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Assessment of weight gain following adenotonsillectomy in children with Down syndrome

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ABSTRACT

Introduction: Adenotonsillectomy (T&A) has been associated with postoperative weight gain in children. The purpose of this study is to determine whether a similar association exists in children with Down syndrome (DS).

Methods: The medical records of 311 DS patients were reviewed. Subjects were classified into either a control group or surgical group based on whether they had undergone adenotonsillectomy (T&A). Subjects were excluded if they only had one recorded BMI. Cases were analyzed in a pairwise fashion to maximize available data. 113 total patients with DS were identified: 84 (74.3%) in the control group and 29 (25.7%) in the T&A group. Height, weight, BMI, and Z-score data were compared between the control and T&A groups at 6-month intervals over a 24-month period.

Results: Children with DS who underwent T&A were comparable by demographics to children with DS who did not undergo T&A. Mean weight gain at 24 months for the T&A group was 8.07 ± 5.66 kg compared with 5.76 ± 13.20 kg in controls. The median Z-score at 24 months for the T&A group was 1.11 (0.10–1.88) compared with 1.17 (0.80–1.75) in controls. Children undergoing T&A had a stable median Z-score change of 0.09 at 24 months ($p = 0.861$, compared to baseline) while children who did not undergo T&A had a significantly increased median Z-score of 0.52 ($p = 0.035$, compared to baseline). Despite this, there were no significant intergroup differences between weight change, BMI, nor Z-score at any interval ($p > 0.05$).

Conclusions and relevance: Children with DS did not have an increased rate of weight gain or increased BMI after T&A. BMI Z-scores were shown to stabilize over 24 months in the T&A group and increase in the control group. While this suggests that T&A provides an added benefit of weight control in patients with DS, the results should be interpreted with caution due to the small sample size and the fact that not all patients had complete follow up across a 24-month period.

1. Introduction

Adenotonsillectomy (T&A) is routinely performed to treat obstructive sleep apnea (OSA) or sleep-disordered breathing (SDB) in children. Weight is an established risk factor for OSA, with heavier individuals more prone to more severe and/or persistent disease [1,2]. Children with Down syndrome (DS) are at high risk for OSA not only because of anatomic differences, but also due to their propensity for obesity [3]. As such, T&A may not be as effective in this specific population compared to non-syndromic patients [4].

Concerns have been raised about postoperative weight gain after T&A in children [5]. A recent study examined the association between T&A and weight gain in children and found significant increases in postoperative weight for obese, non-syndromic children [6]. The objective of this study was to determine whether children with DS who undergo T&A experience increased weight

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gain compared to children with DS who do not undergo T&A. The null hypothesis was that DS patients that receive T&A do not experience significant weight gain.

2. Methods

Institutional Review Board approval was granted by the Medical University of South Carolina under protocol #00039250. Inclusion criteria were age <18 years old, International Classification of Disease (ICD-9) diagnosis of DS, and a recorded preoperative BMI. Exclusion criteria included no postoperative BMI and active heart disease. The medical records of 311 patients with DS were reviewed; after exclusion, 113 subjects were included in the study. Subjects were classified into either a control group or surgical group based on whether they had undergone adenotonsillectomy (T&A). Demographics, height, and weight data were collected; using these data BMI was calculated as $BMI\left(\frac{kg}{m^2}\right) = mass(kg)/height(m)^2$. Z-scores were based on BMI and calculated using an online calculator managed by the Children's Hospital of Philadelphia (http://stokes.chop.edu/web/zscore/). The Z-score indicates how many standard deviations above or below the mean a data value is and is calculated as $Z = \frac{data\ point - mean}{standard\ deviation}$.

As of 2011, the American Academy of Pediatrics recommended against plotting children with DS on specialized DS growth curves as these curves were considered outdated [7]. We therefore calculated Z-scores using CDC references for non-syndromic children. There have yet to be published data to reestablish the normal growth curves in the DS population. Data was collected over a 24-month period at 6-month intervals. Subjects were excluded if they only had one recorded BMI. Cases were analyzed in a pairwise fashion, in that all cases with available data were analyzed in a cross-sectional fashion at each time point without excluding patients missing data at other time points.

