely retractable foreskins practised personal hygiene. This study revealed what most parents already know: boys do not enjoy washing. It was undertaken to provide data on which to base recommendations for educational programs. However, the efficacy of such programs could be questioned. Neonatal circumcision would remove the voluntary aspect of personal hygiene programs, eliminate the need to monitor young boys for retractability of their foreskin and prevent circumcision from having to be performed at a later age, when it would be more dangerous and more traumatic.

### *Cancer of the penis*

Available data on the incidence of cancer of the penis show a strong relation to the circumcision status of the population studied. Among Jews who practise neonatal circumcision its incidence is so low that its very occurrence merits mention.<sup>45</sup> In the United States, where the prevalence of circumcision is high, the incidence of penile cancer is 1 to 2 per 100 000 annually, and penile cancer represents 0.5% to 1.5% of all malignant diseases in males.<sup>46</sup> These cases of cancer must be drawn almost exclusively from the uncircumcised; at least three studies over long periods have apparently detected no cases of penile cancer among circumcised males.<sup>3,47,48</sup> Dodge and associates<sup>39</sup> found a higher rate among uncircumcised as compared with circumcised tribes in Africa. In the uncircumcised Asian population cancer of the penis represents 10% to 20% of all malignant disease in males. In India cancer of the penis is extremely rare among neonatally circumcised Jews, more frequent among Moslems who prac-

tise prepubertal circumcision, and quite common among Hindus and Christians, who do not practise circumcision.<sup>49</sup> This study also brought out the point, confirmed by most other large series, that circumcision is more effective for prophylaxis when performed in the neonatal period.<sup>50-52</sup> Indeed, adult circumcision offers little or no protection against the development of penile cancer.<sup>53</sup>

Penile cancer is most frequently located on the glans or the coronal sulcus. It is least commonly found on the prepuce, shaft or meatus. The development of penile cancer may be related to irritation caused by the build-up of smegma, which is a product of the action of bacteria on the desquamated cells retained within the preputial sac. Some authors have suggested that there is a specific carcinogen in the smegma.<sup>54,55</sup>

Patients presenting with cancer of the penis have tended to be of a lower socioeconomic class and to have lower standards of personal hygiene.<sup>56,57</sup> Thus, Morgan<sup>1</sup> says that as much could be done with a little soap and water as with circumcision, and at a much reduced cost. However, this argument is based on the chronic irritant theory, which is still being investigated.

In those not receiving treatment cancer of the penis is characterized by a progressive course, with death usually occurring within 2 years. For those receiving treatment for this disease the prognosis is improved. Unfortunately, men with cancer of the penis are noted for their tendency to delay seeking medical attention.<sup>58</sup> Various studies have found that 15% to 50% of patients delay obtaining medical care for more than 1 year.<sup>47,51,56,59,60</sup> Different papers have reported the mean age at the time of diagnosis as 55<sup>61</sup> and 58<sup>51</sup> years, with some cases occurring in younger men. At present, the best treatment is surgical excision of the lesion, if possible. The prognosis, with treatment, is related to the degree to which the lesion has spread. If the carcinoma is limited to the glans or foreskin the proportion of patients surviving is close to 100%. If the corpora is involved, with or without invasion of regional nodes, the survival rate drops to 50%; those with distant metastases are not treatable.

#### *Sexually transmitted disease*

Herpes genitalis appears to be the only sexually transmitted disease associated with circumcision status. Taylor and Rodin<sup>41</sup> found that only 12.1% of the men in their study who had herpes genitalis were circumcised as compared with 25.4% of a control group without this disease, a statistically significant difference. There was no relation between the incidence of gonorrhoea or nonspecific urethritis and circumcision status.

