ABSTRACT

Objectives:
1. Identify features of Kallman’s syndrome.
2. Describe olfactory embryologic development.
3. Describe the Keros classification.
4. Recognize significance of olfactory fossa height and congenital anosmia.

Study Design:
Retrospective chart review.

Methods:
Review of CT or MRI with measurement of olfactory cleft height.

Results:
Patients with congenital anosmia had a flat olfactory cleft (low Keros score) when compared to normal controls.

Conclusions:
Patients with flat olfactory clefts noted on imaging may also suffer from olfactory dysfunction.

INTRODUCTION

Permanent sense of smell loss is an uncommon complaint for Americans. Approximately 2 million people estimated to suffer from permanent disturbances. Olfactory ability is also known to diminish with age.

Etiology of Olfactory Loss

• Transport: Physical barriers to transmission
  • Nasal polyposis
  • Neural: Damaged or absent olfactory neurons
  • Kallmann’s Syndrome, head trauma
  • Sensory: Damage to the olfactory neuroepithelium.
  • Post-URI, post radiation therapy

Embryology of the Olfactory System

• Development begins at 24 days’ gestation
• Olfactory epithelium visible at 28 days
• Cell axons grow into telencephalon
• Ethmoid bone ossifies around axons, forming cribriform plate
• Axonal growth relies on GnRH

GnRH and Olfactory Development

• Travel from nasal epithelium into anterior pituitary
• Cytokines (FGF) direct GnRH migration
• Kallmann Syndrome: absence of GnRH
• Hypogonadism, congenital anosmia, and lack of olfactory bulbs
• Olfactory neuroepithelium is rudimentary vs. normal controls

Keros Classification

• Olfactory cleft defined by roof of ethmoid and lateral lamella of cribriform plate (see figure 1)
• Depth of fossa described by Keros in 1964
  • Type I: <3mm; Type II: 4-7mm; Type III: >8mm
  • Keros score not previously correlated with smell disturbances

RESULTS

• Total number of participants: 104
• Control: 57: Smell Disturbances: 47 subjects
• Smell disturbance etiologies:
  • Post Head Trauma (13%)
  • Congenital (10%)
  • 2 patients with Kallmann’s Syndrome
  • Post Upper Respiratory Infection (URI) (23%)
  • Rhinosinusitis (13%)
  • Other/Unknown (40%)
• No differences between men and women
• Congenital had a statistically significant younger age group
• Comparisons were made separately for right and left nasal passageways
• Lower olfactory fossa height in congenital anosmia vs. controls
  • Left side: 2.24mm less in congenital vs. control (p<0.0001) (see figure 2)
  • Right side: 0.95mm less in congenital vs. control (p<0.004) (see figure 3)

METHODS

Study Design:
Retrospective chart review.

Study participants: rhinology patients with diagnosis of taste and smell disturbances (ICD-9 781.1), CT or MRI scan on file

• Etiology of smell disturbance recorded
• Control patients: CT or MRI on file without opacity on scan

• CT/MRI reviewed and olfactory fossa height recorded to nearest 0.01

• See Figure 1 (A-B = Fossa Height)
• Aquarius NetViewer Software package used

Study Aims

• Compare olfactory fossa heights in participants with smell disturbance to control participants

Statistical Analysis

• Kruskal Wallis test was used to determine difference in cleft heights between etiology groups

DISCUSSION

• Goal of study: evaluate olfactory fossa height (Keros score) in patients with olfactory disturbances
• Unexpected finding: patients with congenital anosmia had lower olfactory cleft (Keros Type I) vs. normal controls

Embryology and Flat Olfactory Cleft

• Embryologic etiology not fully understood
• Olfactory epithelium, cribriform plate, and olfactory bulb development rely on normal GnRH function

Congenital Anosmia (CI)

• Defined as inability to detect odors from birth
• Diagnosis often unrecognized
• Can occur isolated or with other syndromes
  • Kallmann Syndrome most widely known
• Diagnosis of CI
  • History of life-long smell loss
  • Elimination of other causes
• Evaluate for lack of puberty to consider Kallmann diagnosis

REFERENCES