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SCIENTIFIC ARTICLE

Upper airway morphology in Down Syndrome patients under dexmedetomidine sedation

Rajeev Subramanyam[a,*], **Robert Fleck**[b], **John McAuliffe**[a], **Rupa Radhakrishnan**[b], **Dorothy Jung**[b], **Mario Patino**[a], **Mohamed Mahmoud**[a]

[a] *Department of Anesthesia, Cincinnati Children's Hospital Medical Center, OH, USA*
[b] *Department of Radiology, Cincinnati Children's Hospital Medical Center, OH, USA*

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Abstract
Background and objectives: Children with Down Syndrome are vulnerable to significant upper airway obstruction due to relative macroglossia and dynamic airway collapse. The objective of this study was to compare the upper airway dimensions of children with Down Syndrome and obstructive sleep apnea with normal airway under dexmedetomidine sedation.
Methods: IRB approval was obtained. In this retrospective study, clinically indicated dynamic sagittal midline magnetic resonance images of the upper airway were obtained under low (1 mcg/kg/h) and high (3 mcg/kg/h) dose dexmedetomidine. Airway anteroposterior diameters and sectional areas were measured as minimum and maximum dimensions by two independent observers at soft palate (nasopharyngeal airway) and at base of the tongue (retroglossal airway).
Results and conclusions: Minimum anteroposterior diameter and minimum sectional area at nasopharynx and retroglossal airway were significantly reduced in Down Syndrome compared to normal airway at both low and high dose dexmedetomidine. However, there were no significant differences between low and high dose dexmedetomidine in both Down Syndrome and normal airway. The mean apnea hypopnea index in Down Syndrome was 16 ± 11. Under dexmedetomidine sedation, children with Down Syndrome and obstructive sleep apnea when compared to normal airway children show significant reductions in airway dimensions most pronounced at the narrowest points in the nasopharyngeal and retroglossal airways.

* Corresponding author.
E-mail: Rajeev.Subramanyam@cchmc.org (R. Subramanyam).

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PALAVRAS-CHAVE
Vias aéreas;
Dexmedetomidina;
Imagem;
Síndrome de Down;
Apneia obstrutiva do sono;
Sedação

Morfologia das vias aéreas superiores em pacientes com síndrome de Down sob sedação com dexmedetomidina

Resumo
Justificativa e objetivos: As crianças com síndrome de Down (SD) são vulneráveis à obstrução significativa das vias aéreas superiores devido à macroglossia relativa e colapso dinâmico das vias aéreas. O objetivo deste estudo foi comparar as dimensões das vias aéreas superiores de crianças com SD e apnéia obstrutiva do sono (AOS) com vias aéreas normais (VAN) sob sedação com dexmedetomidina (DEX).
Métodos: Aprovação IRB foi obtida. Neste estudo retrospectivo, imagens clinicamente indicadas de ressonância magnética da dinâmica das vias aéreas superiores em plano sagital na linha média foram obtidas sob dose baixa (1 mcg/kg/h) e dose alta (3 mcg/kg/h) de DEX. Os diâmetros ânteroposteriores das vias aéreas e as áreas seccionais foram medidas como dimensões mínimas e máximas por dois observadores independentes, no palato mole (região nasofaríngea) e na base da língua (região retroglossal).
Resultados e conclusões: O diâmetro mínimo anteroposterior e a área seccional mínima das regiões nasofaríngea e retroglossal estavam significativamente reduzidos na SD em comparação com VAN, tanto com a dose baixa quanto com a dose alta de DEX. Contudo, não houve diferenças significativas entre as doses baixa e alta de DEX em SD e VAN. A média do índice de apneia e hipopneia na SD foi de 16 ± 11. Sob sedação com DEX, as crianças com SD e AOS quando comparadas com as crianças com VAN apresentaram reduções significativas nas dimensões das vias aéreas, mais pronunciadas nos pontos mais estreitos das regiões nasofaríngea e retroglossal.

Introduction

Down Syndrome (DS) or trisomy 21 is the most common genetic disorder in humans with an estimated birth rate of 6000 infants/year (1 in 691 live births) in the United States.[1] Obstructive sleep apnea (OSA) is common and noted in 79% of children with DS (95% confidence interval, 54–94%).[2] Risk factors for OSA in these children include midface hypoplasia, macroglossia, adenoid and tonsillar hypertrophy, laryngotracheal anomalies, obesity, and muscular hypotonia.[3] Even in the absence of OSA, children with DS have reduced airway size caused by soft tissue crowding within a smaller facial skeletal anatomy.[4]

Children with OSA, with or without DS, are sensitive to respiratory depression by opioids, sedatives, and hypnotics. They are especially vulnerable to the development of upper airway obstruction during sedation and anesthesia.[5] Dexmedetomidine (DEX) is an α-2 receptor agonist currently being used off-label for sedation in pediatric patients at many institutions. In contrast to other sedative agents, DEX has been shown to have sedative properties that parallel natural non-rapid eye movement sleep, without significant respiratory depression.[6,7] These advantages make DEX an attractive agent for sedating children with OSA.[8] We have previously used magnetic resonance imaging (MRI) to assess the effect of increasing doses of DEX on airway dimensions in children with normal upper airways (age range 3–10 years) and showed that increasing doses of DEX in these children is not associated with significant increase in the degree of airway obstruction.[9] We recently used a similar methodology to compare the dose–response effects of DEX and propofol on airway morphology in children with OSA (age range 1–16 years). We found that as the dosage increased, average airway dimensions were typically unchanged or slightly increased with DEX compared to unchanged or slightly decreased with propofol.[10]

Our aim in the present study was to test the hypothesis that DS children with OSA have significant upper airway collapsibility even at low doses of DEX compared to children with normal airway (NA). We therefore designed a retrospective cohort study comparing the upper airway morphologies of children aged 3–10 years with DS and OSA to those with NA under increasing doses of DEX sedation.

Materials and methods

After institutional review board approval, the data were obtained in children aged 3–10 years with DS and children with NA who underwent MRI airway analysis with DEX. Written informed consent had been obtained for sedation. The need for a separate informed consent for the retrospective review was waived by our IRB.

Down Syndrome (DS) group

The methodology used in children with DS is described in our previous study that examined the dose–response effects of DEX and propofol on airway morphology. This was done in 22 children and adolescents aged 3–16 years with a history of OSA scheduled for MRI sleep study.[10] Out of the 22 patients who completed the study, a subgroup of 7 patients, aged 3–10 years, had the diagnosis of DS. No premedication was given. Intravenous access was obtained in the