#### *Phimosis*

In phimosis the opening of the prepuce is too narrow and prevents the foreskin from being retracted over the glans. This condition should not be confused with that in which adhesions cause the squamous epithelium of the glans and the prepuce to be continuous. In a true case of phimosis, balanitis and urinary tract ob-

struction may develop. The incidence of true phimosis in uncircumcised men has, unfortunately, not been reported. Most authors find a high incidence of phimosis in patients with cancer of the penis.<sup>62</sup> Circumcision is the appropriate treatment for uncomplicated phimosis.

#### *Paraphimosis*

In this condition the prepuce is drawn back and trapped proximal to the glans and may cause severe swelling and necrosis. Should manual reduction fail, a dorsal slit procedure followed by circumcision is the preferred treatment.<sup>62</sup> We do not have data on the incidence of paraphimosis, but this condition can be prevented by early circumcision.

#### *Balanitis and balanoposthitis*

Inflammation of the glans, or of the glans and the prepuce, is most frequently the result of retained secretions and bacterial infection beneath the prepuce, especially if phimosis is already present. Again a dorsal slit procedure followed by elective circumcision, in conjunction with local measures and the administration of antibiotics, is the treatment of choice.<sup>62</sup> Males with diabetes have a higher incidence of balanitis.<sup>63</sup> Balanitis and balanoposthitis are more common in uncircumcised males,<sup>41,64</sup> but no figures on the number of men with these conditions that have to be circumcised are available.

#### *Pain and possible psychologic effects of late circumcision*

Many authors view neonatal circumcision with disfavour because of the physical discomfort and psychologic damage they suppose it causes. Grimes<sup>9</sup> cited studies dispelling the myth that an infant does not feel pain by showing that the newborn has a definite somatic response to circumcision that consists of flushing, vomiting, increased crying, increased levels of cortisol in the plasma and altered sleep patterns; the last two may persist for several days. Katz,<sup>65</sup> however, has carefully studied this issue and concluded that if circumcision is to be done the neonatal period is certainly the best time since, in infants up to 3 weeks of age, the pain and irritability that result from circumcision are restricted to the immediate time of surgery. Infants from 4 weeks to 3 months of age are still irritable during the night following the surgery, and the use of analgesics is recommended. When infants from 3 months to 1 year of age are circumcised the pain and irritability may last for 3 to 4 days; in those beyond the age of 1 year the response is variable. The average adult has pain and discomfort for 7 to 10 days.

There is evidence that neonatal circumcision has no long-term psychologic effects. Calnan and colleagues<sup>66</sup> studied a cohort of 2000 11-year-old boys born in 1946 and found no difference on a number of development and behaviour indices between those who were circumcised as infants and those who were still uncircumcised. In contrast, Cansever,<sup>67</sup> who performed psychologic tests on 12 children circumcised between

the ages of 4 and 7 years, found that the procedure was viewed by the children as an attack on their bodies and seemed to cause an increase in their aggressive drives. However, these boys were tested 3 to 7 days after surgery, and the tests were not repeated later.

#### *Risk associated with anesthesia for later circumcision*

Although neonatal circumcision is not an entirely painless procedure, it is thought that the afferent nerves are sufficiently immature during the first 2 to 3 months of life that an anesthetic is unnecessary.<sup>65</sup> For older patients a general anesthetic is almost always used in Canada. In the United States some centres prefer to use a local anesthetic if the patient is old enough to cooperate and be motionless.<sup>65,68</sup>

The risk of a serious disorder or death following the administration of a general anesthetic to a healthy person is considered to be about 1 in 10 000.<sup>69</sup> At present in Canada over 10 000 circumcisions are performed annually on males who require general anesthesia because they are no longer infants.<sup>69</sup> On the basis of recent data that indicate a neonatal circumcision rate of 50% in Canada, we would expect the number of circumcisions performed with a general anesthetic to double, to over 20 000 annually, if neonatal circumcision were abandoned in this country. This could cause an estimated two fatalities a year — six times the expected mortality from neonatal circumcision of the 180 000 males born each year, given an expected mortality of two per million for this procedure.<sup>19</sup>

Even the use of a local anesthetic is not without hazards. Palmer and Link<sup>68</sup> have reported two cases of impotence in young men following circumcision with a local anesthetic. Apparently the agent, lidocaine, irreversibly damaged the endothelium of the corpus cavernosum, thereby interfering with the normal erectile process; in both cases cavernography showed an obstruction that prevented the distal penile shaft from filling.

