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*Trends in pediatric circumcision in
Belgium and the Brussels University
Hospital from 1994 to 2012*

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Abstract

Background: It has been suggested that the number of pediatric circumcisions is rising in Belgium. This report has a two-fold character. Firstly, it describes how the circumcision rates, the mean age during circumcision and the indication to circumcise have changed in the Brussels University Hospital between 1994 and 2012. Secondly, the pediatric circumcision rate and the rate in the indications to circumcise are studied in Belgium from the year 2002 to 2011.

Materials and methods: To analyze the trends in pediatric circumcisions in the Brussels University Hospital, data were extracted from the Electronic Medical Dossier of the Hospital. A total of 3,937 patients, all boys from 0 to 15 years old who underwent a circumcision between 1994 and 2012 in the Brussels University Hospital, were included in the study. To analyze the trends in pediatric circumcisions in Belgium, data were obtained from the National Institute for Health and Disability Insurance (NIHDI or RIZIV). A total of 162,833 boys below 16 years of age were included in the study. Data regarding the Belgian male population over the study interval were excerpted from the Belgian National Institute for Statistics and the Research Department of the Flemish Government.

Results: The pediatric circumcision rate is increasing. From 1994 to 2012, the number of circumcisions performed in the Brussels University Hospital increased by 59.75%, from 187.79 in 1994 to 300.00 in 2012. From 2002 to 2011 the national pediatric circumcision rate increased by 49.81%, from 13.23 per 1000 boys per year in 2002 to 19.82 per 1000 boys per year in 2011. If the 2011 circumcision rate remains stable, 31.71% of boys will be circumcised by their 16th birthday. The number of circumcisions performed for parental request is increasing and the number of medically indicated circumcisions declined.

Conclusion: The increase of the pediatric circumcision rate is probably due to a rise in the number of circumcisions performed for parental request. Although the number of circumcisions performed for phimosis declined, it is estimated that, if the 2011 circumcision rate remains stable, 5.88% of boys will undergo a circumcision by their 16th birthday to treat phimosis in Belgium. This number is about 9 times higher than the reported incidence of phimosis at that age, which indicates that phimosis is currently still overdiagnosed.

Introduction

Male circumcision is a very common procedure. Worldwide, an estimate of one on three males is circumcised.¹

History of male circumcision

Anthropologists disagree on the origins of this widespread operation. Some suggest that 15 000 years ago there was one 'heliolithic' culture that performed circumcision and that this act spread over of the world. Others believe that this practice originated independently among several different cultures. Fact is that circumcisions were performed in the Near East, among Australasian Aborigines, in some tribes in Africa, among the Muslim peoples of India and South-east Asia and by the inhabitants of the 'New World' for as long as we can tell. The earliest Egyptian mummies from 2300 BC were circumcised and ancient Egyptian wall paintings dated several thousand years before show that circumcision was a custom in that time.²

The motive to circumcise also remains unclear. There are many theories. None of these theories suggest that circumcision was introduced as a hygienic measure. In the days before aseptic surgery, a circumcision was performed in unhygienic circumstances, with high risk of bleeding, infection and death. One theory suggests that the ritual is a mark of cultural identity or tribal identification, like a tattoo or a body piercing. In Aboriginal Australia for example, those who were not circumcised were not considered proper members of the group and were shunned as outcasts. Another theory is that male circumcision arose as a way of 'purifying' individuals and society. Sexual pleasure was seen as 'impure' in some societies and the removal of the prepuce was said to reduce this pleasure and to promote chastity. Circumcision was a sacrifice of 'sinful' human enjoyment for the sake of holiness in the afterlife.³ Among the Polynesians, Aborigines and South American tribes, circumcision started as an initiation rite. It was a test of bravery and endurance, a part of the introduction to the responsibilities of manhood.⁴ According to another theory male circumcision began as a mark of slavery or defilement. In ancient Egypt captured warriors were circumcised to mark them before condemning them to slavery. This marking was initially done by amputation of digits or castration, but the morbidity of these actions was very high. Eventually, all male offspring of Egyptian slaves were circumcised. There is a theory that the Jews, who were largely enslaved, adopted and ritualized this custom and, in time, this was incorporated into Judaic religious practice.⁵

In the beginning circumcisions were performed by the mother. Gradually mohels, man who had surgical skills and religious knowledge, took over. In ancient Egyptian society, a Priest performed the procedure and throughout medieval times it remains to be performed by religious men. From the latter half of the 19th century, circumcision entered the medical practice. In the beginning, doctors only performed circumcision on adults as a cure for phimosis.⁵ In time it was claimed to be a cure for several diseases such as paralysis, hip joint disease, hernia, stricture of the bladder, eczema, oedema, elephantiasis, gangrene, nervousness, impotence, convulsions, hypstero-epilepsy and many more.⁶ There was a theory that masturbation caused many and varied ills. Some physicians therefore performed circumcision on males to stop masturbation and prevent these conditions. In a 75-year period from 1875 to 1950, there were many articles in medical journals and textbooks lauding the practice of routine newborn male circumcision. But the habit of routine circumcision was only accepted in the English speaking countries; no other country has adopted this routine. Routine male circumcision progressively declined from British medical practice from the 1940s.⁷

Global estimates in 2006 suggest that about 30% of males are circumcised. Male circumcision is common (20-80%) in Australia, Canada and the United States. However, the popularity of this practice is declining. It is mainly performed for the preventive health benefits of the procedure and for social desirability. In North Africa, most of West Africa The Middle East, Central Asia, Bangladesh, Indonesia and Pakistan male circumcision is almost universal (>80%). In these countries, males are circumcised primarily for religious and cultural reasons. In the Republic of Korea and the Philippines male circumcision is also widespread (>80%) and is mainly practiced for social desirability.¹

Potential benefits of male circumcision

According to the American Academy of Pediatrics, the potential benefits from male circumcision include the prevention of urinary tract infections, acquisition of HIV, transmission of some sexually transmitted infections and penile cancer. There is discussion if the risk of cervical cancer in his female partner is reduced.^{1,8,9} Infancy is the optimal age to circumcise. Circumcision later in life may evoke a fear of pain, penile damage or reduced sexual pleasure. Time off work or school will be needed, cost is much greater, as are risks of complications, healing is slower and stitches or tissue glue must be used.¹⁰

Prevention of urinary tract infections

The Centers for Disease Control defines a urinary tract infection as an infection involving any part of the urinary system, including kidney, ureter, bladder and urethra.¹¹

The incidence of urinary tract infections among boys is reduced in circumcised boys, compared with uncircumcised boys.¹² The biologically plausible explanation is that increased periurethral bacterial colonization is a risk factor for urinary tract infections and there are more uropathogenic organisms around the urethral meatus in uncircumcised boys.⁸ The risk of urinary tract infections in the first year of life is 1% in uncircumcised boys and 0.1% in circumcised boys. So for every 100 neonatal circumcisions, the risk of urinary tract infections would be reduced in only one child. This is insufficient to recommend routine circumcision in the prevention of urinary tract infections.¹³ In male infants who have a urological pathology and have urinary tract infections despite the administration of antibiotic prophylaxis, a circumcision can be recommended.¹⁴ A meta-analysis showed that the benefit of circumcision to urinary tract infections only outweighs the risk in boys who had a urinary tract infection in the past and who have a predisposition to repeated urinary tract infections.¹²

Prevention of sexually transmitted infections (STIs)

Male circumcision reduces the prevalence of HPV infection in males and herpes simplex virus type-2 transmission.^{1,8} According to the American Academy of Pediatrics, the evidence for male circumcision in the protection against syphilis is less strong and the risk of gonorrhea or Chlamydia is not decreased in circumcised males.⁸ Contradictory, the WHO states that there is a reduced risk of syphilis and gonorrhea among circumcised men and a significantly reduced risk of Chlamydia in the female partners of circumcised men. In the industrialized world, routine circumcision is not recommended by national pediatric societies for the prevention of these conditions, as the risks are judged to outweigh the benefits of the procedure.

Circumcision can protect men from acquiring HIV through heterosexual intercourse. In Southern Africa, the region of the world with the highest incidence of HIV infections, this procedure will likely be integrated in the WHO package of HIV prevention measures. In this region the acquisition of HIV is mainly through heterosexual sexual contact. The current prevention strategies include the promotion of abstinence, delayed sexual debut in young people, fidelity, reduction in the number of partners and correct condom use. It must be clearly stated that

male circumcision does not provide complete protection against HIV. The other prevention practices must still be followed. This message may be difficult to communicate and risky behavior may increase in circumcised men.¹ In Western countries, the prevalence of HIV infections is much lower and the acquisition of HIV is mainly through homosexual contact.¹⁵ According to the centers for disease control (CDC), newborn circumcision performed in the United States of America is cost effective for the prevention of HIV infection.⁸ The Royal Dutch Medical Association (a.k.a KNMG) refutes this. The incidence of circumcision is much lower in The Netherlands than in the United States of America and the number of HIV infections is much lower, thus the promotion of safe sex is a better prevention strategy.¹⁶

Prevention of penile cancer

Penile cancer is a relatively rare disease in Western countries. In the United States of America the annual incidence is only 0.58 per 100 000 males.¹⁷

However, it is a more common condition in developing countries.¹⁸

The risk of penile cancer is higher in uncircumcised males than in males who are circumcised in childhood. Phimosis, balanitis, penile lichen sclerosis*, smegma and HPV infection are some of the predisposing factors to penile cancer. These conditions are more common in uncircumcised males (cf. infra "Potential benefits of male circumcision - Prevention of penile problems including phimosis"). In contrast, there is some evidence that the risk of invasive penile cancer is higher in males that are circumcised in adulthood than in uncircumcised males. This can be explained by the fact that the indications to circumcise in adulthood are also some of the predisposing factors to penile cancer (phimosis, balanitis and lichen sclerosis).^{19,20}

There is strong evidence that circumcision offers a risk reduction for penile cancer, but this condition is very rare in Western countries (and is likely to decrease, as there is an increasing rate of HPV vaccination of women). Routine circumcision for the protection against penile cancer is therefore not recommended.⁸

Prevention of cervical cancer

HPV (human papillomavirus) is one of the most common sexually transmitted infections in the United States of America. Persistent infection with high-risk HPV

* Penile lichen sclerosis (also termed balanitis xerotica obliterans) is a progressive inflammatory disorder of the skin that can lead to phimosis. It is the main cause of acquired phimosis and the treatment of choice is complete circumcision. (Becker K. Lichen sclerosis in boys. *Deutsches Ärzteblatt International* 2011. 108(4):53-58)

types (mainly HPV type 16 and 18) is a prerequisite to developing cervical squamous carcinoma.²¹ A large multinational study published in the New England Journal of Medicine in 2002 showed that circumcised males have a lower incidence of HPV detection compared to uncircumcised males (5.5% versus 19.6%). The rate of cervical cancer in women whose partner had more than 6 sexual partners was significantly lower when their partner was circumcised. Thus circumcision can be considered an important cofactor in the natural history of HPV infection, as it may influence the risk of the acquisition and transmission of HPV as well as the risk of cervical cancer.⁹

Prevention of penile problems including phimosis

Infants who are circumcised have less penile problems than uncircumcised boys. A New Zealand prospective cohort study explored rates of penile problems in 635 boys from birth to 8 years of age. These problems include penile inflammation (balanitis, meatitis, inflammation of the prepuce and conditions in which the penis was described as sore or inflamed), phimosis with a need of treatment, inadequate circumcision with a requirement of a repair and postoperative infection after circumcision. From ages 1 to 8 years, 6.5% of the circumcised boys had penile problems, compared to 17.2% of the uncircumcised boys. Findings were not significant during the first year of life.²²

