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**REVIEW ARTICLE**

# Cognitive behavioural therapy in management of hyperacusis: a narrative review and clinical implementation

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## Abstract

**Background and Aim:** The aim of this article was to critically discuss the clinical application of a cognitive behaviour therapy (CBT) protocol for the treatment of hyperacusis and its associated distress.

**Methods:** Narrative review

**Recent Findings:** Reviewing the research literature suggests that hyperacusis, anxiety and safety seeking behaviours may be linked. Therefore, it seems reasonable to suggest that clinical management of hyperacusis should also include addressing co-existing anxiety and avoidance behaviour. Although, there is strong evidence supporting the effectiveness of CBT in treating anxiety, the studies directly assessing the effect of CBT on hyperacusis are limited. In this paper, the clinical implementation of a CBT protocol for hyperacusis rehabilitation is discussed.

**Conclusion:** Although a causal relationship between anxiety and hyperacusis is not clear, there is a growing body of evidence suggesting a possible link between them. In the absence of a cure for hyperacusis, treatment of the anxiety component of the condition could be beneficial.

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## Introduction

*What is hyperacusis?*

Hyperacusis is a term that is used to describe the intolerance to ordinary sounds that causes significant distress and impairment in social, occupational, recreational, and other day-to-day activities. Several authors and patients' groups have devised other definitions to describe the experience of hyperacusis [1-5].

The prevalence of hyperacusis is estimated to be between 7% and 23% of the population [6,7]. Hyperacusis has been reported in patients with various conditions including facial paralysis [8], head trauma [9], tinnitus [10,11], depression [12], anxiety [13,14], post-traumatic stress disorder [15], obsessive compulsive personality disorder [16], schizophrenia [17], Williams syndrome [14,18], autistic spectrum disorder [5], Asperger's Syndrome [19], dementia [20], regional pain syndrome [21], auditory processing disorders [22], hearing loss [23] as well as for normally hearing people with no identified underlying health condition [24]. Hyperacusis can have a great impact on the daily life of the sufferers [25]. In a case study,

**Table 1. Examples of the problems faced by people experiencing hyperacusis**

| Patients' stories | Age (yrs) | Associated conditions |
|---|---|---|
| Patient feels that noises travel through his head and makes him uncomfortable. He described noises as arrows being thrown at his ears. He felt that his face becomes numb when listening to loud noises. He kept changing his jobs in order to avoid noisy environments. | 55 | Normal hearing, no tinnitus |
| Patient feels highly distressed and sick when exposed to environmental loud noises. She stopped her work as a hospital nurse. She has been avoiding shopping centres, cinemas, hospitals and many other places. On occasions that she had to go out she used to wear ear defenders. | 30 | Normal hearing, no tinnitus |
| Patient feels that noises that her children make were painful and reduce her listening capacity. She felt stressed up when trying to listen to conversations through her tinnitus and the pain caused by the environmental noises. She felt angry that her life was like this. Frustrated that such a small thing is a big deal. When her children were talking to her, she felt that their words add to the cement mixer effect in her head. She felt exhausted and wanting to be left alone. | 39 | Tinnitus and mild unilateral hearing loss |
| Patient could not cope with loud environmental noises. She described that loud noises make her tinnitus less bearable. She has been avoiding travelling by aeroplanes and had to turn down a good job offer which included frequent travelling. Then she felt disappointed at herself. | 50 | Mild hearing loss and tinnitus |
| Patient presented with severe hearing handicap combined with hyperacusis. She was unable to use her hearing aids effectively due to her hypersensitivity to noise. Several adjustments in her hearing aids did not lead to any improvement. Work stress and communication problems were followed by severe emotional disturbances. She then was signed off as sick. | 44 | Moderate bilateral hearing loss, migraine, no tinnitus |
| Patient stopped working all together. He has adjusted his lifestyle based on avoiding noisy roads, shops, people and places. He frequently became angry at his noisy neighbours. He even was avoiding certain rooms in his own apartment as these were not enough quiet for him to relax or concentrate. He put extra barriers on his windows in order to damp down the traffic noises. He felt isolated. | 45 | Depression and tinnitus |
| Patient became sensitive to sounds especially high pitched noises. He could not tolerate noises made by his colleagues at work (e.g. opening a pack of crisp, printer, eating etc.). He broke up with his girlfriend whose voice sounded high pitched. He had to use earplugs when working in his office. | 22 | Normal hearing, no tinnitus |

Schwartz et al. [26] reported that their hyperacusis patients suffered from physical discomfort, pain, fear, anxiety and obsessive compulsive disorder (OCD)-like symptoms, which severely interrupted various aspects of their lives. Table 1, lists common problems expressed by people who have attended the Hyperacusis Clinic at the Royal Surrey County Hospital, United Kingdom. This hyperacusis clinic is specialised in treating patients with severe hyperacusis in the UK hence the cases described in Table 1, may not be representative of typical patients referred to the mainstream audiology clinics.