#### *Cost of late circumcision*

The present cost of circumcising 80% of the infant boys born in the United States has been estimated to be about \$60 million annually.<sup>9,13</sup> For Canada, unpublished data for 1977 (J.L. Wirth) indicate that the amount spent for the 40% of infant boys who are circumcised is about \$2 million annually (a figure based on 70 000 circumcisions at an average fee of \$15 for the physician and \$15 for instruments<sup>9</sup>).

Some argue that the money and time spent to perform circumcisions is being drained away from more cost-effective procedures.<sup>9</sup> To determine whether the cost of neonatal circumcision is excessive, we compared the total annual cost of neonatal circumcision with the total annual cost of medically indicated circumcisions in later life, using data from Ontario. As the current neonatal circumcision rate is roughly 50% in this province, the cost of circumcising all infant boys would be double the amount presently spent. Similarly, if neonatal circumcision were abandoned, within 50 years

the cost of medically indicated circumcisions would be about twice the amount presently spent on such procedures, because all instead of only half of the male population would be at risk of requiring a therapeutic circumcision at some time in their life.

In the fiscal year 1977–78 in Ontario 34 267 prophylactic circumcisions were performed on infants under 10 days old at an approximate cost of \$1 030 000. In the same year 4627 therapeutic circumcisions were performed on males over 2 years of age, at a physician's fee of \$60 each, for a total of \$280 000 (unpublished data: Ontario Ministry of Health, information systems division, 1981). This older group also required general anesthesia, with an anesthetist's fee of about \$25 (an estimate for a 30-minute procedure) and an instrument fee of at least \$35 — an additional cost of \$280 000. Thus, the total cost was \$560 000 for the therapeutic procedures. (The 2200 infants aged 10 days to 2 years were omitted as it was not known what percentage of this group were infants who stayed in hospital for more than 10 days because they were premature or ill, and who, in fact, underwent a delayed neonatal prophylactic circumcision.) Thus, the cost for neonatal circumcisions was \$470 000 more than that for therapeutic circumcisions.

However, the additional costs for the hospital care and the possible loss of time at work for boys and men having a therapeutic circumcision must also be considered. According to hospital statistics from the Ontario Ministry of Health, for the over 4000 therapeutic circumcisions performed in Ontario each year the patient is hospitalized for an average of 3 days at \$200 a day, for an approximate cost of \$2.4 million. Data for Canada<sup>69</sup> indicate that in about 1650 of these cases the patients are men between the ages of 15 and 64 years. A conservative estimate of the number of days lost from work, because of the illness that necessitated the circumcision as well as the time spent in hospital, would be at least 10 days a man — that is, about 16 500 days. If this loss is calculated on the basis of \$60 a day it amounts to \$990 000; when this figure is added to the hospital costs a total of \$3.4 million is reached. If neonatal circumcision were abandoned, this figure would double to \$6.8 million. (This figure may be low because until recently the proportion of men who were not circumcised was closer to 40% than 50%.) After adding the physician and instrument fees for therapeutic circumcision, and comparing those costs with those for the routine circumcision of all infant boys (approximately twice the \$1 030 000, or \$2 060 000) we estimate a saving of about \$5.3 million a year in Ontario alone. For all of Canada this could be a saving of about \$18 million a year.

#### *Complications of neonatal circumcision*

The incidence of complications of neonatal circumcision found in the literature ranges from a low of 0.06% reported by Speert<sup>9</sup> to a high of 55% reported by Patel.<sup>10</sup> This discrepancy may reflect differences in the methods of the various studies. Speert studied records of all circumcisions at one hospital

between 1933 and 1951 — a total of about 10 000 — and found complications reported in only six cases: hemorrhage in four, septicemia in one and removal of too much skin in one. Moreover, all six patients responded readily to treatment.