Potential disadvantages of male circumcision

A circumcision is a relatively safe operation and studies report few severe complications. However, mild or moderate complications are seen. The most common short-term complications are bleeding and infection. The most common long-term complications are necessity of revision of the circumcision and meatal stricture.^{23,24}

Complications are less frequent among neonates and infants than among older ages. The nature of the procedure in this age group is simpler, the healing capability in newborns is higher and in newborns stitches are usually not needed. The age of the circumcised boy, the training and expertise of the provider and the sterility of the procedure are factors that are directly associated with the complication rate. When a circumcision is performed in non-clinical settings, there is a higher risk for adverse events. If there are complications, they are generally more serious. A retrospective Turkish study noted the complications after circumcisions in non-sterile conditions by unlicensed providers. 73% of boys reported complications. These complications were wound infection (14%), subcutaneous cysts, bleeding with needed suturing (12%), hematoma (6%) and

urinary tract infections with requirement of IV antibiotics (1.3%). In a Nigerian and Kenyan study, 80% out of 50 patients with complications after circumcision was circumcised by a non-medical provider. One boy died of septicemia, two lost their penis from gangrene and five others had permanent disability from complete or partial amputation of the glans or shaft.^{1,23}

Few studies address the effects of a circumcision on the penile sensitivity, and the results of these studies are contradictory. Some reports show that male circumcision does not adversely affect the penile sensitivity, sexual function and satisfaction.^{25,26,27,28} A recently published large cohort study showed that the prepuce is in fact very important for the penile sensitivity, overall sexual satisfaction and penile functioning. Before circumcision, adult men and parents considering circumcision of their sons should be informed of the possible complications of the procedure and the possible impact on the sexuality.²⁹

Indications for pediatric circumcision

The British Association of Paediatric Surgeons advises that there is rarely a clinical indication for circumcision.³⁰ The only strictly medical reasons to circumcise a boy are pathologic phimosis and recurrent troublesome episodes of balanoposthitis.¹⁴ Other reasons to circumcise are the preventive health benefits, religious or cultural motives and social determinants.¹

Phimosis

Phimosis is a condition in which the foreskin cannot be retracted over the glans penis.³¹ There are two types of phimosis: physiologic and pathologic phimosis. Around 96% of males at birth have a non-retractile foreskin.² This is a physiologic phimosis and results from fused mucosa of the glans penis and the inner lining of the foreskin.³² It is a common condition in boys up to 3 years old and also occurs in older age. The foreskin becomes gradually retractable secondary to keratinisation of the inner epithelium and intermittent erections.³³ Only 4% of the newborns have a fully retractable foreskin. In 20% of 2 year olds, the foreskin cannot be retracted over the glans.² 8% of 6-7 year olds and 1% of 16-17 year olds have a non-retractable foreskin.³⁴

A phimosis is pathologic when the failure to retract is secondary to distal scarring of the prepuce. This appears as a contracted white fibrous ring around the preputial orifice.³¹ The incidence of pathologic phimosis is 0.4 per 1000 boys per year or 0.6% of boys are affected by their 15th birthday.³⁵ The possible consequences of a pathologic phimosis are pain, skin irritation, local infections,

bleeding, dysuria, hematuria, frequent episodes of urinary tract infections and painful erections.³⁶

A physiologic phimosis requires no medical treatment. A 6- to 8- week course of topical steroids can help to speed up the progress, but this is not needed in all cases. A proper reassurance of normalcy and reinforcement of correct preputial hygiene are required.^{31,37}

A pathologic phimosis requires a medical treatment. Since the latter half of the 19th century, surgical correction has been the standard therapy.⁵ This surgery includes circumcision, preputioplasty, dorsal slit, frenulotomy and meatoplasty.³⁶ For more than 2 decades, topical steroids have been tried as an alternative for surgical correction and it has showed good results.³⁸ In randomized controlled trials the efficacy figures of a 4 to 8 week treatment with topical steroids vary from 65 up to 95%.³⁹ Studies also show that it is a less expensive alternative for surgery. The reduction in costs from a treatment with topical steroids ranges from 27.3% to 75%.^{40,41,42} The treatment is well tolerated. Neither local nor systemic side effects are seen. Topical steroid application does not significantly alter the morning blood level of cortisol.^{33,37,43}

Balanoposthitis

Balanitis is an inflammation of the glans penis alone and phosthitis refers to inflammation of the foreskin alone. Balanoposthitis is inflammation of the glans penis and the prepuce in uncircumcised male. It is characterized by erythema and oedema of the foreskin and, pathognomonically, by a purulent discharge from the preputial orifice.¹⁴ A Japanese study showed that 1.5% of uncircumcised boys had balanoposthitis on routine examination and most cases occurred in toddlers.⁴⁴

Balanoposthitis in boys can be due to poor hygiene or, on the contrary, it can be due to excessive cleansing of the foreskin with soap, causing a disruption of the natural barrier and encouraging the growth of pathogenic organisms. Balanitis is more common in uncircumcised males, possibly as a result of irritation by smegma, poorer hygiene and insufficient aeration.^{45,46}

If the patient suffers from recurrent troublesome episodes of balanoposthitis, a circumcision can be considered. If the symptoms are mild and transient, an operative measure is not indicated.¹⁴

Preventive health benefits

From the latter half of 19th century male circumcision entered the field of public health. It was claimed to be a cure for several diseases such as paralysis, hip joint disease, hernia, stricture of the bladder, eczema, oedema, elephantiasis,

gangrene, nervousness, impotence, convulsions, hypstero-epilepsy and many more. This was not scientifically substantiated and these claims were refuted a long time ago.⁶

Circumcision can prevent urinary tract infections, acquisition of HIV, transmission of some sexually transmitted infections and penile cancer. It reduces of the risk of cervical cancer in the female partner and penile problems (cf. supra "Potential benefits of male circumcision").

Over the past several decades, the American Academy of Pediatrics has published several Circumcision Policy Statements. This is a statement based on the evaluation of English-language peer-reviewed literature and describes the recommendations regarding male infant circumcision. In August 2012 the Circumcision Policy Statement was updated. The revised Policy statement dated from 1999. The new Policy Statement is based on a systematic evaluation of English-language peer-reviewed literature from 1995 trough 2012 and indicates that preventive health benefits of elective newborn male circumcision outweigh the risks of the procedure. These health benefits are not sufficient enough to recommend routine circumcision, but they are sufficient enough to justify access to this procedure for families choosing it and to warrant third-party payment.⁸

Circumcision can be recommended in male infants who have a urological pathology and have urinary tract infections despite the administration of antibiotic prophylaxis. This procedure can also be recommended in boys who had a urinary tract infection in the past and have a predisposition to repeated urinary tract infections.^{12,14}

Circumcision can protect men from acquiring HIV trough heterosexual intercourse. The operation will likely be integrated in the WHO package of HIV prevention measures in Southern Africa, the region of the world with the highest incidence of HIV infections. In countries where the incidence of HIV is lower, there is discussion if circumcision is a cost-effective measurement in the prevention of HIV (cf. supra "Potential benefits of male circumcision - Prevention of sexually transmitted infections"). Routine neonatal circumcision was introduced in United States of America for the preventive health benefits. Nowadays the reason to circumcise in this country is mainly social desirability.¹

Religious and cultural motives

In the past South Sea Islanders, Sumatrans, Incas, Aztecs, Mayans and ancient Egyptians have practiced ritual male circumcision.⁴ Today it is still practiced among Jews and Muslims, less so among Christians and rarely among other religions.⁶ Ritual circumcision is also practiced in some parts of tribal Africa and

by Australasian Aborigines. The timing of the circumcision varies from religion to religion and from culture to culture. In Judaism, boys are circumcised on the eight-day after birth. In many tribal cultures the ritual is performed in early adult life. In some African tribes circumcision is performed at birth. Islamic scholars and jurist are not unanimous about the timing of the circumcision; it varies from an early age (the seventh day after birth) up to the age of 7 years.³ Male circumcision is not mentioned in any form in the Koran. In Muslim societies the practice is attributed to the Prophet Abraham, who Muslims (and Jews) revere as a patriarch. Therefore circumcision has acquired the status of tradition. If a man converts to Islam, it is not mandatory for him to be circumcised. If Muslim parents decide not to circumcise their son, he would not be considered non-Muslim. In the Torah on the other hand, circumcision is mentioned. It is said to represent the covenant made between God and Abraham and Abraham's descendants. Any child born to a Jewish mother is Jewish according to Jewish law, and circumcision is another vital component confirming a male child as Jewish. It is the father's duty to ensure their son is circumcised. If it is not performed, God will punish the father by shortening his life. Traditionally, the circumcision is performed by a specially trained mohel of traditional circumciser in a ceremony called a Bris Milah.^{1,3}

Social determinants

In the United States of America, the majority of boys are circumcised (cf. "Trends in pediatric circumcision – Trends in the United States of America"). A study in Denver showed that parents cited social reasons (for example not wanting their son to look different) as the main reason for choosing to circumcise their newborn. 90% of circumcised fathers chose to circumcise their sons, compared with 23% of non-circumcised fathers.⁴⁷

In the Philippines and the Republic of Korea circumcision is widespread and mainly performed for non-religious reasons. In the Philippines two thirds of boys chose to be circumcised "to avoid being uncircumcised" and 41% stated that it was "part of the tradition". In the Republic of Korea, 61% of respondents believed that their peer group would ridicule them if they were not circumcised.¹

Trends in pediatric circumcision

The percentage of infant male circumcisions varies by geographic location, by religious affiliation and by socioeconomic classification. Circumcision is uncommon in Asia, South America, Central America and most of Europe.⁴⁸ Amongst the Western nations, it is a common practice in the USA, Canada and Australia.⁷

Trends in the United States of America

Trends in circumcision rate

From the latter half of the 19th century to 1950, the habit of routine male circumcision was accepted in the English speaking countries.⁷ In the United States of America most circumcisions are performed in newborns.⁸ All following studies examine routine neonatal circumcisions. Boys who were circumcised at a later age were not included in the studies.

Since the second half of the 19th century, male circumcision entered the medical practice. The newborn circumcision rates increased to about 55% in 1938 and about 80% in the 1960s.¹

An American study published in 1987 examined the circumcision frequency rate in all newborns in United States Army Hospitals from 1975 to 1984. There was an initial plateau in the number of circumcisions performed during the first 4 years of the study period at approximately 84.3%. In the following 6 years there was a steady, significant decrease in the circumcision frequency to 70.5%.¹³

The circumcision rate varies with the guidelines set forth by the American Academy of Pediatrics and the American Medical Association.³⁸

The incidence of circumcision in newborns steadily increased in the United States between 1988 and 2000 by 6,8% (from 48.3% during 1988-1991 to 61.1% during 1997-2000). In 1989 the American Academy of Pediatrics Task Force on Circumcision revised its previous statement (that there are no valid medical indications for circumcision in the neonatal period) and stated that "newborn circumcision has potential medical benefits and advantages as well as disadvantages and risks" and that "an informed consent should be obtained from the parents". This change could explain the increase in the number of circumcisions in newborns between 1988 and 2000.^{49,50}

A more recent study of the Centers for Disease Control and Prevention (CDC) assessed the trends in the incidence of in-hospital newborn male circumcision from 1999 to 2010 in the USA. In this study 3 independent databases were analyzed and all 3 showed a decrease in the incidence of newborn male circumcision (from 62.5% in 1999 to 59.6% in 2008 according to the NHDS; from 63.5% in 1999 to 56,3% in 2008 according to the NIS and from 58.4% in 2004 to 54.7% in 2010 according to the CDM).⁵¹

According to the 2012 Circumcision Policy Statement of the American Academy of Pediatrics, the preventive health benefits of elective newborn male circumcision outweigh the risks of the procedure. These health benefits are not sufficient

enough to recommend routine circumcision, but they are sufficient enough to justify access to this procedure for families choosing it and to warrant third-party payment.⁸