The mechanism underlying hyperacusis is unknown. Hwang et al. [27] compared the brain activation in response to sound in three patients with hyperacusis and three healthy subjects with no hyperacusis, using functional magnetic resonance imaging (fMRI). They observed that the brain activity in patients with no hyperacusis was mainly clustered in the right superior temporal gyrus, which contains the primary auditory cortex. However, in patients with hyperacusis, brain activities were increased and extended beyond the auditory areas to the frontal and occipital lobes. This finding is consistent with the theory that systems outside the auditory pathway are responsible for patient's adverse reaction to sound [28].

Jastreboff and Hazell [28] suggested that people experiencing hyperacusis typically have negative emotional associations with environmental noises or sound in general leading to an abnormally high gain (amplification) to signals arriving from the cochlea. Consistent with this theory, there are several research studies indicating that the processing of

emotionally significant stimuli in the brain is enhanced in comparison with the processing of neutral stimuli [29-32]. This means that when a sound induces negative emotions, such as anxiety, fear, annoyance, anger, or guilt, then it is more likely to be perceived and to remain the focus of attention than if it does not evoke negative emotions.

Lader et al. [33] compared the reaction of people with anxiety and a normal control group to sequences of sounds. The anxious group showed continual increase in sweating suggesting an increase in their anxiety, while people in the control group quickly adapted to the sounds presented. Beck [34] suggested that people with anxiety neurosis do not discriminate between safe and non-safe stimuli and any sound is interpreted as a danger signal and creates a false alarm leading to further anxiety. As the patient gets anxious, he interprets his anxiety as a sign of danger. Then the patient thinks, "I am feeling anxious; therefore, the situation must really be threatening" (Beck 1976, p.151). In an attempt to maintain their perceived safety, the patient may also avoid an anxiety-provoking noise which forfeits the opportunity to test the validity of their thoughts [35].

The relationship between anxiety and hyperacusis has been suggested by several authors [36]. There is strong evidence in the psychology literature supporting the effectiveness of cognitive behavioural therapy (CBT) in treating anxiety [37,38]. Therefore, in the absence of a definitive cure for hyperacusis, treatment of the hyperacusis-related anxiety using CBT could be beneficial.

*What is cognitive behavioural therapy?*

Cognitive behavioural therapy is a psychological intervention, which aims to help the patient to modify their unhelpful beliefs and safety-seeking behaviours [34]. CBT explains the individual's emotional reaction to sound in the following way. The patient's interpretation of the effect or the source of noise may be unrealistic and/or catastrophic. The patient may think that environmental noises damage their hearing/or they may believe that the people who make the noises deliberately want to annoy them. For instance, someone may think that environmental noises affect his concentration and reduce his efficiency at work, thereby leading to the catastrophic conclusion that they will never work again. These so-called negative automatic thoughts (NAT) occur when patients face situations that violate rules and assumptions they have established across their lifespan such as "in order to survive I should always be at my peak efficiency". These rules of life are in turn assumed to reflect an individual's core belief (e.g. I am a failure). The onset of hyperacusis can precipitate a perceived threat to these life rules and some people therefore direct their behaviour at reducing this threat (e.g. avoiding noise at work). The paradoxical effect of this is a heightened awareness of the source of the threat (i.e. sound) and limiting their life. This leads to anxiety and depression. CBT aims to enable the patient to identify and modify NATs, their maladaptive rules for living and negative core beliefs. This helps the patient spend less time guarding against the perceived threat of sound and instead re-engage in meaningful activity, thereby alleviating anxiety and improving depressed mood. The use of behavioural interventions in CBT is, according to Beck "effective because of the conceptual changes that are produced" (1976; p.331). There has been much debate on the mediators of change in CBT since Beck posited his cognitive theory and it is likely that both cognitive and behavioural changes are necessary to achieve improved functioning in patients with hyperacusis.

