Canadian Audiologist

The Official Publication of the Canadian Academy of Audiology

# Acoustic Shock

Don McFerren, MA, FRCS

Published March 12, 2015

It has long been recognised that excessive sound can damage the auditory system. This can happen either by exposure to a single extremely loud sound, typically greater than 120 dB or by chronic exposure to sound at a lesser intensity. For this reason most countries have legislation in place that covers occupational noise exposure, providing both an absolute upper limit and an average daily or weekly sound limit. In the latter part of the 20th century a different pattern of noise damage to the auditory system started to emerge: employees working in call centres reported symptoms following brief exposure to sudden unexpected sounds through their telephone handsets or headsets. They described pain in around the ear, tinnitus, dizziness, hyperacusis, altered hearing and a blocked sensation in the affected ear or ears. For some people the symptoms were short lived but in others the problem persisted and other symptoms developed including hypervigilance, anxiety, depression, insomnia and post-traumatic stress disorder (PTSD). This symptom cluster following unexpected noise exposure through telecommunications equipment became known as acoustic shock injury, acoustic shock disorder, acoustic shock syndrome or simply acoustic shock.[1–4] The sounds that triggered acoustic shock were entitled acoustic incidents.

The first major report regarding acoustic shock was published in Denmark[5] but this was part of an internal company report and the text not easily accessible. The first widely available publication was from Australia[1] and described the clinical features of 103 call centre workers who had been exposed to acoustic incidents. There have been further publications describing acoustic shock from Australia,[6] the United Kingdom[7,8] and India.[9] Although there has been some interest generated regarding this geographical distribution there are unofficial reports of acoustic shock occurring in many other countries. There are also anecdotal reports of acoustic shock symptomatology occurring in people exposed to sudden unexpected sound but not wearing headsets or handsets. In these cases the causative sound is usually generated close to the person and this proximity of the sound source to the ear does seem to be a common feature of the syndrome. There have been reports of acoustic shock occurring in clusters. There is a slight female preponderance of cases of acoustic shock though further work is

needed to ascertain whether this gender imbalance is genuine or simply reflects the gender distribution of call centre work.

Because call centres often record conversations between their operatives and customers it has been possible to analyse the sounds that give rise to acoustic shock. Sounds have included electrical interference, acoustic feedback, tones from fax machines and noises produced by disgruntled customers. Work in Denmark[5] isolated sounds between 100 Hz and 3.8 kHz with intensities varying from 56 to 100 dB. A similar study in Australia[1] showed a frequency range of 2.3 to 3.4 kHz with intensities from 82 to 120 dB. The duration of exposure is very difficult to assess because affected call centre operatives remove the handsets or headsets from their ears as quickly as possible after exposure. Certainly the exposure is unlikely to be more than a few seconds. One feature common to acoustic incident sound is that they have a short rise time varying between 0 and 20 ms, reflecting the sudden and unexpected nature of the sound.

Various theories about the pathophysiology of acoustic shock have been proposed.[2–4,6,7] One popular theory is that the symptoms are caused by tonic tensor tympani syndrome[2,3]: the initial response after an acoustic incident is thought to be an exaggerated startle response with contraction of the tensor tympani muscle in addition to the normal acoustic protection provided by the stapedial reflex. Continued contraction of the tensor tympani muscle then generates many of the symptoms of acoustic shock including aural pain and fullness, tinnitus, vertigo and distortion of hearing. Although this model has many proponents there is as yet no robust scientific support. Cochlear damage has been suggested as a mechanism but the absence of sensorineural hearing loss in many cases militates against this theory.

Vinodh and Veeranna[9] argue that pure tone audiometry is an insensitive method of detecting subtle cochlear damage and if a more sensitive technique such as distortion product otoacoustic emission testing is used cochlear defects can be found in many patients with acoustic shock. Some workers have noted a high prevalence of previous mental health symptoms among people with acoustic shock leading to the suggestion that there is a psychological component.[7] One recent publication has suggested that the condition is usually psychogenic in origin and malingering or hysteria may be involved.[9] This latter theory is opposed by the majority of workers in the field.

The diagnosis of acoustic shock is largely based on taking a detailed clinical history. There should be a clear history of exposure to an acoustic incident. The vast majority of sufferers describe pain in or around the ear following exposure to the acoustic incident, often using graphic descriptors such as “it felt like an electric shock going through my ear” or “it felt like someone was jabbing a knife into my ear.” Tinnitus is the next most common otological symptom followed by distorted hearing, hyperacusis and vertigo. A feeling of aural blockage is common and most people will have multiple otological symptoms, the mean figure reported at 2.7 to 3.2 symptoms per patient.[1,7] Collapse has been observed in a few people following acoustic shock. Other non-otological symptoms include insomnia, headaches, disorientation, hypervigilance, anxiety, depression and anger. Clinical examination is often normal and audiometric testing is usually either normal or age appropriate. If there is a hearing loss it is often of an atypical pattern and may not have the characteristic 4 to 6 kHz dip of noise induced

hearing loss. Tympanometry is usually normal despite the common symptom of aural blockage.

Management is unclear. Various electronic filtering and limiting devices have been developed to try and prevent the problem. Many call centres now are very aware of the problem and have active occupational health teams who remove operatives from call handling duties after an acoustic incident, at least until the immediate symptoms have settled. For patients with persistent symptoms the techniques used for tinnitus and hyperacusis may be applied. Sound therapy for acoustic shock patients can be useful but may be difficult to provide as many people with acoustic shock do not tolerate having sound generators in their ears. Westcott gives useful advice on how to administer sound therapy using techniques such as having headphones loosely around the neck rather than over the ears.[2] Sleep management and relaxation strategies may be useful. For those with significant anxiety depression symptoms of PTSD a psychological opinion may be beneficial.

## References


1. Milhinch JC. Acoustic shock injury: real or imaginary. AudiologyOnline 2002. http://www.audiologyonline.com/articles/acoustic-shock-injury-real-or-1172.
2. Westcott M. Acoustic shock injury (ASI). Acta Otolaryngol Suppl 2006;556:54–8.
3. Westcott M. Acoustic shock disorder. NZMJ 2010;123:25–31.
4. McFerran DJ, Baguley DM. Acoustic shock. J Laryngol Otol 2007;121(4):301–5.
5. Hinke K and Brask K. An investigation of the telephone services of the call centre of TeleDanmark in Aarbenraa [in Danish]. Haderslev: Milijomedicinsk Klinik 1999.
6. Hooper RE. Acoustic shock controversies. J Laryngol Otol 2014;128 Suppl 2:S2–9.
7. Parker W, Parker V, Parker G, Parker A. 'Acoustic shock': a new occupational disease? Observations from clinical and medico-legal practice. Int J Audiol 2014;53(10):764–9.
8. Lawton BW. Audiometric findings in call centre workers exposed to acoustic shock. Proc Inst Acoustics 2003;25:249–58.
9. Vinodh RS, Veeranna N. Evaluation of acoustic shock induced early hearing loss with audiometer and distortion product otoacoustic emissions. Indian J Med Sci 2010;64(3):132–9.