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# A longitudinal population analysis of cumulative risks of circumcision



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## ARTICLE INFO

### Article history:

Received 12 April 2018

Received in revised form  
27 June 2018

Accepted 19 July 2018

Available online xxx

### Keywords:

Circumcision

Long-term complications

Pediatric surgery

Revision circumcision

Operative complications

Informed consent

Risk benefit ratio

Large data base research

Outcomes

OSHPD

## ABSTRACT

**Background:** Circumcision is widely accepted for newborns in the United States. However, circumcision carries a risk of complications, the rates of which are not well described in the contemporary era.

**Methods:** We performed a longitudinal population analysis of the California Office of Statewide Health Planning and Development database between 2005 and 2010. Using International Classification of Procedures, Ninth Revision, Clinical Modification and Current Procedural Terminology codes, we calculated early and late complication rates by Kaplan–Meier survival estimates. Late complications were defined as those that occurred between 30 d and 5 y after circumcision. Descriptive analysis of complications was obtained by analysis of variance, chi-square test, or log-rank test. On adjusted analysis, a Cox proportional hazard model was performed to determine the risk of early and late complications, adjusting for patient demographics.

**Results:** A total of 24,432 circumcised children under age 5 y were analyzed. Overall, cumulative complication rates over 5 y were 1.5% in neonates, 0.5% of which were early, and 2.9% in non-neonates, 2.2% of which were early. On adjusted analysis, non-neonates had a higher risk of early complications (OR 18.5). In both neonates and non-neonates, the majority of patients with late complications underwent circumcision revision.

**Conclusions:** Circumcision has a complication rate higher than previously recognized. Most patients with late complications after circumcision received an operative circumcision revision. Clinicians should weigh the surgical risks against the reported medical benefits of circumcision when counseling parents about circumcision.

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## Introduction

Circumcision is the most common surgical procedure in children, with more than one million performed each

year in the United States (US).<sup>1</sup> Although it is reported that only 38% of males are circumcised globally, at least 60% of male children born in the US are electively circumcised.<sup>2,3</sup>

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<https://doi.org/10.1016/j.jss.2018.07.069>

In 2012, the American Academy of Pediatrics released a policy statement on circumcision, which states that the benefits of elective circumcision outweigh the risks of the procedure.<sup>4</sup> Many studies have reported medical benefits of circumcision, including decreased risk of urinary tract infection (UTI), human immunodeficiency virus (HIV), and other sexually transmitted infections, penile cancer, and human papillomavirus (HPV)-related cervical cancer.<sup>5–13</sup> However, fewer contemporary studies have reported the complication rates, and those that do, focus on short-term outcomes.<sup>14,15</sup> The most recent large population study in the US used data from a collection of private insurance databases and reported a 0.4% complication rate when babies were circumcised in the first year of life, whereas the risk of complication increased by 10- to 20-fold when the procedure was performed later in life. The emphasis of this study was on complications that occurred within 30 d, and the reported late complications had variable follow-up times, with a few up to 3 y. In addition, their reported complications included conditions unlikely related to circumcision, for example, pneumothorax and meningitis.<sup>14</sup> Other, older US studies report complication rates ranging between 0% and 30%,<sup>16,17</sup> and international studies report complication rates ranging between 2% and 14%.<sup>15,18,19</sup>

Given the widely variable study designs and outcome data on circumcision, it is understandably difficult for providers to compare the surgical risks with the reported medical benefits of circumcision when counseling parents. Therefore, the goal of this study is to analyze patient demographics and characterize clinically meaningful early and late complication rates after circumcision in a large heterogeneous population.

## Methods

A retrospective longitudinal analysis of the California Office of Statewide Health Planning and Development database was performed for the years 2005 to 2010. This database contains all inpatient admissions in public and private hospitals in the state of California, excluding US military and Veterans Affairs hospitals ( $n = 350$ ). We also searched the ambulatory and emergency department databases. Ambulatory surgeries are defined as day surgeries that do not require an overnight stay but does not include clinic procedures that are done in physician offices or clinics. All data are deidentified with a unique record linkage ID (encrypted social security number (SSN)) that allows patients to be tracked over time in all hospitals and years.