Data was analyzed using SPSS 23.0 (IBM Corporation, Armonk, NY). Categorical variables were summarized by frequency and percentage. Continuous variables were summarized by mean ± standard deviation and range where appropriate. All continuous variables were assessed for normality using the Shapiro-Wilk test. If these variables were not normally distributed, descriptive measurements such as median and interquartile range (IQR) were calculated. Comparisons of baseline characteristics and outcomes (categorical variables) were performed using a Fisher's exact test or Chi-square test. For continuous variables, comparisons between groups were done with an independent *t*-test or a Mann-Whitney rank sum test. A repeated measures generalized linear model was used to compare the change in Z-score over time between groups. A Wilcoxon signed rank sum test was utilized to compare results over time within groups. A p value of <0.05 was considered to indicate a statistically significant difference for all statistical tests.

3. Results

113 total patients with DS were identified: 84 (74.3%) in the control group and 29 (25.7%) in the T&A group. All patients in the T&A group had the procedure for adenotonsillar hypertrophy and/or OSA. Patients in the control group did not have adenotonsillar hypertrophy or OSA indicated in their medical records at time of review. Mean age at baseline for the T&A group was 5.5 years (range 2.0–17.1) compared to 3.2 years (1.3–14.0) for the control group. Patient demographics and weight category data are presented in Table 1. The groups were comparable in measured demographics and BMI. Upon presentation for surgery, 28.6% of patients in the T&A group were obese, compared with 17.3% of patients in the control group, $p = 0.402$. Mean BMI of the T&A group was 18.6 (13.53–37.8) compared with 20.7 (11.87–54.3) in the control group, $p = 0.571$. Mean weight gain at 24 months for the T&A group was 8.07 ± 5.66 kg compared with 5.76 ± 13.20 kg in controls.

First, overall change in Z-score over time was compared between groups with a repeated measures generalized linear model. There was not a statistically significant difference in overall change in Z-score over time comparing T&A group with controls, $p = 0.296$. However, there were not enough cases with complete height and weight data at all time points to achieve necessary power for a reliable model.

As a result, differences in Z-score between the T&A and control groups at each time point were examined. As presented in Table 2, there were no significant differences Z-score in the T&A group compared to the control group at baseline, 6, 12, 18, or 24 months ($p > 0.05$ for all comparisons). Z-score was then compared between groups split by weight categories (Table 3). The median Z-score of overweight patients at 6 months was significantly higher for the T&A group [2.48 (2.01–2.50)] compared with controls [1.57 (0.98–1.76)], $p = 0.010$. The median Z-score of obese patients at 18 months was significantly higher for the T&A group [2.70 (2.63–2.76)] compared with controls [1.96 (1.82–2.26)], $p = 0.040$. There were no other significant differences between groups split by weight category at baseline, 6, 12, 18, or 24 months.

In order to examine how Z-score changed over time, Z-score was compared over time within the T&A and control group (Table 4). At 6 months, both the T&A [change in Z-score from baseline (ΔZ) = 0.18] and control ($\Delta Z = 0.33$) groups changed significantly from baseline, $p = 0.019$ and 0.049, respectively. At 12 months, only the T&A group had significantly increased Z-score from baseline ($\Delta Z = 0.32$, $p = 0.03$); while the control group was not significantly changed ($\Delta Z = 0.50$, $p = 0.19$). At 18 months, only the control group had significantly increased Z-score from baseline ($\Delta Z = 0.82$, $p = 0.002$); while the T&A group was not significantly changed ($\Delta Z = 0.14$, $p = 0.203$). At 24 months, only the control group had significantly increased Z-score from baseline ($\Delta Z = 0.52$, $p = 0.035$); while the T&A group was not significantly changed ($\Delta Z = 0.09$, $p = 0.861$). Trending Z-score over time the T&A group stabilizes long term; whereas, the Z-score of the control group continues to increase.

4. Discussion

This is the first study to examine weight change following T&A in children with DS. The study also compared patients receiving surgery to a control cohort with similar demographics. We found that overweight patients at 6 months and obese patients at 18 months that underwent T&A had significantly higher Z-scores compared to controls. When compared within treatment groups, controls had a higher increase in Z-score compared to the T&A group at 18 and 24 months.

It is unclear why patients with DS that underwent T&A did not show a significant increase in weight as the literature has indicated an association of weight gain with T&A in the general population. A recent systematic review noted weight gain in the short term (7 months) for children and a later review observed similar findings in normal and overweight children [8,9]. Furthermore, Lewis et al. noted this finding particularly in patients that were preoperatively overweight or obese [6]. However, these studies examined *non-syndromic* patients and so the conclusions cannot necessarily be applied analogously. Coexisting congenital heart disease may also inhibit weight gain, but none of the patients in this study had