Trends in indications

Neonatal circumcision is the custom in The United States of America. In the past it was mainly performed for the preventive health benefits. Despite the statements of the American Academy of Pediatrics against routine circumcision in 1975, there was virtually no change in the circumcision practices in the USA in this time. A study performed in 1983 has showed that parental education had little impact on the circumcision decision. The circumcision decision is emerging as a cultural ritual rather than as the result of medical misunderstanding among parents. The most important determinant for parents choosing to circumcise their son was whether the father was circumcised or not. 90% of circumcised fathers chose to circumcise their son as opposed to 23% of uncircumcised fathers. Concerns about the attitude of peers and their sons' self-concept in the future were prominent among parents deciding to circumcise their son. Concerns about medical issues (cleanliness and less chance of infection or cancer) were also a factor in the decision-making, but less important.⁴⁷

A study published in 1999 also examined the indications to circumcise at birth. It showed that the most important factors in the decision making in that time were hygienic factors, the fact that it is easier to circumcise neonatal than when their son is older, the medical benefits of circumcisions and the fact that the father is circumcised. Medical benefits were cited more frequently than in past studies, probably because in 1989 the previous Circumcision Policy Statement (from 1975, that "there are no valid medical indications for circumcision in the neonatal period") was revised and it was stated that "newborn circumcision has potential medical benefits and advantages as well as disadvantages and risks".^{50,52}

A study published in 1990 investigated the indications of postneonatal circumcisions in two Salt Lake City hospitals. The families of patients were contacted by telephone. The circumcised boys were divided in two groups: the 'sick' group and the 'well' group. The 'sick' group included boys who were not fit for circumcision in the neonatal period (prematures or other medical problems). The parent's indications to circumcise in the postneonatal period were primarily hygienic factors, father's choice and social reasons. The boys in the 'well' group were fit for circumcision at birth, but their parents chose not to circumcise them. Many boys of this group were circumcised later in life for non-medical reasons, because their parents changed their minds about circumcision. A number of boys

in this group were eventually circumcised because of the parents' perception that there was a problem with their son's prepuce, needing circumcision as a treatment. Surgeons listed phimosis as the predominant indication for postneonatal circumcision. However, many boys were younger than 3 years, thus the accuracy of this diagnosis is suspect.⁵³

Trends in Australia and New Zealand

Trends in circumcision rate

From the latter half of the 19th century, the habit of routine male circumcision was accepted in Australia and New Zealand.⁷ In Australia, circumcision peaked at 85% prevalence in the 1950s and has declined ever since. In 1971 the official policy of the Australian College of Pediatrics has been to discourage circumcision of newborns.³⁸ Currently, an estimate of 10-20% of male newborns is circumcised in Australia and New Zealand. After reviewing the available evidence in 2010, the Royal Australasian College of Physicians (RACP) states that there is no evidence to warrant routine infant circumcision. However, parental choice should be respected.⁵⁴

Trends in indication

A 2003 Australasian study investigated the incidence rate of postneonatal circumcision for medical indications in Western Australian boys from the 1st of January 1981 to the 31st of December 1999. This was a population-based incidence study using hospital discharge data of circumcisions performed in all Western Australian hospitals. Circumcisions performed for routine (non-medical) reasons were excluded from analysis. Overall 56% of the circumcisions were performed for medically indicated reasons. The most common medical indication for circumcision at all ages was phimosis, followed by balanoposthitis and balanitis xerotica obliterans. There was a steady increase in the rate of medically indicated circumcisions in boys aged less than 15 years. This was due to an increase in the rate of circumcisions performed for phimosis. If the 1999 rate remains stable, it is estimated that 4% of all boys will be circumcised for phimosis by their 15th birthday, a number that is 7 times higher than the estimated rate of pathologic phimosis at that age. Over half of these boys will undergo circumcision for phimosis before their 5th birthday, despite that this condition is uncommon in this age group. There are two possible explanations for the high incidence rate of circumcisions performed for phimosis. One is that physicians may be mistaking a physiologic phimosis for a pathologic phimosis. This hypothesis is supported by 2 studies concluding that physicians had difficulty discriminating these two

conditions. The second theory is that hospital physicians may feel some pressure to encode a medical indication for routine (non-medical) circumcisions. The Australasian Association of Paediatric Surgeons does not support this practice and the rate of routine circumcisions in boys aged less than 6 months has dropped from 20.5% in 1982-1983 to 7.9% in 1999. However, there was no evidence to confirm this theory.⁵⁵

Trends in Europe

The United Kingdom

Trends in circumcision rate

From the latter half of the 19th century to 1950, the habit of routine male circumcision was accepted in the United Kingdom.⁷

In 1949, there was a wide difference in the incidence of circumcised infants among the English and Welsh region. The average percentage of circumcised boys was estimated at 20%. Boys from the upper classes were more often circumcised. In a survey among university students, 84% of students coming from the best-known public schools were circumcised as apposed to only 50% of students coming from other grammar or secondary schools. In this survey, data were extracted from observations among 1212 infants, school children and university students around the country. The first serious questioning of the practice of routine circumcision occurred in late 1949, which began to affect the practice by the British.^{1,7}

Fifty years later the average percentage of English boys who underwent circumcision by their 15th birthday was only 3.9%.²⁴ The current guideline of the British Medical Association (BMA) and of the British Association of Paediatric Surgeons states that there is rarely a medical indication for circumcision. The medical evidence about the health impact of male infant circumcision remains questionable according to the BMA.³⁰

An English nationwide study published in 2006 describes the trends in pediatric circumcision in England between 1997 and 2003. Data were extracted from the Hospital Episode Statistics database of admissions to National Health Service hospitals in England. Results show that there is a decrease in the circumcision rate from 2.6 per 1000 boys per year in 1997 to 2.1 in 2003. 3.9% of English boys were circumcised in 1997 by their 15th birthday and 3.1% in 2003. The circumcision rate in boys aged less than 5 years declined by about 30%. In boys aged between 5 and 9 years it declined by nearly 10% and for boys aged between 10 and 14 years the rate increased slightly (1.3 to 1.4%). The indications to circumcise were also investigated in this study (cf. infra "Trends in

pediatric circumcision – Trends in Europe - The United Kingdom - Trends in indications”).²⁴

There also was a 66% decrease in the circumcision rate in boys aged 0 to 13 years in Northern Ireland from 1991-1992 to 2001-2002. In 1991-1992 5.7% of boys aged 0 to 13 years underwent circumcision. In the year 2001-2002 this number fell to 1.9%. These data were consistent with trends noted across the other parts of the United Kingdom.⁵⁶

Trends in indications

An English study described the trends in pediatric circumcision in England between 1997 and 2003. Overall, 90% of the circumcisions were performed for phimosis, 8% for recurrent balanitis and 2% for other reasons. Boys who underwent circumcision for religious or cultural reasons were not included in the study. The decline in the circumcision rate was due to a drop in the frequency of circumcision for phimosis. The number of circumcisions performed for phimosis fell by 23% over the 7 years. The number of circumcisions performed for recurrent balanitis was stable over the 7 years. If the 2003 circumcision rate remains unchanged, 3.1% of English boys would undergo circumcision by their 15th birthday. This number is about five times higher than the reported incidence of phimosis.²⁴

A Scottish study investigated the trends in pediatric circumcision from April 1990 to March 2000. Data were extracted from the Information and Statistics Division of the NHS in Scotland. Over this 10-year period 69.8% of the circumcisions were performed for phimosis, 17.5% for non-medical/religious reasons and 12.8% for other indications (including hypospadias). There was a decrease in the overall number of circumcisions. This is due to a reduction in the circumcisions performed for phimosis. If the 1999-2000 circumcision rate remains stable, 1.98% of boys in Scotland will be circumcised for phimosis by their 13th birthday. The number of procedures performed for non-medical indications has remained relatively stable. However, because of the drop in the circumcisions performed for phimosis, an increasing proportion of boys are circumcised for non-medical reasons (13.4% in the first 5 years of the study period compared to 23.5% in the last five years).⁵⁷

The Netherlands

The habit of routine male circumcision was never the custom in continental Europe.² The Royal Dutch Medical Association (a.k.a. KNMG) states that non-therapeutic circumcision of male minors is a violation of children's rights to

autonomy and physical integrity. KNMG is calling upon doctors to actively and insistently inform the parents of the absence of medical benefits and the danger of complications (bleeding, infection, urethral stricture and panic attacks).¹⁶

Belgium

There are no studies that describe the trends in pediatric circumcision in Belgium. In August 2012, an article was published in 'Le Soir', a non-scientific magazine, claiming that there is a rise in the number of circumcisions in Belgium, due to an increase in the circumcisions performed for religious reasons. The yearly number of circumcisions performed in Belgium was obtained from numbers of the National Institute for Health and Disability Insurance (NIHDI or RIZIV). The number of circumcisions performed in Belgium increased by about 21%, from 19,853 in 2006 to 25,286 in 2011. These numbers includes non-pediatric circumcisions. The claim that this increase was due to a rise in the circumcisions performed for religious reasons was based on interviews of six doctors.⁵⁸

The Belgian Medical Association (a.k.a. Orde van Geneesheren) has not (yet?) published an official circumcision policy.

Objective of the study

The rise of the number of circumcisions in Belgium differs from the tendency in The United Kingdom, The United States of America, Australia and New Zealand. So far, the trends in pediatric circumcisions in Belgium are not investigated and the cause of the rising number of circumcisions remains uncertain.

The objective of this study is to describe the trends in circumcisions of boys aged between 0 and 16 years in the Brussels University Hospital and in Belgium.

The study has a two-fold character. Firstly, trends in pediatric circumcision in the Brussels University Hospital are investigated from 1994 to 2012. The number of circumcisions, the mean age during circumcision and the indication to circumcise are analyzed. Secondly, trends in pediatric circumcision are studied in Belgium from 2002 to 2011. The goal is to describe how the number of circumcisions, the circumcision rate and the rate in the indications to circumcise have changed in Belgium in boys aged 0 to 15 years during the ten-year study period.

Methods

Trends in pediatric circumcision in the Brussels University Hospital

Objective of the study

The objective of this retrospective study is to describe the trends in circumcisions of boys aged between 0 and 16 years. It describes how the numbers of circumcisions, the mean age during circumcision and the indication to circumcise have changed in the Brussels University Hospital from 1994 to 2012.

Patients included

All boys who had a circumcision in the Brussels University Hospital from 1994 to 2012 and who were younger than 16 years old during the circumcision were included in the study.

Material and methods

This study was approved by the Etical Comitee of the Brussels University Hospital (cf. infra "Attachment 1").

Data were extracted from the Electronic Medical Dossier of the Brussels University Hospital. This database contains information of all patients admitted in the Brussels University Hospital. All patients who had a circumcision in the Brussels University Hospital from 1/1/1994 to 31/12/2012 were listed, based on the code of circumcision (260945 K75). All boys who were younger than 16 years old during circumcision were selected.

Per patient the date of the circumcision, the age during circumcision (in years) and the indication to circumcise are noted. If there is no clear indication, the patient is still included in the study to analyze the number of circumcisions and the mean age during circumcision. To identify the indication for circumcision, the dossier of the patient is examined. The patient is never contacted. When the indication noted in the consultation report differs from the indication in the surgical report, the indication of the consultation report is used. 46 patients that were listed based on the code of circumcision, did not have a circumcision. 23 patients had an adhesiolysis and/or frenulotomy and/or preputioplasty. 12 patients had a correction of a buried penis, 3 patients had a hypospadias correction, 1 had an excision of a penile botryomycoma and 7 had other interventions. These cases were excluded from the study.