Gee and Ansell<sup>23</sup> criticized this and similar studies because only indexed complications were reported. They found that most complications following circumcision had not been indexed and that the true incidence could be calculated only by carefully reading the nurses' notes. In their study of over 5000 cases they found data on 14 complications (an incidence of 0.2%): life-threatening hemorrhage in 1 case, systemic infection in 4 cases, hypospadias in 8 cases in which the infant was circumcised before this problem was discovered and complete denudation of the penile shaft in 1 case. Even this careful study, however, looked only at problems in hospital and failed to report on complications that arose after the infant was discharged from hospital. This may reflect the fact that the obstetrician, who generally performs the circumcision, rarely sees the infant when complications occur outside hospital. (In Canada, unlike the United States, this is less likely, as most neonatal circumcisions are performed by general practitioners or pediatricians.) Apparently, local infections were also omitted from the Gee and Ansell statistics; these cause complications in another 0.4% of cases. The subjective aspect of the term "complication" may be seen in the rate of 55% found by Patel, who included the occurrence of slight oozing under the heading "hemorrhage". Thus, although he did a careful follow-up of 100 cases for complications after discharge, his figures may be misleading.

These examples indicate that simple overall morbidity rates may be meaningless unless the methods and criteria for including each case are clearly defined. More information can be derived by examining the frequency, method of treatment and prognosis of each type of complication.

**Hemorrhage:** This most common complication of circumcision occurs in about 1% of cases<sup>29</sup> and usually responds to simple hemostatic measures.<sup>5,19,23,70</sup> Hemorrhage is most likely to occur 3 days after birth because of the physiologic depression of plasma levels of vitamin-K-dependent clotting factors that occurs 48 to 72 hours after birth; the levels of these factors gradually rise to normal by the 7th to 10th day. This depression can be prevented by an injection of vitamin K at birth.<sup>65,71</sup> (According to Jewish ritual, circumcision is done on the eighth day of life, either at home or in the synagogue, unless there are contraindications.)

**Infection:** Reports on the incidence of infection vary markedly. One group found that the use of the Plastibell caused an infection rate five times higher than that with the Gomco clamp.<sup>23</sup> Patel<sup>10</sup> reported that in the cases he studied most infections occurred after discharge; he claimed that the much lower figures on the incidence of infection reported in other studies are a result of inadequate follow-up. Wright,<sup>72</sup> however, noted that although the wound may appear to be super-

ficially infected, especially with the Plastibell, which causes a foreign body reaction producing mild redness and swelling, clinical evidence of bacterial invasion is rarely obtained. Patel found that other researchers agreed with this observation.

Differences in defining infection may also account for differences in management. Gee and Ansell,<sup>23</sup> who reported a 0.4% incidence of infection, advocated initial treatment with hydrogen peroxide and hexachlorophene, followed by the administration of antibiotics only if fever and irritability occurred. Perhaps in those cases in which antibiotics are not needed the wound is not really infected. Katz<sup>65</sup> stressed that in the rare cases of true infection antibiotics are mandatory. A few cases have been reported in which diphtheria, tuberculosis and tetanus pathogens were cultured from the wound.<sup>13</sup>

Aside from the obvious risk of systemic spread of infection, significant local sequelae include scarring, deformity, paradoxical phimosis<sup>10</sup> and, most serious of all, the very rare Fournier's syndrome, a malignant gangrenous infection of the scrotum, penis and perineum.<sup>73</sup> Systemic infection caused by such common organisms as *Staphylococcus aureus* and *Proteus mirabilis*<sup>26</sup> is an occasional complication of local infection.<sup>23</sup> Rare complications include the staphylococcal scalded skin syndrome (toxic epidermal necrolysis),<sup>11,27</sup> hematogenous osteomyelitis,<sup>26</sup> lung abscess<sup>28</sup> and death.<sup>27</sup>

