Computed tomography imaging for superior semicircular canal dehiscence syndrome

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Abstract Superior semicircular canal dehiscence is a newly described syndrome of sound and/or pressure induced vertigo. Computed tomography (CT) imaging plays an important role in confirmation of a defect in the bone overlying the canal. A high resolution CT technique utilising 0.5 mm or thinner slices and multi-planar reconstructions parallel to the superior semicircular canal is required. Placement of a histogram over a suspected defect can assist CT diagnosis.

Keywords: Computed tomography, temporal bone, superior semicircular canal dehiscence.

Introduction

In 1998, Minor, Solomon and Zinreich et al. presented symptoms and computed tomography findings of eight patients who presented with sound- or pressure-induced vertigo or oscillopsia. Dehiscence of bone overlying the superior semi-circular canal was identified as the cause of the patient’s symptoms in each case.

Pathogenesis

It is postulated that dehiscence occurs after a traumatic or erosive event in abnormally thin bone overlying the superior semicircular canal. A failure during the ossification process is believed to be responsible for the initial defect in bone thickness. The membranous portion of the canal underlying a defect in the bony roof becomes mobile and deflects in response to changes in pressure within the inner ear or cranium. This causes stimulation of afferent nerves within the canal, resulting in eye motion parallel to the direction of flow of the endolymph.

Diagnosis of superior semicircular canal dehiscence syndrome (SSCDS) is based on clinical findings. The presence of sound and/or pressure induced eye movements aligned to the plane of the superior semicircular canal is definitive for SSCDS, however symptoms of the syndrome may also be present in other conditions such as Meniere’s disease, Lyme disease, syphilis, and cholesteatoma. Other symptoms of the syndrome include vertigo and conductive hearing loss. Dehiscence is frequently bilateral and is rarely found in children. Intact bone, no matter how thin, does not produce symptoms of dehiscence.2 Computed tomography (CT) scans of the temporal bones are obtained to confirm the presence of dehiscence and to aid pre-surgical planning.

Imaging technique

Computed tomography imaging of the petrous bone for SSCDS requires a scan technique weighted towards high contrast resolution. Multi-slice scanning in the transverse plane with multi-planar reconstructions is the preferred method. Computed tomography examinations utilising collimation thicknesses of 1 mm or greater should not be used for the confirmation of SSCDS as partial volume artifacts may mimic a defect. A collimation thickness of 0.5 mm or thinner is recommended in addition to a low pitch factor, longer rotation time, high resolution scan field of view and a sharp reconstruction kernel. Use of a small image field of view and separate reconstruction of the left and right sides of the petrous bone will improve spatial resolution.

Suggested projections for the imaging of SSCDS include orthogonal axial and coronal views of the petrous bones, with additional views parallel and perpendicular to the plane of the super semicircular canal. The canal lies at approximately 45° to the coronal and sagittal planes on an axial view, and is slightly oblique to the sagittal plane on a coronal view. When the viewing plane is manipulated parallel to the superior semicircular canal, the non-dehiscent canal appears as a ‘bullseye’.

In the dehiscent canal, a defect will be apparent in the bony roof. Dehiscence can be confirmed by placing a histogram across a suspected defect. The roof of the superior semicircular canal is very dense, producing CT values between 1800 and 2000 Hounsfield units. Even if the bone is very thin and only occupies a small portion of the voxel, its density is sufficient to produce a significant change in Hounsfield units for that voxel compared to the surrounding brain tissue and otic fluid. A histogram placed across an intact canal will display a sharp increase as it passes across the bony roof. If placed over an area of dehiscence, the histogram will appear relatively flat.

Case study

A 33-year-old female with a history of sound-induced vertigo and nystagmus on the left side presented to the Royal Brisbane and Women’s Hospital for CT of the petrous bone. High resolution volume imaging was performed on a 4-channel CT scanner (Volume Zoom, Siemens Medical Solutions, Erlangen, Germany) utilising 0.5 mm collimation.

Axial and coronal reformations of the left inner ear suggest dehiscence of the superior semicircular canal (Figure 1). Profile and perpendicular views of the canal confirm the presence of a bony defect (Figure 2). A small area of dehiscence is suggested on the orthogonal reconstructions of the right inner ear (Figure 3),...
however the profile and perpendicular views demonstrate continuous bony covering of the superior semicircular canal (Figure 4). The findings are confirmed by placing histograms across the suspected defects in the perpendicular view. The histogram of the right side shows a definite peak across the suspicious area (Figure 5), while the histogram of the left side shows no change in density across the defect (Figure 6).

**Treatment**

Management of patients with SSCDS is determined by the severity of symptoms. Avoidance of provocative stimuli is sufficient in many cases. Surgical plugging of the defect may be indicated for patients with persistent, disabling symptoms.8,11

**Conclusion**

Dehiscence of bone overlying the superior semicircular canal has recently been identified as a cause of sound- and/or pressure-induced vertigo. Research suggests dehiscence is produced by a traumatic or erosive event in developmentally thin bone. A thin slice (≤ 0.5 mm) CT technique with multiplanar reconstructions parallel to the canal is required for confirmation of the syndrome.

**References**