20 patients underwent a second circumcision. In 2 cases there was a re-phimosis of the circumcised foreskin and in 18 cases parents found the circumcision

inadequate with a requirement of a repair (to much foreskin left, esthetically insufficient,...). The second circumcision was excluded from further analysis. Some older files (from 1994 to 2000) were lost; only the code of circumcision, the date of the operation and the patient's date of birth were noted. The protocol of the operation and the consultation reports were missing. As 1.89 % of the patients who had a code of circumcision, did not have a circumcision, 1.89% of the patients with a lost file were not taken into account in the analysis of the total number of circumcisions.

The indications for circumcision noted in the study are phimosis, (recurrent episodes of) balanoposthitis, parental request, (recurrent episodes of) urinary tract infections and other reasons. These other reasons are all medical indications and include cure of paraphimosis (3 cases) and traumas of the foreskin (6 cases). It is important to note that a phimosis, adherent prepuce and tight foreskin are not distinguished. They are all noted under the 'phimosis' code, bearing in mind that some of the patients have a pathologic phimosis and others have a healthy non-retractile foreskin. Parental request includes ritual circumcision and non-ritual circumcision.

Statistical analysis

First the yearly total number of circumcisions in the Brussels University Hospital was analyzed. As 1.89 % of the patients who were listed on the code of circumcision, did not have a circumcision, 1.89 % of the patients with a lost file were not taken into account in the calculation of the total number of circumcisions.

The yearly number of pediatric circumcisions was compared with the yearly number of boys aged from 0 to 15 years in the catchment area of the Brussels University Hospital. This catchment area was based on estimations of the 2008 catchment population and includes the municipalities in which the catchment population of the Brussels University Hospital is 25% or more of the total population of the municipality. There are five different methods to estimate a catchment population; the Norris-Bailey proportionate flow method is the most commonly used and is generally considered to be the best method.^{59,60} The catchment population was estimated per municipality. The percentage of number of boys aged from 0 to 15 years living in this Municipality in the year 2008 was extracted from tables of the official Flemish en Brussels website for statistics (cf. infra "Attachment 2").^{61,62} The goal was to compare the yearly number of pediatric circumcisions with the yearly number of boys aged from 0 to 15 years in the catchment area of the Brussels University Hospital. As there are no data

available of the population of each Belgian municipality before the year 1997, data were used from the population of the Brussels Capital Region and Flemish Brabant. This is obviously an overestimation of the catchment population, but the number of boys aged less than 16 years is not important. The trend of this number over time is important. This trend in the Brussels Capital Region and Flemish Brabant can be considered comparable with the trend in the municipalities.

The age during circumcision (in years) was analyzed. The yearly mean age and median age was calculated. The circumcision rates over time were studied according to age. The boys were divided in 3 groups: boys from 0 to 4 years of age, boys from 5 to 9 years of age and boys from 10 to 15 years of age.

The indications to circumcise were studied. In some files, the indication was not noted. First the yearly percentage of each indication was calculated. The absolute yearly number of each indication of the patients with lost files was estimated with respect to the percentage of the indications in that according year. The trends in the indications to circumcise were also stratified by 3 groups: boys from 0 to 4 years of age, boys from 5 to 9 years of age and boys from 10 to 15 years of age.

Trends in pediatric circumcision in Belgium

Objective of the study

The objective of this population-based incidence study is to describe the trends in circumcisions of boys aged between 0 and 16 years. It describes how the numbers of pediatric circumcisions, the pediatric circumcision rate and the rate in the indications to circumcise have changed in Belgium from 2002 to 2011.

Patients included

All boys who had a circumcision in Belgium from 2002 to 2011 and who were younger than 16 years old during the circumcision were included in the study.

Material and methods

All analyses were performed on anonymous data.

Data regarding the number of circumcisions of boys who were younger than 16 years old during the circumcision were obtained from the National Institute for Health and Disability Insurance (NIHDI or RIZIV). The total number of circumcisions performed in Belgium was listed from 2002 to 2011, based on the code of circumcision (260934 and 260945). From 2006 to 2011, this list was divided in 2 groups : persons younger than 16 years and persons of 16 years and older.

Data regarding the total Belgian male population and the number of boys aged between 0-15 years over the study interval were obtained from the Belgian National Institute for Statistics and the Research Department of the Flemish Government.^{63,64}

Statistical analysis

From 2002 to 2005, the total number of circumcisions performed in Belgium was listed; there was no division in age groups. The yearly total number of circumcised boys aged 0 to 15 years was estimated in this period. The circumcision rate of persons aged 16 years and older remained stable between 2006 and 2011 at an average of 1.17 per 1000 persons per year. This yearly circumcision rate was calculated by dividing the number of circumcised persons older than 16 years by the mid-year estimate of the number of persons in that age group. The mean circumcision rate was extrapolated to the years 2002 to 2005 for this age group. There is no reason to believe this circumcision rate changed and study showed that this circumcision rate remained stable from 1981 to 1999.⁵⁵ Thus the yearly total number of circumcisions and the circumcision rate of boys aged 0 to 15 years old could be estimated (cf. *infra* "Attachment 3"). The Belgian circumcision rate of boys aged 0 to 15 years was calculated from the year 2002 to 2011. To calculate the circumcision rate in a reporting year, the number of boys who underwent circumcision in that year was divided by the mid-year estimate of the number of boys aged less than 16 years living in Belgium. The proportion of boys who would undergo circumcision by their 16th birthday, if the circumcision rate in a specific reporting year remained unchanged, was estimated by multiplying the circumcision rate between 0 and 15 years by 16. The circumcision rate per indication was calculated by extrapolating the yearly percentage of each indication in the Brussels University Hospital to a national level. The circumcision rate is also calculated per age group. There are 3 different groups: boys from 0 to 4 years of age, boys from 5 to 9 years of age and boys from 10 to 15 years of age. The yearly percentage of circumcisions in each age group in the Brussels University Hospital was extrapolated to the national number of circumcisions. To calculate the circumcision rate per age group, this figure was divided by the number of Belgian boys in these age groups. The indications to circumcise stratified by age group are calculated on a national level by extrapolating the percentages of the Brussels University Hospital to the Belgian figures.

Results

Trends in pediatric circumcision in the Brussels University Hospital

From the 1st of January 1994 to the 31st of December 2012 3927.27 boys aged less than 16 years underwent a circumcision in the Brussels University Hospital. Over the 19-year study period, the number of circumcisions performed in the Brussels University Hospital increased by about 59.75%, from 187.79 in 1994 to 300.00 in 2012.

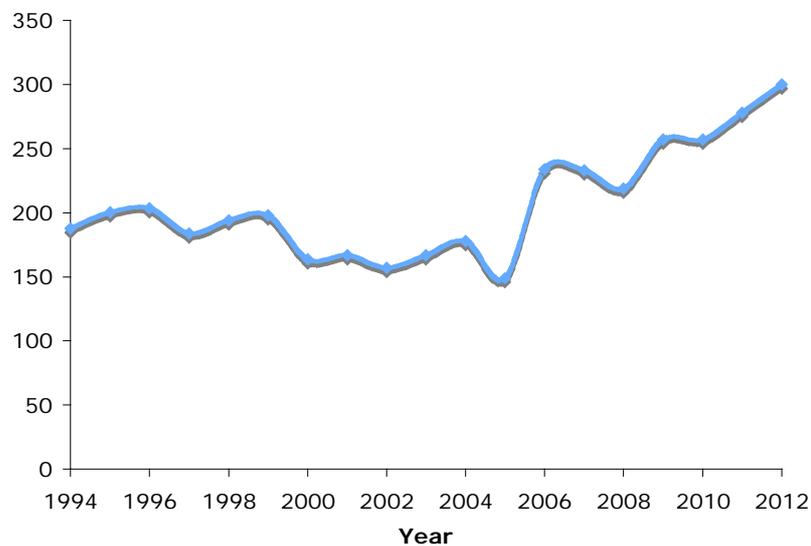


Figure 1 Number of pediatric circumcisions in the Brussels University Hospital over the 19-year study period

The catchment area of the Brussels University Hospital includes the municipalities of Jette, Brussel, Sint-Jans-Molenbeek, Ganshoren, Sint-Agatha Berchem and Koekelberg in the Brussels Capital Region. In Flanders, these municipalities are Vilvoorde, Wemmel, Dilbeek, Grimbergen, Asse, Merchtem, Meise, Londerzeel, Opwijk, Lennik and Ternat; these are all municipalities in the region of Flemish Brabant. The catchment area of the Brussels University Hospital does not include any municipality in Wallonia. The calculation of the catchment area can be found in attachment 2.

The number of boys aged between 0 and 15 years in the Brussels Capital Region and Flemish Brabant was 173,025 in 1994 and 206,746 in 2012. This corresponds to an increase by about 19.49%.

Year	Brussels Capital Region	Flemish Brabant	Total
1994	85,152	87,873	173,025
1996	85,247	88,357	173,604
1998	86,048	88,261	174,309
2000	87,665	88,597	176,262
2002	90,790	89,156	179,946
2004	93,159	89,619	182,778
2006	96,039	90,297	186,336
2008	99,679	91,142	190,821
2010	104,240	92,363	196,603
2012	112,367	94,379	206,746

Table 1 Number of boys aged 0 to 15 years living in the Brussels Capital Region and Flemish Brabant over the 19-year study period

From 1994 to 1999 the number of circumcisions performed in the Brussels University Hospital remained relatively stable. In this period, the number of boys aged 0 to 15 years living in Brussels and Flemish Brabant increased. There was a drop in the number of circumcisions performed in the Brussels University Hospital in the years 2000 and 2005. From 2002 on, the number of circumcisions performed in the Brussels University Hospital steadily increased (2005 not included).

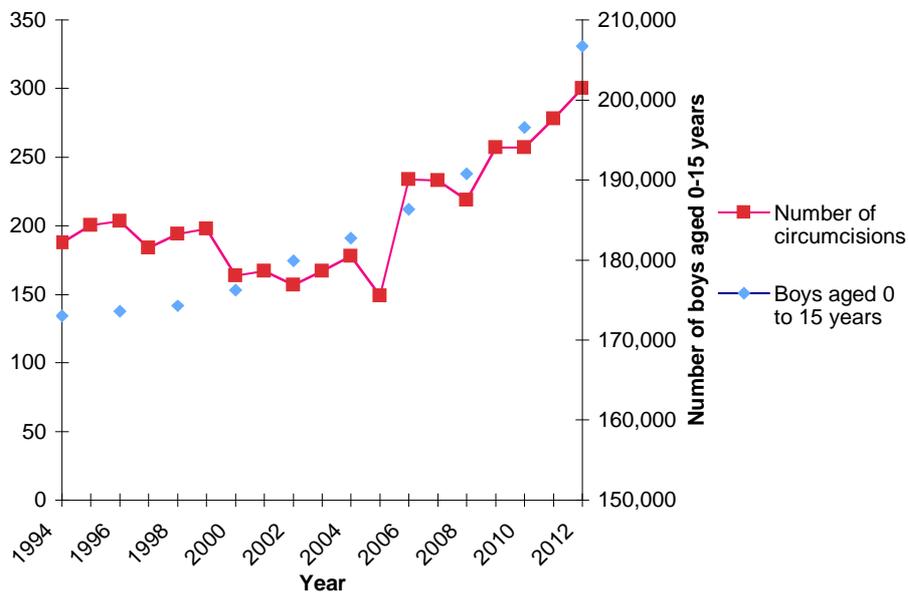


Figure 2 Number of pediatric circumcisions compared to the number of boys aged 0 to 15 years living in the Brussels Capital Region and Flemish Brabant over the 19-year study period

72.90% of all pediatric circumcisions in the study interval were performed in boys aged less than 5 years, 20.68% in boys aged 5 to 9 years and 6.43% in boys aged 10 to 15 years. The number of circumcisions of boys aged less than 5 years doubled over the study period, from 120.00 in 1994 to 243.00 in 2012. In boys

aged between 5 and 9 years, the number of circumcisions decreased by 22.80%, from an average of 47.80 in 1994-2003 to an average of 36.90 in 2003-2012. In boys aged between 10 and 15 years, the number of circumcisions remained relatively stable.