**Surgical complications (Table II):** The formation of a bridge of skin between the penile shaft and the glans can result in the accumulation of smegma and bacteria, or a tethering of the erect penis that can cause pain or curvature or both. It can probably be prevented by completely freeing the inner preputial epithelium during surgery. It is easily cured by simple division, although good hemostasis is necessary as the tissue is very vascular.<sup>13</sup> Wound dehiscence and denuding of the penile shaft are less common complications that respond to surgical restoration.<sup>23,74</sup>

Most other surgical complications are very rare and readily corrected surgically. One such complication is inadequate removal of the prepuce, causing secondary phimosis. Some researchers have quoted incidence rates for this condition that seem very high: from 2%<sup>78</sup> to 10%.<sup>21</sup> Whether it is this common or not, the treatment is to perform a second circumcision. Kaplan<sup>13</sup>

Table II—Surgical complications of neonatal circumcision

Relatively common
Bridging of skin between penile shaft and glans
Wound dehiscence
Denuding of penile shaft
Rare
Lymphedema of penile skin <sup>74</sup>
Lacerated scrotum and penile skin <sup>74</sup>
Deformity of penis (result of several possible complications)
Cauterization burns
Bivalved, <sup>75</sup> grooved or amputated glans <sup>74</sup>
Concealed penis <sup>74</sup>
Urethral fistula <sup>13,76</sup>
Necrosis of distal portion of penis <sup>77</sup>
Slough of penis <sup>23</sup> (only one recorded case)



claimed that this complication can be completely prevented by marking the coronal sulcus on the shaft and freeing the inner preputial epithelium from the glans prior to circumcision. Dislocation of the Plastibell ring proximally on the glans mimics paraphimosis and causes compression and ulceration of the corona, glans and shaft. Rarely the Plastibell ring will be retained, causing edema of the penile shaft; this should be suspected if the ring fails to fall off within 5 to 8 days, and is treated by simply removing the ring as soon as possible.<sup>23</sup> Urinary retention can also result from a dressing that is too tight.<sup>74</sup> Other complications can occur if an infant with unrecognized hypospadias is circumcised.<sup>25</sup>

**Late complications:** These can arise after the circumcision site is well healed, and thus may be unrelated to the method used or to the skill with which it was performed. The obstetrician who circumcises infants but does not give neonatal care may never have to recognize or treat these complications, is often unaware that they occur and is certainly unaware of their frequency.<sup>79</sup> This is significant not only because it explains some of the variations in the incidence of complications quoted in the literature but also, far more importantly, because it has a bearing on the parents' ability to come to an informed decision about circumcision. Particularly in the United States, where most infants are delivered by obstetricians, it is important that these specialists be aware of these complications when discussing with the parents whether an infant should be circumcised.

Meatitis (meatal ulceration) is caused by exposure of the glans, no longer protected by the prepuce, to irritation from the ammonia in wet diapers.<sup>14,29,72</sup> The reported incidence of this complication varies from 8% to 31%, and it seems highest towards the end of the first year of life.<sup>13</sup> Occasionally it can be prevented by frequent diaper changes or the application of ointments until keratinization develops.<sup>14</sup> The importance of this condition is controversial. Some authors argue that it is a benign condition responding quickly to treatment and matched by an equally high rate of balanoposthitis in the uncircumcised, which is just as troublesome.<sup>80</sup> We were unable to find a controlled study that compared the frequency of these conditions. Moreover, it would be difficult to prove which condition is subjectively more uncomfortable for the infant, although one would suspect that an inflamed meatus in direct contact with urine would be more painful than inflammation of the less sensitive foreskin or secondary inflammation of the glans somewhat away from the meatal area. The argument by some authors that meatitis is a serious risk because it leads to meatal stenosis<sup>10,17,29</sup> has been questioned.

