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The Association Between BXO and Obesity in Boys Undergoing Circumcision

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Abstract

This study investigated whether boys with balanitis xerotica obliterans (BXO) have increased rates of obesity compared with boys with no concern for BXO (NCB). Boys ≤18 years old with circumcision pathology–confirmed BXO were compared with an age-matched group who had NCB during circumcision. Boys with BXO were found to have a mean body mass index of 70.64 percentile for age compared with 52.43 percentile in age-matched controls ($P = .0005$). The rate of obesity was significantly higher in boys with BXO (42%) compared with 12.4% in boys with NCB (odds ratio = 5.12; 95% CI = 2.6 to 10.06). Given the increasing rates of childhood obesity and the long-term health consequences of both BXO and obesity, special attention should be paid to this population. Further research is needed to determine if BXO in obese children may represent an early indicator of a systemic disease process where intervention may be warranted.

Keywords

balanitis xerotica obliterans, BXO, circumcision, obesity, lichen sclerosus

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Introduction

Balanitis xerotica obliterans (BXO), also known as lichen sclerosus, is a condition of hyperkeratosis and hyperplasia of the squamous mucosa and homogeneous collagen deposition in the dermis that affects the penile skin.[1,2] Although the exact etiology is unclear, BXO is seen at an increasing rate in some conditions such as hypospadias and phimosis.[3,4] BXO was first described in 1928 by Stühmer[5] and was thought to be a disease of adulthood until 1962, when Catterall and Oates[6] reported the first pediatric case in a 7 year-old boy with isolated BXO of the prepuce. The incidence of BXO is estimated to be 0.6/100 000 in males younger than 10 years and 0.1/100 000 in males 11 to 20 years old.[7] Early on, the rate of BXO in children was thought to range from 9% to 19% of boys undergoing circumcision for preputial pathology.[8,9] However, more recent publications argue that BXO is more common than previously thought.[10,11] Indeed, some have described rates of BXO as high as 40% in boys with phimosis.[12,13]

In the adult literature, several medical comorbidities have been associated with BXO, including cardiovascular disease, diabetes, and an increased body mass index (BMI).[14] However, despite an increasing rate of diagnosis of BXO in children, little is known regarding the potential for associated comorbidities, such as obesity.[15] The purpose of this study was to determine if boys with BXO at the time of circumcision have a higher rate of obesity than age-matched boys undergoing circumcision with normal appearance and no clinical concerns for BXO.

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Materials and Methods

In this case control study, 50 patients diagnosed with BXO on circumcision pathology report between 2008 and 2015 were selected from a tertiary pediatric hospital data warehouse. Patients were excluded if they were >18 years of age, underwent circumcision revision, or circumcision in combination with another penile procedure, including chordee, torsion, and hypospadias. An age-matched control group of 250 boys who also underwent primary circumcision during the same time and who had no concern for BXO in the operative report was identified. To improve the power of our sample, we included a 5:1 ratio of controls to cases. No pathological confirmation of normal foreskin was available in this group because of clinical practice for disposal of these specimens without evaluation. Height, weight, and BMI from the day of surgery were recorded from the medical record of all participants. *Obese* and *overweight* were characterized using the Centers for Disease Control and Prevention BMI-for-age growth chart. Obese and overweight were defined as BMI ≥95th percentile for age and BMI 85th to 94th percentile for age, respectively. Odds ratios (ORs) and 95% CIs were calculated. Continuous variables were compared between groups using the Mann-Whitney *U* test.

Results

The mean ages of the BXO and control groups were similar (10.24 vs 10.06 years; $P = .98$). Mean BMI percentile for age was significantly different between the 2 groups. Boys with BXO had a mean BMI of 70.64 percentile for age compared with the control group mean BMI of 52.43 percentile for age ($P = .0005$). The rate of obesity (BMI ≥ 95th percentile for age) was significantly higher in boys with BXO (21/50, 42%) compared with controls (31/250, 12.4%; OR = 5.12, 95% CI = 2.6 to 10.06). When broadening the criteria to include both overweight and obese boys (BMI ≥ 85th percentile for age), the difference between the groups was less pronounced but still significantly higher in boys with BXO (26/50, 52%) compared with controls (58/250, 23.2%; OR = 3.6, 95% CI = 1.91 to 6.72).