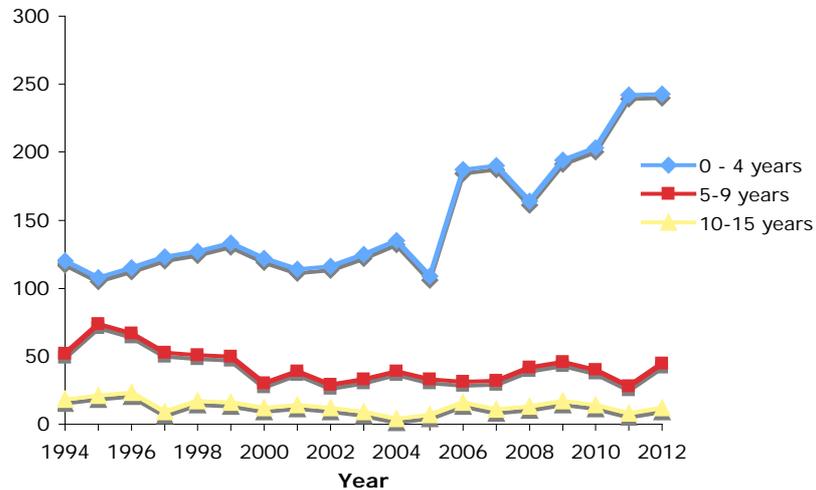


Figure 3 Number of pediatric circumcisions over time according to age

The mean age of the boys who underwent a circumcision during the study interval was 3.6 years. This age declined by about 38.67%, from 4.50 years in 1994 to 2.76 in 2012. The median age that boys were circumcised during the study period was 3 years. The number declined by 50%, from the age of 4 in 1994 to the age of 2 in 2012.

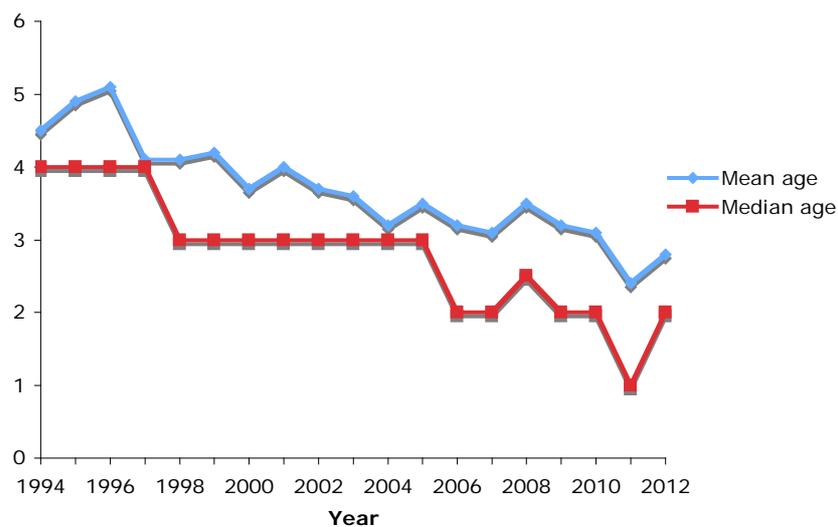


Figure 4 Mean age and median age of circumcised boys over time

The indication for circumcision was documented in 3400 of the 3937 boys

included in the study. In boys with a known indication, a total of 44.12% underwent a circumcision for phimosis, 52.31% for parental request, 1.91% for balanoposthitis (recurrent and non-recurrent), 1.36% for urinary tract infections (recurrent and non-recurrent) and 0.30% for other reasons. Over the 19-year interval, the number of circumcisions for phimosis fell by 58.14 % from 133.77 cases in 1994 to 56.00 in 2012. The decrease in the number of circumcisions to treat phimosis is substantial between 1999 and 2002. The number decreased by 61.49%, from 142.97 in 1999 to 55.05 in 2002. From 2002 on, this number remained relatively stable. However, because of a rise in the circumcisions performed for parental wish, a decreasing percentage of boys are circumcised to treat phimosis. The number of circumcisions performed for balanoposthitis and for urinary tract infections remained relatively stable. The number of circumcisions performed for parental request increased by 382.85% from 48.88 in 1994 to 236.00 in 2012. Parental request includes ritual circumcision and non-ritual circumcision. The parental motive for requesting circumcision for their son was not specified in the medical files. From 1994 to 2000, the number of circumcisions performed for parental request remained relatively stable at an average of 45.13 circumcisions per year. From 2000 on, this number increased by 372.05%, from 50.00 in 2000 to 236.00 in 2012.

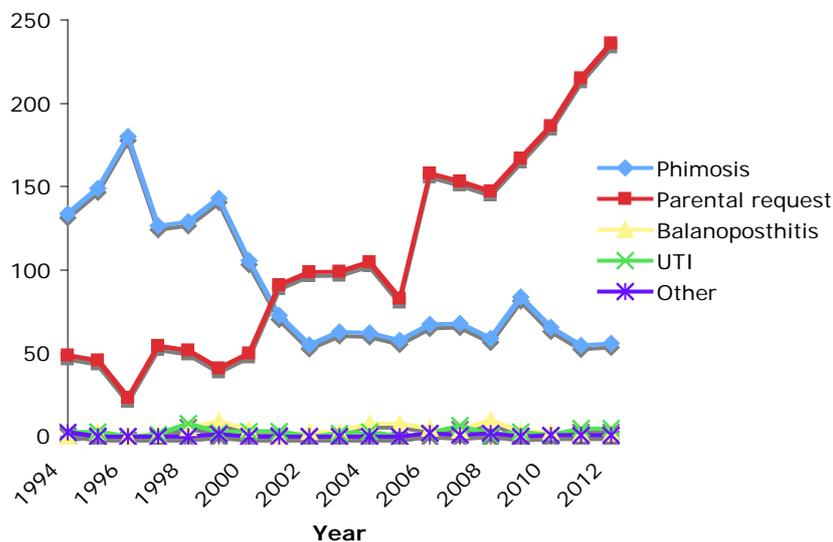


Figure 5 Indications for pediatric circumcision over time (absolute number)

Trends in pediatric circumcision in Belgium and the Brussels University Hospital from 1994 to 2012

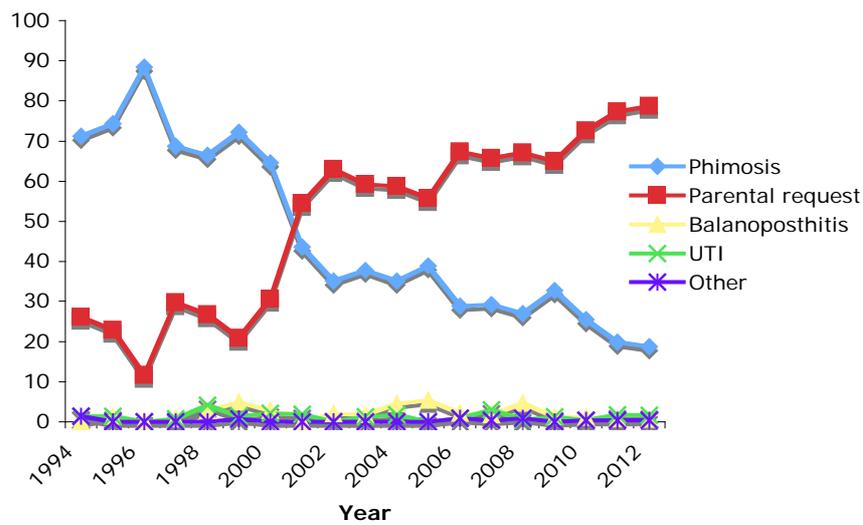


Figure 6 Indications for pediatric circumcision over time (percentage)

When the indications to circumcise are stratified by age group, there is over a five-fold increase in the number of circumcisions performed for parental request in the group of 0 to 4 year old boys, from 32.31 in 1994 to 206.00 in 2012. The number of circumcisions performed for phimosis in this age group decreased by 63.89%, from 83.08 in 1994 to 30.00 in 2012. This decrease is substantial between 1999 and 2001. The number of circumcisions performed for phimosis in 0 to 4 year old boys decreased by 53.03%, from 93.88 in 1999 to 44.09 in 2001.

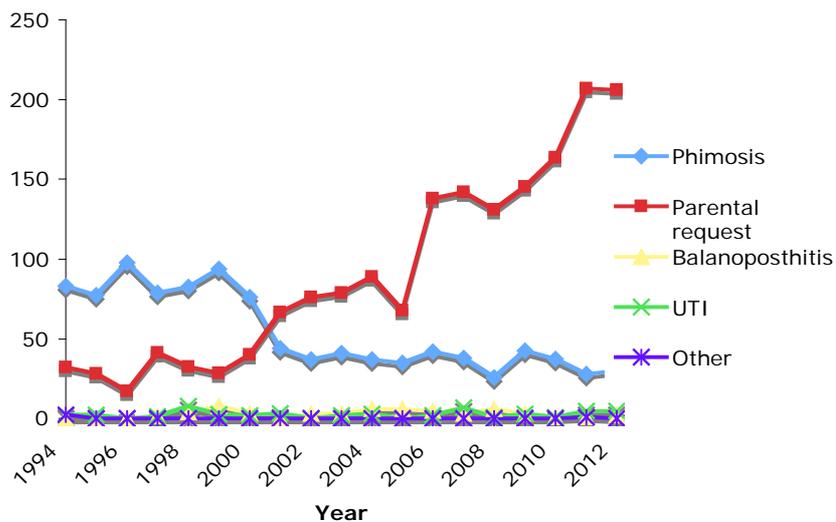


Figure 7 Indications to circumcise over time in boys aged 0 to 4 years old (absolute number)

In 5 to 9 year olds and 10 to 15 year olds, the number of circumcisions performed for medical indications (M I) decreased by about respectively 38.94% and 36.57%, from an average of 36.18 and 10.80 in 1994-2003 to an average of 22.09 and 6.85 in 2003-2012. These medical indications include phimosis, balanoposthitis, urinary tract infections and other reasons. The number of circumcisions performed for parental request (P R) increased by about 27.43% in 5 to 9 year olds, from an average of 11.62 in 1994-2003 to an average of 14.81 in 2003-2012. The number of circumcisions performed for parental request remained relatively stable in 10 to 15 year olds at an average of 4.40 circumcisions per year.

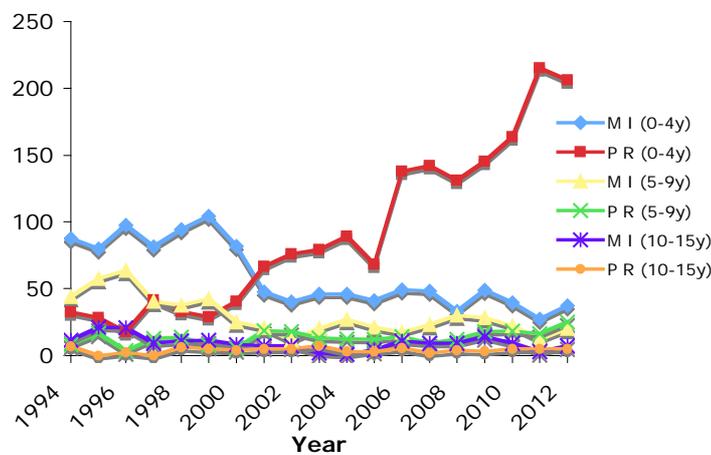


Figure 8 Indications to circumcise stratified by age group over time (absolute number)

Trends in pediatric circumcision in Belgium

From the 1st of January 2002 to the 31st of December 2011, 162,833 boys aged less than 16 years underwent a circumcision in Belgium. This corresponds to a mean circumcision rate of 16.41 per 1000 boys per year. The pediatric circumcision rate increased by 49.81%, from 13.23 per 1000 boys per year in 2002 to 19.82 per 1000 boys per year in 2011.