It is well documented that the meatus of a circumcised penis tends to acquire a smaller diameter than that of a noncircumcised penis, probably because of clinical or subclinical meatitis.<sup>10,81,82</sup> This anatomic "stenosis", however, is almost never associated with urinary tract obstruction, as manifested by dysuria, frequent urination or enuresis.<sup>8</sup> In the rare case in

which such obstruction does occur it can be corrected by a simple office procedure.<sup>14</sup> This condition is also found in uncircumcised adults, in whom it is probably caused by chronic, low-grade balanitis.<sup>83</sup>

**Mortality:** Indexed mortality rates for circumcision are universally negligible figures. In his study of half a million cases between 1933 and 1951 Speert<sup>19</sup> found only one death, which occurred after a ritual circumcision that was performed at home and complicated by a delay in obtaining a transfusion. In the three largest studies done since then — involving over 24 000 patients — only one death occurred.<sup>9</sup> However, even these studies do not provide a large enough sample to calculate a true rate for such a rare event. A few writers have claimed that death after neonatal circumcision is less frequent than death after circumcision later in life.<sup>83</sup> Unfortunately, we could not obtain data to substantiate this claim, as deaths from circumcision are listed under the general category of "complications of surgery". However, considering the known risk associated with anesthesia, this claim seems to be valid.

## Conclusions

From our review of the literature we conclude that:

- Neonatal circumcision does not appear to be helpful in preventing cancer of the prostate or sexually transmitted disease, although it may be associated with a lower prevalence of herpes genitalis.

- The relation of circumcision status to the occurrence of cancer of the cervix is unclear because of the difficulty of controlling the many associated variables in long-term prospective studies.

- The highly subjective nature of sexual satisfaction makes it an unsatisfactory measure of the effects of circumcision, either positive or negative.

- Circumcision facilitates penile hygiene.

- Cancer of the penis may be prevented by circumcision. Though the mortality of this disease is low, the risk of death from circumcision is probably lower.

- Recurrent balanitis, phimosis, a short frenulum and paraphimosis are indications for circumcision. Though these conditions are not completely prevented by circumcision, their incidence would be reduced by neonatal circumcision. The high incidence of balanoposthitis in males with diabetes makes prophylactic circumcision particularly advantageous for individuals at high risk of diabetes.

- Medically indicated circumcision, which is quite common, causes more complications, has a higher risk because of the need for general anesthesia and costs more than neonatal circumcision.

- Hemorrhage, infection and other immediate complications of circumcision have been reported. Most are easily treated; those that are not are very rare.

- Meatitis is more common in circumcised infants but it is also easily treated. As well, it is probably not more common than balanoposthitis in the uncircumcised. The relative meatal stenosis found in the circumcised is anatomic and usually of no clinical importance.

● Neonatal circumcision does not appear to have any long-term psychologic effects, and the physiologic reaction to stress that it induces is usually brief.

● The mortality of circumcision is extremely low.

Thus, circumcision is a low-risk procedure that is demonstrably effective in preventing the occurrence, or lowering the incidence, of a limited number of diseases. In comparison with therapeutic circumcision at a later age, neonatal circumcision saves time and money and carries less risk of complications or death even though it involves a larger number of operations.

For the male population as a whole we recommend circumcision because of its medical and economic advantages. For the individual the known benefits usually outweigh the risks. However, the physician should not pressure parents who, after explanation and discussion, prefer not to have their child circumcised.

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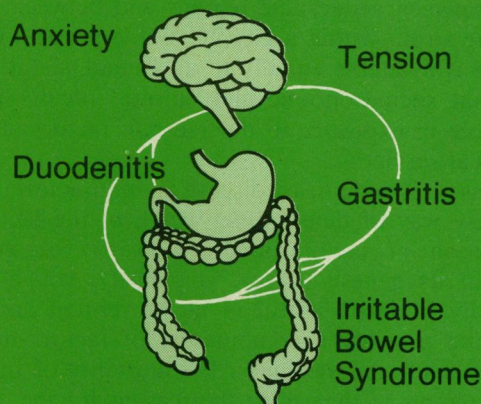
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