The inclusion criteria were male patients under age 5 y, with a circumcision defined by International Classification of Procedures, Ninth Revision, Clinical Modification (ICD-9) procedural code 64.0, or Current Procedural Terminology (CPT) codes 54150 (circumcision, using clamp), 54160 (circumcision, surgical excision other than clamp, 28 d of age or less), 54161 (circumcision, surgical excision other than clamp, patient older than 28 d), and with a linkage ID at the time of initial circumcision. We were not able to differentiate the methods of circumcision, clamp or nonclamp, for neonates as these patients were coded with ICD-9 procedural codes. We defined neonates as babies under 3 mo old because some infants, such as those born prematurely, may have a nonoperative circumcision within the first few months of life, rather than at birth.

Preoperative indications for circumcision were grouped into five categories: redundant prepuce or phimosis, infection or vesicoureteral reflux (VUR), non-VUR hydronephrosis, neurogenic bladder, and posterior urethral valves. Redundant prepuce or phimosis was defined by ICD-9 code 605. Infection or VUR was defined by the following ICD-9 codes: balanoposthitis (607.1), balanitis xerotica obliterans (607.81), UTI, site not specified (599.0), VUR, unspecified or without reflux nephropathy (593.70), VUR with reflux nephropathy, unilateral (593.71), VUR with reflux nephropathy, bilateral (593.72), VUR with reflux nephropathy, not otherwise specified (593.73). Non-VUR hydronephrosis included ICD-9 diagnosis codes of 593.70 (VUR, unspecified or without reflex nephropathy) and 593.5 (hydroureter). Neurogenic bladder was defined by ICD-9 codes of 596.51 (hypertonicity of the bladder), 596.52 (low bladder compliance), 596.53 (paralysis of the bladder), 596.54 (neurogenic bladder, not otherwise specified), 596.55 (detrusor sphincter dyssynergia), and 596.59 (other functional disorder of the bladder). Posterior urethral valve was defined by ICD-9 codes of 753.6 (atresia and stenosis of the urethra and bladder neck) and 753.8 (other specified anomalies of the bladder and urethra). Patients were defined as having a preoperative indication for circumcision when these codes were captured within a year before circumcision.

Complications included accidental puncture or laceration during a procedure (ICD-9 998.2), hemorrhage complicating a procedure (ICD-9 998.11), hematoma complicating a procedure (ICD-9 998.12), seroma complicating a procedure (ICD-9 998.13), infection, nonhealing wound, and complications requiring surgical revisions after initial circumcision. Infection was defined by the following ICD-9 codes: postoperative infection (998.5), infected postoperative seroma (998.51), or other postoperative infection (998.59). Nonhealing wounds included ICD-9 codes of disruption of wound (998.3), disruption of wound unspecified (998.30), disruption of internal operation (surgical) wound (998.31), disruption of external operation (surgical) wound (998.32), nonhealing surgical wound (998.83), open wound of penis without mention of complications (878.0), or open wound of penis, complicated (878.1).

Complications requiring surgical revisions were defined as the presence of the following procedural codes at a subsequent event after the initial circumcision: urethral meatoplasty (ICD-9 58.47), release of urethral stricture (ICD-9 58.5), suture of penile laceration (ICD-9 64.41), release of chordee (ICD-9 64.42), construction of penis (ICD-9 64.43), reconstruction of penis (ICD-9 64.44), replantation of penis (ICD-9 64.45), other repair of penis (ICD-9 64.49), amputation of penis (ICD-9 64.3), partial amputation of penis (CPT 54120), complete amputation of penis (CPT 54125), partial division of penile adhesions (ICD-9 64.93), suture of unspecified blood vessel (ICD-9 39.30), suture of artery (ICD-9 39.31), suture of vein (ICD-9 39.32), hemorrhage control (ICD-9 39.98), incision and drainage of penis (CPT 54015), incomplete circumcision (CPT 54163), lysis of post circumcision adhesion (CPT 54162), complex revision (CPT 54300), lysis of skin bridges and suture tracts (CPT 11420), removal of inclusion cyst (CPT 54060), or a second encounter with one of the circumcision codes. We included the aforementioned ICD-9 procedure codes 39.30, 39.31, 39.32, 39.98, and diagnosis codes 998.11, 998.12 into the category of hemorrhage.

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