The proportion of boys who would undergo circumcision by their 16th birthday, if the circumcision rates observed in a reporting year remained stable, increased by about 49.79%, from 21.17% in 2002 to 31.71% in 2011.

Year	Mid-year estimate 0-15 year old boys in Belgium	Number of pediatric circumcisions in Belgium	Circumcision rate (/1000 boys/year)	Circumcision by age 16 (%)
2002	983814.50	13,016.43	13.23	21.17
2003	982907.00	13,313.90	13.55	21.68
2004	982350.00	14,041.13	14.29	22.86
2005	983321.50	14,552.90	14.80	23.68
2006	985249.00	15,097.00	15.32	24.51
2007	986333.00	16,984.00	17.22	27.56
2008	989458.50	17,607.00	17.79	28.46
2009	995850.50	19,048.00	19.13	30.61
2010	1005449.50	19,028.00	18.92	30.27
2011	1016288.50	20,145.00	19.82	31.71

Table 2 Pediatric circumcision rates (/1000 boys/year) over time in Belgium

The yearly percentages of the indications to circumcise in the Brussels University Hospital are extrapolated to a national level. The circumcision rate for phimosis remains relatively stable, at an average of 4.91 per 1000 boys per year. The circumcision rate for parental request increased by about 91.66 %, from 8.33 per 1000 boys per year in 2002 to 15.97 per 1000 boys per year in 2011.

If the 2011 circumcision rate remains stable, 5.88% of boys will undergo a circumcision by their 16th birthday to treat phimosis in Belgium.

Year	Circumcision rate for phimosis (/1000 boys/year)	Circumcision rate for parental request (/1000 boys/year)	Circumcision rate for balanoposthitis (/1000 boys/year)	Circumcision rate for UTI (/1000 boys/year)	Circumcision rate for other reasons (/1000 boys/year)
2002	4.64	8.33	0.26	0.00	0.00
2003	5.11	8.03	0.24	0.16	0.00
2004	5.01	8.40	0.65	0.24	0.00
2005	5.76	8.24	0.79	0.00	0.00
2006	4.41	10.32	0.33	0.13	0.13
2007	5.03	11.31	0.30	0.52	0.07
2008	4.79	11.94	0.81	0.08	0.16
2009	6.25	12.42	0.23	0.23	0.00
2010	4.82	13.73	0.22	0.07	0.07
2011	3.92	15.33	0.14	0.36	0.07

Table 3 Pediatric circumcision rates (/1000 boys/year) per indication over time extrapolated to a national level

The increase in the circumcision rate is most notable in boys aged less than 5 years. In the 10-year study interval, the circumcision rate in this age group rose

by 62.23%, from 32.79 per 1000 boys per year to 53.20 per 1000 boys per year. The circumcision rate remains relatively stable in boys aged 5 to 9 years old and 10 to 15 years old at a mean circumcision rate of respectively 9.04 and 2.20 per 1000 boys per year.

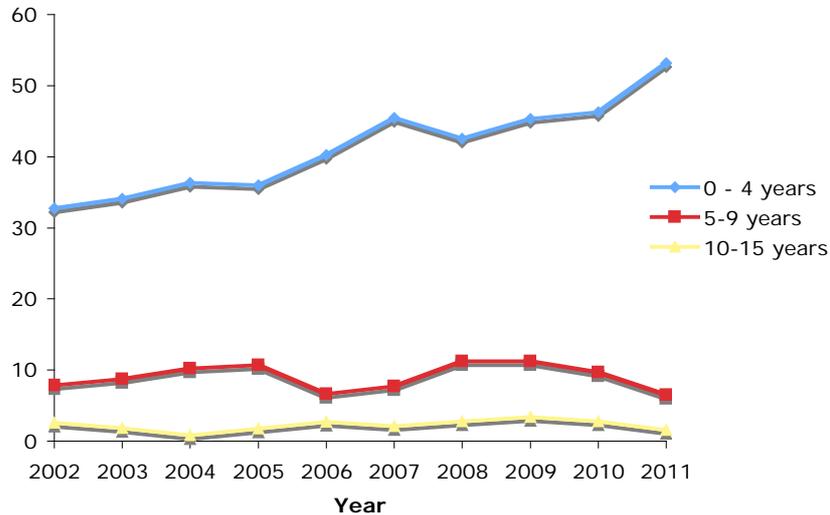


Figure 9 Pediatric circumcision rate (/1000 boys/year) over time stratified by age group

The indications to circumcise stratified by age group are extrapolated to a national level. The circumcision rate for parental request increased by about 111.82 % in boys aged 0 to 4 years, from 21.48 per 1000 boys per year in 2002 to 45.50 per 1000 boys per year in 2011.

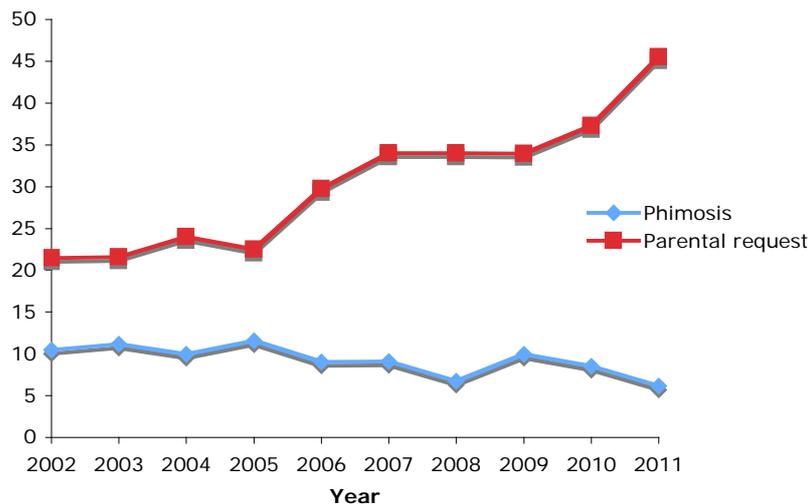


Figure 10 Pediatric circumcision rate (/1000 boys/year) per indication over time in boys aged 0 to 4 years old

A total of 48,491.28 circumcisions were performed to treat phimosis. Overall, 58.16% of these circumcisions were performed in 0 to 4 year old boys, 32.07% in 5 to 9 year olds and 9.78% in 10 to 15 year olds. The circumcision rate for phimosis increased by 9.18% in 5 to 9 year old boys, from an average of 4.90 per 1000 boys per year in 2002-2006 to an average of 5.35 per 1000 boys per year in 2007-2011. In 0 to 4 year olds, this rate decreased by 22.47%, from an average of 10.45 per 1000 boys per year in 2002-2006 to an average of 8.10 per 1000 boys per year in 2007-2011. The circumcision rate for phimosis increased in 10 to 15 year olds by 73.78%, from 0.91 per 1000 boys per year in 2002-2006 to 1.59 in 2007-2011.

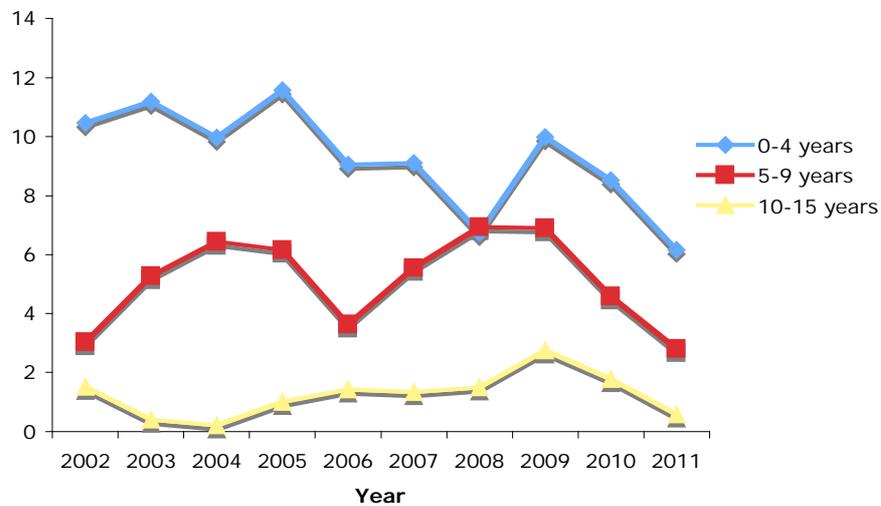


Figure 11 Pediatric circumcision rate (/1000 boys/year) for phimosis over time stratified by age group

The circumcision rate for parental request (P R) remained relatively stable in 5 to 9 year olds and 10 to 15 year olds at an average of respectively 3.59 per 1000 boys per year and 0.86 per 1000 boys per year. The trends in the circumcision rate for medical indications (M I) were similar to the trends in the circumcision rates for phimosis.

Trends in pediatric circumcision in Belgium and the Brussels University Hospital from 1994 to 2012

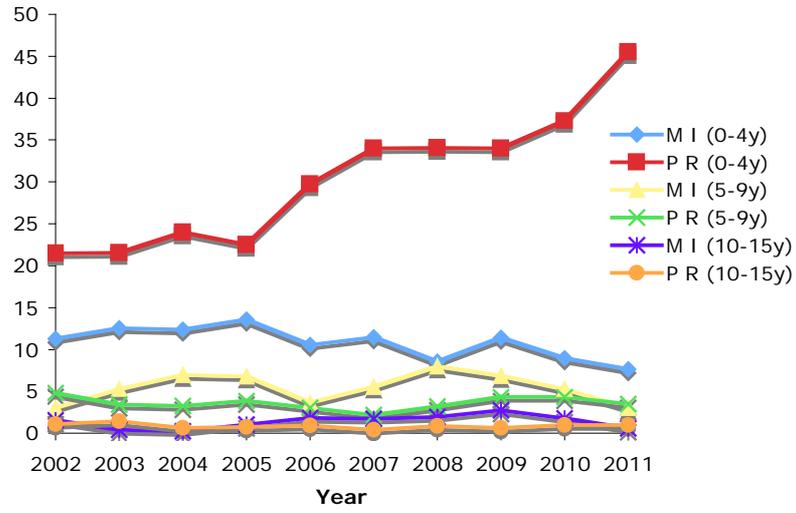


Figure 12 Pediatric circumcision rate (/1000 boys/year) per indication over time stratified by age group

Discussion

The goal of the study, i.e. the description of the trends in circumcisions of boys aged between 0 and 16 years in the Brussels University Hospital and in Belgium, has been achieved.

Between 1994 and 2012 the total number of circumcisions in the Brussels University Hospital increased by about 59.75 %, from 187.79 in 1994 to 300.00 in 2012. From 2002 to 2011 the national pediatric circumcision rate increased by 49.81%, from 13.23 per 1000 boys per year in 2002 to 19.82 per 1000 boys per year in 2011. If the 2011 circumcision rate remains stable, it is estimated that 31.71% of boys will be circumcised by their 16th birthday.

In England, Scotland, New Zealand, Australia and the United States of America the circumcision rate is dropping. The studies in New Zealand, Australia and the United States of America only examine the trends in newborn male circumcision, so post-neonatal circumcisions are not captured (cf. supra "Trends in pediatric circumcision"). From the latter half of the 19th century, the habit of routine neonatal circumcision was accepted in these countries.⁷ Nowadays this habit is questioned. The Royal Australasian College of Physicians (RACP) stated in 2010 that there is no evidence to warrant routine infant circumcision, but parental choice should be respected.⁵⁴ The American Academy of Pediatrics Circumcision stated that preventive health benefits of elective newborn male circumcision outweigh the risks of the procedure. These health benefits are not sufficient enough to recommend routine circumcision, but they are sufficient enough to justify access to this procedure for families choosing it and to warrant third-party payment.⁸ As routine neonatal circumcision is no longer recommended, the number of circumcisions is dropping in these countries. In Belgium routine neonatal circumcision was never a custom.