Discussion

In this study, we evaluated a large cohort of boys with the pathological diagnosis of BXO and compared them with an age-matched cohort who underwent circumcision without suspicion of BXO. We identified a 5.12-times increase in the likelihood of obesity in a child with pathology-confirmed BXO on circumcision compared with a similarly aged child without any suspicion for BXO at the time of circumcision. With expanded criteria to include both obese and overweight children, these factors were also more likely to be present in the BXO cohort.

In the adult literature, associations between BXO and obesity, diabetes, and coronary artery disease have been reported. These associations possibly exist because BXO represents an end-organ type response to systemic disease effects.[14] The evidence presented in the current study, demonstrating that in children there is an association between BXO and obesity. raises the concern that these patients may also be at an increased risk for other comorbidities.

Obesity alone is unlikely to be an isolated cause of BXO but rather represents a single factor in a complex disease process that involves multiple physiological systems. Similar findings to this assumption have been identified in adults where metabolic syndrome describes a clustering of symptoms, including obesity, insulin resistance, type 2 diabetes, hypertension, dyslipidemia, elevated triglycerides, low high-density lipoprotein, and elevated cardiovascular risk.[16] Although data in children are sparse, there is some evidence that metabolic syndrome also occurs in younger age groups. Thus, it is possible that BXO represents a downstream effect of one or more of the disease comorbidities that are associated with metabolic syndrome. If this is true, then the association of BXO in obese and overweight children could potentially act as a clinical risk factor. Although we did not evaluate for these comorbidities in our study, it is reasonable to assume that an obese child would be at elevated risk both at the time of BXO diagnosis and in the future. Therefore, in the child found to have both obesity and BXO, one might consider further evaluation for other signs of metabolic syndrome or, at a minimum, closer follow-up as they enter adulthood.

It has also been suggested that BXO is related to poor genital hygiene. When the inner prepuce of an uncircumcised male is not properly cared for, an environment of local irritation and inflammation may develop.[17] A combination of this chronic irritation and improper immune response seen in obesity may in part be responsible for the increased risk.[18] In fact, it has been shown that in obese children as young as 3 years of age, there is an abnormal response to inflammation characterized by elevated biomarkers, including C-reactive protein.[19] Future studies are necessary to better understand the relationships among BXO, chronic inflammation, and the immune response.

There are several potential limitations in this study. First, this was a case-control study where the data were collected retrospectively. Unlike in the BXO group

where diagnosis was confirmed by pathology, children in the control group did not have their normal foreskins sent for pathological evaluation. Thus, it is possible that despite no clinical indicators to suggest BXO in the control group, some of these children could have had BXO. If there were some patients in the control group misclassified as a result of lack of pathological examination, this could have biased our results. However, despite this limitation, this does represent real-world practice because most institutions do not send normal-appearing foreskins routinely for pathological analysis. Second, obese and overweight children may be more likely to undergo circumcision as a result of hygiene and functional concerns compared with other children. This could increase the rate of circumcision for symptom control and increase the likelihood of obesity in the BXO group compared with the controls. Third, boys without obesity, whether they have BXO or not may lack symptoms and, thus, have a lower likelihood to request circumcision evaluation where the diagnosis may be made. Fourth, although we controlled for age in our study, we did not standardize for other characteristics such as race, family history, medical comorbidities, socioeconomic status, hygiene, or the presence or severity of phimosis. If any of these factors are independently associated with BXO and were not evenly distributed between groups, this could potentially affect the results. Future prospective studies with robust multivariate analyses of patient characteristics are warranted to better define the relationship between obesity and BXO.

Conclusion

There is a significant increased likelihood of obesity in boys with BXO at the time of circumcision compared with boys with normal-appearing foreskin undergoing circumcision. Given the increasing rates of childhood obesity and the long-term health consequences of both BXO and obesity, special attention should be paid to this population. Further research is needed to determine if BXO in obese children may represent an early indicator of a systemic disease process where earlier intervention may be warranted.

Author Contributions

MEF: Contributed to conception and design; contributed to acquisition, analysis, and interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

NB: Contributed to interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

DGD: Contributed to conception and design; contributed to acquisition, analysis, and interpretation; drafted manuscript; critically revised manuscript; gave final approval; agrees to be accountable for all aspects of work ensuring integrity and accuracy.

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Declaration of Conflicting Interests

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