The decrease in the circumcision rates in England and Scotland was due to a drop in circumcisions performed to treat phimosis.^{24 57} If the 2003 circumcision rate remains unchanged in England, 3.1% of English boys will undergo circumcision by their 15th birthday.²⁴ If the 2003 circumcision rate remained unchanged in Belgium, 21.68% of Belgian boys will undergo circumcision by their 16th birthday. This is about 7 times the English percentage. In the English study, only medically indicated circumcisions are investigated. In Belgium, all circumcisions performed in a hospital setting are included.

The increase in the total number of circumcisions is due to more circumcisions performed for parental request. Over the 19-year study interval, there is a 382.85% increase in the number of circumcisions performed for parental request in the Brussels University Hospital, from 48.88 in 1994 to 236.00 in 2012. A total of 52.54% of the circumcisions were performed for parental request. From 1994 to 2000, the number of circumcisions performed for parental request remained relatively stable at an average of 45.13 circumcisions per year. From 2000 on, this number increased by 372.05%, from 50.00 in 2000 to 236.00 in 2012. If we extrapolate the percentage of circumcisions performed for parental request in the Brussels University Hospital to the national numbers, there is a 91.66% increase in the circumcision rate for parental request, from 8.33 per 1000 boys per year in 2002 to 15.97 per 1000 boys per year in 2011.

In the English study, there was a decrease in the circumcision rates from 1997 to 2003. Only medically indicated circumcisions were analyzed. Boys who underwent a ritual circumcision were excluded from further analysis. If there was an increase in the number of ritual circumcisions in England, this was not detected in the study.²⁴

In Scotland, the circumcisions performed for non-medical/religious reasons remained stable during the study period. A total of 17.5% of the circumcisions were performed for these indications. This study interval was from 1990 to 2000.⁵⁷ In the Brussels University Hospital, the number of circumcisions performed for non-medical reasons also remained relatively constant from 1994 to 2000, at 24.09% of the total number of circumcisions. This percentage is 27.36% higher than the percentage in Scotland. The percentage of Muslims in the catchment population of the Brussels University Hospital is higher than the percentage of Muslims in Scotland. The average percentage of Muslims in Scotland was 0.84% in 2001.⁶⁵ The average percentage of Muslims in Brussels is 25.5% and in Flanders 3.9% in 2005.⁶⁶ This could explain the dissimilar percentages of circumcisions performed for non-medical reasons.

In Western Australia, the yearly number of circumcisions performed for non-medical reasons was not investigated. From 1981 to 1999, 44% of the total number of circumcisions was performed for non-medical reasons.⁵⁵ In the Brussels University Hospital, 22.77% of the total number of circumcisions was performed for parental request from 1994 to 1999, about half the Western Australasian percentage. The Western Australasian percentage includes routine neonatal circumcision. This is a habit in Western Australia and not in Belgium and

could explain the variations in the percentages.

In the Brussels University Hospital, the number of circumcision performed for phimosis declined by 58.14%, from 133.77 in 1994 to 56.00 in 2012. The Belgian circumcision rate for phimosis remained stable from 2002 to 2010 at an average of 4.91 per 1000 boys per year.

There are two possible explanations. The first is that fewer circumcisions are performed for phimosis, not because there are fewer boys with phimosis, but because there is an improved understanding of the natural history of physiological non-retractile foreskin and the pathophysiology of phimosis. What many surgeons would have considered in the past to be "phimosis" (and treated by circumcision) was in fact physiological non-retractile foreskin. Secondly, there has been a move toward conservative management of phimosis. For more than two decades topical steroids are used to treat phimosis and it has showed good results (cf. supra "Indications for pediatric circumcision - Phimosis").

In England and Scotland the number of circumcisions performed for phimosis declined as well.^{24 57}

In Western Australia, the circumcision rate for phimosis increased from 1981 to 1999. There were two possible explanations. One is that physicians may be mistaking a physiologic phimosis for a pathologic phimosis. The second theory is that hospital physicians may feel some pressure to encode a medical indication for routine (non-medical) circumcisions, as the Australasian Association of Paediatric Surgeons does not support this practice.⁵⁵ The number of circumcisions performed for phimosis in the Brussels University Hospital remained relatively stable from 1994 to 1999.

In the year 2000 there was a substantial drop in the number of circumcisions performed in the Brussels University Hospital. This number decreased by 17.35%, from 197.96 in 1999 to 163.62 in 2000.

This was not due to a decrease in the number of 0 to 15 year old boys in the catchment area, as this number increased.

The drop in the number of circumcisions performed in the Brussels University Hospital is most likely due to a drop in the circumcisions performed to treat phimosis. This number decreased by 61.49%, from 142.97 in 1999 to 55.05 in 2002. From 1999 on, the urology department systematically started topical steroid treatment for phimosis. This resulted in a drop in the total number of circumcisions.

It is estimated that 5.88% of boys will undergo a circumcision by their 16th birthday to treat phimosis if the 2011 circumcision rate for phimosis remains stable.

The incidence of pathologic phimosis is 0.4 per 1000 boys per year or 0.64% of boys are affected by their 16th birthday.³⁵ Thus, this circumcision rate is about 9 times higher than the reported incidence of phimosis at that age. This indicates that phimosis currently is still overdiagnosed.

If the English 2003 circumcision rate remains unchanged, 3.1% of English boys would undergo circumcision by their 15th birthday. This number is about 5 times higher than the reported incidence of phimosis.²⁴ If the Australasian 1999 circumcision rate remains stable, it is estimated that 4% of all boys will be circumcised for phimosis by their 15th birthday, a number that is 7 times higher than the estimated rate of pathologic phimosis at that age.⁵⁵ These percentages are lower than the Belgian 2011 figures and indicate that phimosis is better managed in these countries. It is important to distinguish a physiologic phimosis from a pathologic phimosis. A physiologic phimosis requires no medical treatment and a pathologic phimosis does. This treatment can be either surgical or medical. For more than 2 decades, topical steroids have been used as an alternative for surgical correction and it has showed good results (cf. supra "Indications for pediatric circumcision - Phimosis").

Mainly boys from 0 to 4 years of age are circumcised to treat phimosis, despite this condition being rare in this age group (cf. supra "Indications for pediatric circumcision - Phimosis").

This shows that a review of current practice guidelines for the pediatric management of phimosis in Belgium may be warranted. A physiologic phimosis is a very common condition at that age. Only 4% of the newborns have a fully retractable foreskin. In 20% of 2 year olds, the foreskin cannot be retracted over the glans.² This does not require treatment. A reassurance of normalcy and reinforcement of proper preputial hygiene are required. Young boys with a confirmed diagnosis of phimosis do not necessarily need to be circumcised. Topical steroids have been shown to be a cost-effective treatment for phimosis (cf. supra "Indications for pediatric circumcision - Phimosis"). In Western Australia boys aged 0 to 4 years also had the highest rate to treat phimosis.⁵⁵ In Belgium this number declined from 1994 to 1999, whereas this number increased in Western Australia from 1981 to 1999.

The number of circumcisions performed for parental request is highest in 0 to 4 years olds.

This is a favorable trend. Infancy is the optimal age to circumcise and complications are less frequent among younger ages (cf. supra "Potential benefits of male circumcision"). If parents choose to circumcise their son, it is in the best interest of the boys to circumcise at a young age.

Shortcomings of the study

Trends in pediatric circumcision in the Brussels University Hospital

The study of the trends in pediatric circumcision in the Brussels University Hospital is a retrospective study in which data are extracted from the Electronic Medical Dossier of the Brussels University Hospital. This database was not entirely complete. Mainly older files were missing and sometimes the indication to circumcise was not noted. The absolute yearly number of each indication of the patients with a lost files or no clear indication was estimated in function of the percentage of the indications in that according year. Thus, the indications are not fully accurate.

1.89 % of the patients who had a code of circumcision were not circumcised and are false positive. The number of circumcisions of patients with a lost file were corrected accordingly. It is possible that there are also false negative cases ; patient that are not listed under the circumcision code, but were circumcised. This percentage was not assessed and the number of circumcisions was not adjusted accordingly.

Medical files were made by different doctors with a different definition for phimosis. A phimosis, adherent prepuce and tight foreskin are all noted under the 'phimosis' code, bearing in mind that some of the patients have a pathologic phimosis and others have a healthy but non-retractile foreskin. It was not possible to distinguish these 3 conditions.

The indications to circumcise were acquired by analyzing the medical files. It is possible that some of the indications to circumcise were misinterpreted, as sometimes the indication was not clearly noted.

Some of the municipalities that are included in the catchment area of the Brussels University Hospital are in fact not part of the actual catchment area. This is due to an overestimation of the number of persons admitted in the Brussels University Hospital. The number of admissions in the Brussels University Hospital was based on anonymous data; only the municipality of the admitted person was noted. Therefore, a person who was admitted twice in an according year was

accounted as 2 persons. But the number of pediatric circumcisions performed in the Brussels University Hospital was not compared with the number of boys aged between 0 and 15 years in each municipality of the catchment area, as there were not enough data to do so. This number was compared with the number of boys aged between 0 and 15 years in the Brussels Capital Region and Flemish Brabant and in these regions there are other municipalities that are also not part of the catchment area. This is obviously an overestimation of the catchment population, but the number of boys aged 0 to 15 years old is not important. The trend of this number over time is and this trend in the Brussels Capital Region and Flemish Brabant can be considered comparable with the trend in the municipalities.

In 2005 there is a drop in the number of circumcisions performed in the Brussels University Hospital. This decrease cannot be explained, which indicates that the data of the Brussels University Hospital depend on unknown variables and a change in these factors can have a substantial effect on the figures.

The indications to circumcise were found in the medical reports and entered in a file. Data input always contains errors. The data of the years 1996, 2000, 2006 and 2011 were double-checked and no discrepancy was found.

The data from this study are hospital-based and therefore exclude a proportion of procedures. Jews are traditionally circumcised at the 8th day of life. Neonatal circumcisions are not performed in the Brussels University Hospital. Circumcisions in the Jewish community are mainly done by a specially trained mohel of traditional circumciser in a ceremony called a Bris Milah. Therefore circumcisions of Jewish boys are not included in the study.

Trends in pediatric circumcision in Belgium

The total number of circumcisions performed in Belgium was listed based on the code of circumcision. In the Brussels University Hospital, 1.89% of patients who were listed on the code of circumcision were not circumcised. Some patients were circumcised twice and, as the patients were listed based on the code of circumcision, will be accounted as 2 circumcisions. Consequently, there will be false positive cases. It is possible that there are false negative cases ; patients who were circumcised, but were not listed under the circumcision code. The total number of circumcisions performed in Belgium is probably incorrect, as there are false negative and false positive cases.

In other countries, the indication to circumcise is clearly noted with codes and there is no need to examine patient files. Unfortunately, this is not the habit in Belgium. The indications to circumcise in the Brussels University Hospital are

extended to a national level to study the circumcision rate per indication and/or per age. This is not the most accurate method and the analysis of patient files to determine the indications is a labor-intensive job.

We must be careful in the extrapolation of the percentage of the indications to circumcise of the Brussels University Hospital to the rest of the country. Firstly, the percentage of circumcisions performed for parental request is probably higher in the Brussels area than the national average. Brussels is a multicultural city with a large Muslim community.⁶⁶ There are in all likelihood more circumcisions performed in the Brussels University Hospital for religious reasons than in the other parts of Belgium, as there is a larger percentage of Muslim boys in the catchment population of the hospital. Secondly, the yearly number of circumcisions in the Brussels University Hospital was analyzed per age group and per indication. This resulted in small study groups with risk of errors when these numbers are extrapolated to a national level. Analyses of the trends in pediatric circumcisions in other hospitals in other parts of the country are needed get a more precise idea of the trends in Belgium.

The data from this study is also hospital-based and therefore exclude a proportion of procedures (cf. supra "Shortcomings of the study – Trends in Pediatric circumcision in the Brussels University Hospital").

Conclusion

There is a rise in the Belgian circumcision rate from 2001 to 2011. This is due to an increase in the number of circumcisions performed for parental request, including religious motives. This trend began in the year 2001 and is continuing as we speak. The fact that a competent surgeon in a sterile environment performs non-medical circumcisions is in the very best interest of the boy. When a circumcision is performed in non-clinical settings, there is a higher risk for adverse events and if there are complications, they are generally more severe. In Belgium, the National Institute for Health and Disability Insurance (NIHDI or RISIV) covers the costs of this intervention for the most part. The question arises if it is up to the Belgian society to pay for this non-therapeutic intervention. Routine circumcision is no longer recommended in Western countries. There are some health benefits of this procedure, but they are not sufficient enough to advise routine circumcision. A circumcision is a relatively safe operation, however mild or moderate complications are seen. Parents considering circumcision of their son should be informed of the possible complications of the procedure and the possible impact on the sexuality.

Although the number of circumcisions performed for phimosis declined, it is estimated that, if the 2011 circumcision rate remains stable, 5.88% of boys will undergo a circumcision by their 16th birthday to treat phimosis in Belgium. This number is about 9 times the reported incidence of phimosis at that age. This indicates that phimosis currently is still overdiagnosed and shows that a review of current practice guidelines for the pediatric management of phimosis in Belgium may be warranted. It is important to distinguish a physiologic phimosis from a pathologic phimosis. A physiologic phimosis requires no medical treatment and a pathologic phimosis does. This treatment can be either surgical or medical. For more than 2 decades, topical steroids have been used as an alternative for surgical correction and it has showed good results.

Attachments

Attachment 1: Permission of the Ethical Comitee of the Brussels University Hospital to perform this study



Universitair Ziekenhuis Brussel



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Brussel, 03-01-2013

Ons Kenmerk : 2012/311

ADVIES VAN DE COMMISSIE MEDISCHE ETHIEK

Betreft :

Trends in paediatric circumcision in the UZ Brussel between 1992 and 2012
B.U.N. 143201215718

Na kennis genomen te hebben van de documenten betreffende het bovenvermelde project,
besluit de Commissie Medische Ethiek tijdens haar vergadering van 3 januari 2013

dat de voorziene studie mag ondernomen worden.

Deze goedkeuring blijft geldig voor de duur van het project. De Commissie wenst een
jaarlijks overzicht van de stand van zaken van het project te ontvangen. De studieresultaten
dienen overgemaakt te worden aan de Commissie bij het beëindigen van de studie. Zij
herinneren de verantwoordelijke van het experiment eraan dat dit experiment onder zijn
persoonlijke verantwoordelijkheid zal worden uitgevoerd. Het gunstig advies van de
Commissie betekent geenszins dat de Commissie de verantwoordelijkheid van het
experiment op zich neemt. De Commissie Medische Ethiek werkt en is georganiseerd
volgens de richtlijnen van ICH-GCP.

Met de meeste hoogachting,

P. Devroey, voorzitter

Cc: FAGG, Departement R&D, Eurostation blok 2, Victor Hortaplein 40 / 40, 1050 BRUSSEL

**Attachment 2: Estimating the 2008 catchment area of the
Brussels University Hospital**

Data of the Brussels Capital Region

Municipality	Wa	P	ΣWi	CP	CA?
JETTE	8790	44601	7760.574	50517.24138	113.2648178
BRUSSEL	11,019	148873	25903.902	63327.58621	42.53799292
ST-J-MOLENBEEK	7266	83674	14559.276	41758.62069	49.90632776
GANSHOREN	4651	21743	3783.282	26729.88506	122.9355887
ST-A-BERCHEM	2681	20976	3649.824	15408.04598	73.45559676
ANDERLECHT	2481	99085	17240.79	14258.62069	14.39029186
KOEKELBERG	2305	19020	3309.48	13247.12644	69.64840398
SCHAARBEEK	2108	116039	20190.786	12114.94253	10.44040584
ELSENE	803	79768	13879.632	4614.942529	5.785455983
EVERE	665	34727	6042.498	3821.83908	11.00538221

Wa = number of persons admitted in the Brussels University Hospital

P = population of the municipality

ΣWi = total number of persons of the municipality admitted in any hospital. This number was calculated based on the 2008 national Health Survey. 17.4% of the population of the Brussels Capital Region was hospitalized in the year 2008

CP = catchment population

CA? = percentage of the population of the municipality included in the catchment population of the Brussels University Hospital. If this number is 25 or higher, the municipality is included in the catchment area

XX = Municipalities included in the catchment area of the Brussels University Hospital

Data of Flanders

Municipality	Wa	P	ΣWi	CP	CA?
VILVOORDE	3,964	38,557	7557.172	20224.4898	52.45348392
WEMMEL	3,699	14,916	2923.536	18872.44898	126.5248658
DILBEEK	5,228	39,654	7772.184	26673.46939	67.26552022
GRIMBERGEN	5,510	34,526	6767.096	28112.2449	81.42340525
ASSE	3,556	29,558	5793.368	18142.85714	61.38053029
MERCHTEM	1,717	15,110	2961.56	8760.204082	57.97620173
MEISE	2,770	18,466	3619.336	14132.65306	76.53337518
LONDERZEEL	1,392	17,525	3434.9	7102.040816	40.52519724
HALLE	1,637	35,350	6928.6	8352.040816	23.62670669
SINT-PIETERS- LEEUEW	1,456	31,119	6099.324	7428.571429	23.87149789
OPWIJK	820	12,575	2464.7	4183.673469	33.26976914
ZAVENTEM	653	29,500	5782	3331.632653	11.29367001
BUGGENHOUT	446	13,973	2738.708	2275.510204	16.2850512
LIEDEKERKE	489	12,206	2392.376	2494.897959	20.43993085
TERNAT	759	14,781	2897.076	3872.44898	26.19882944
LENNIK	439	8,747	1714.412	2239.795918	25.60644699
AFFLIGEM	396	12,229	2396.884	2020.408163	16.52145035
OVERIJSE	489	24,394	4781.224	2494.897959	10.2275066
KAPELLE-OP-DEN- BOS	416	8,969	1757.924	2122.44898	23.66427673
STEENOKKERZEEL	478	11,201	2195.396	2438.77551	21.77283734
GOOIK	312	8,931	1750.476	1591.836735	17.82372338
BEERSEL	942	23,587	4623.052	4806.122449	20.37614978

Wa = number of persons admitted in the Brussels University Hospital

P = population of the municipality

ΣWi = total number of persons of the municipality admitted in any hospital. This number was calculated based on the 2008 national Health Survey. 19.6% of the population of Flanders was hospitalized in the year 2008

CP = catchment population

CA? = percentage of the population of the municipality included in the catchment population of the Brussels University Hospital. If this number is 25 or higher, the municipality is included in the catchment area

XX = Municipalities included in the catchment area of the Brussels University Hospital

Estimating the 2008 catchment area of the Brussels University Hospital using the Norris-Bailey proportionate flow method

1. Estimating the catchment population in a reporting year

The catchment population was estimated using the following formula:

$$\mathbf{CPax} = \mathbf{\sum (Wax \times Pa / (\sum Wai))}$$

CPax = Catchment population of hospital 'x' in municipality 'a' in the reporting year

Wax = Number of persons admitted in hospital 'x' living in municipality 'a' in the reporting year

Pa = Population of municipality 'a' in the reporting year

\sum Wai = Total number of persons living in municipality 'a' that are hospitalized in the reporting year

2. Estimating the catchment area

The proportion of the catchment population of the total population of the municipality was calculated. If this proportion is 25% or higher, the municipality is included in the catchment area.

$$\mathbf{CAx?} = \mathbf{(CPax / Pa) / 100}$$

CAx = Is the municipality included in the catchment area of hospital 'x' ?

CPax = Catchment population of hospital 'x' in municipality 'a' in the reporting year

Pa = Population of municipality 'a' in the reporting year

NOTE: In Wemmel, Jette and Ganshoren the catchment population is greater than the population of the municipality. This is due to an overestimation of the number of persons admitted in the Brussels University Hospital. The number of admissions in the Brussels University Hospital was based on anonymous data; only the municipality of the admitted person was noted. Therefore a person who was admitted twice in an according year was accounted as 2 persons.

Consequently some of the municipalities that are included in the catchment area of the Brussels University Hospital are not part of the actual catchment area. The number of pediatric circumcisions performed in the Brussels University Hospital

was not compared with the number of boys aged between 0 and 15 years in each municipality of the catchment area, as there were not enough data to do so. This number was compared with the number of boys aged between 0 and 15 years in the Brussels Capital Region and Flemish Brabant and in these regions there are other municipalities that are also not part of the catchment area.

Attachment 3: Estimating the yearly total number of circumcisions in Belgium of boys aged 0 to 15 years from 2002 to 2005

1. Calculation of the mean circumcision rate of males of 16 years and older from the year 2006 to 2011

Year	MYE of males ≥ 16 years	Number of circumcision of males ≥16 years	Circumcision rate (/1000 males ≥16 years /year)
2006	4177365.5	4755	1.138277
2007	4216525.5	4937	1.170869
2008	4257021.5	4952	1.163255
2009	4294585.5	5152	1.19965
2010	4335778	5085	1.1728
2011	4376229	5141	1.17476
MCR			1.16993

MYE of males ≥ 16 years = the mid-year estimate of males of 16 years and older. The yearly numbers were obtained from the Belgian National Institute for Statistics and the Research Department of the Flemish Government.^{63,64}

The mid-year estimate was calculated using the following formula:

$$\text{population year A} + \left(\frac{\text{population year A} + \text{population year B}}{2} \right)$$

Number of circumcision of males ≥16 years = this number was provided by the National Institute for Health and Disability Insurance (NIHDI or RIZIV)

The circumcision rate was calculated by dividing the number of circumcisions of males ≥ 16 years by the mid-year estimate of males ≥ 16 years

MCR = the mean circumcision rate. This was calculated dividing the sum of the yearly circumcision rates by the total number of years (6).

2. Extrapolation of the mean circumcision rate of males of 16 years and older to the year 2002 to 2005, calculation of the yearly total number of circumcisions in that age group and calculation of the yearly total number of circumcisions of boys aged between 0 and 15 years from 2002 to 2005

Year	MYE of males ≥ 16 years	Number of circumcision of males ≥16 years	Total number of circumcisions	Number of circumcisions of males <16 years
2002	4083639	4777.571775	17794	13016.42822
2003	4104608	4802.104037	18116	13313.89596
2004	4129193	4830.866766	18872	14041.13323
2005	4159310	4866.101548	19419	14552.89845

MYE of males ≥ 16 years = the mid-year estimate of males of 16 years and older. This was estimated with the following formula:

$$\text{population year A} + \left(\frac{\text{population year A} + \text{population year B}}{2} \right)$$

Number of circumcision of males ≥16 years = this number was calculated by multiplying the mid-year estimate of males of 16 years and older with the mean circumcision rate

Total number of circumcisions = this number was provided by the National Institute for Health and Disability Insurance (NIHDI or RIZIV)

The number of circumcisions of males <16 years was calculated by subtracting the total number of circumcisions with the number of circumcision of males ≥16 years

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