The aims of this study were to 1) review the research evidence that assess the relationship between anxiety and hyperacusis, 2) review the research evidence on the effect of CBT on hyperacusis, and 3) discuss clinical implementation of CBT for hyperacusis.

## Methods

*Study design*

This is a narrative review study.

*Study selection criteria*
Studies were included in this review if they investigated the relationship between hyperacusis and anxiety or assessed the effects of CBT on hyperacusis.

*Search and identification of studies*
Electronic search: A search of literature was conducted utilizing the following resources: AMED (Allied and Complementary Medicine Database); British Nursing Index; CINAHL (Cumulative Index to Nursing and Allied Health Literature); Embase; Health Business Elite; Medline; PsycInfo; and HMIC (Health Management Information Consortium). To maximize sensitivity, no filters were employed in the search. In addition, hand search was conducted on the reference list of the included studies.
Search strategy: the search strategy used the terms listed below.
Search 1: "hyperacusis" [in title] AND "anxiety" [in title or abstract]
Search 2: "hyperacusis" [in title] AND "cognitive AND behavioural AND therapy" [in title or abstract]
Study identification: The titles and abstracts of the articles retrieved using the search strategy were reviewed. Articles that failed to meet the inclusion criteria were not reviewed. The full text of the articles that could not be excluded based on their titles and abstracts was retrieved and reviewed by the first author. Only studies that met the inclusion criteria were included in the review. Full texts of the included studies were reviewed.

## Results

*Outcome of the search strategy*
Search 1 identified 17 articles. Seven studies that met the inclusion criteria were included in the review. Ten studies were excluded, as they did not meet the inclusion criteria (i.e. they were not assessing the relationship between hyperacusis and anxiety).
Search 2 identified 4 articles. One study that met the inclusion criteria was included in the review. The other 3 studies were excluded, as they did not meet the inclusion criteria (i.e. they were not assessing the effect of CBT on hyperacusis).

*Included studies on the relationship between anxiety and hyperacusis*
Dauman and Bouscau-Faure [39] assessed psychiatric co-morbidity in 163 patients with chronic tinnitus with and without hyperacusis. They reported statistically significant differences in the prevalence of depression and anxiety disorders between those with and without hyperacusis. The group of patients who had tinnitus combined with hyperacusis presented with 16% more anxiety disorders in comparison with those who just had tinnitus. Goebel and Floezinger [40] reported that 39% of patients with hyperacusis combined with tinnitus had an anxiety disorder compared to 23% of patients with tinnitus only. However, Dubal and Viaud-Delmon [17], who studied hyperacusis and anxiety symptoms in 50 people with psychosis, reported that anxiety did not predict an increase in hyperacusis symptoms. In their study, participants with higher scores on a hyperacusis questionnaire did not present with higher scores on an anxiety questionnaire. Blaesing and Kroener-Herwig [13] assessed the anxiety symptoms and sound avoidance behaviour in 56 tinnitus patients with and without hyperacusis. Their results revealed that patients who had hyperacusis showed significantly more anxiety symptoms and avoidance behaviour than those without hyperacusis. The mean total score in Beck Anxiety Inventory for the group with tinnitus plus hyperacusis was 16 (SD=10) and for the group with tinnitus only was 8 (SD=7) ($p < 0.05$). The mean score on noise avoidance questionnaire for the group with tinnitus plus hyperacusis was 39 (SD=20) and for the group with tinnitus only was 13 (SD=12) ($p<0.05$). Juris et al. [41] reported that 47% of 62 patients with hyperacusis who took part in their research had an anxiety disorder.
These data support the hypothesis that hyperacusis, anxiety and safety seeking

behaviours maybe linked. Therefore, it seems reasonable to suggest that clinical management of hyperacusis should also include addressing co-existing anxiety and avoidance behaviour.

Blomberg et al. [14] studied the relationship between fear and hyperacusis among 45 individuals with Williams syndrome. They reported that there was a strong significant correlation between symptoms of fear and hyperacusis ($r=0.6$, $p<0.001$). Their conclusion was that if hyperacusis is related to heightened general arousal levels, then the person experiencing hyperacusis not only develops fear and anxiety in response to sound but also may become vulnerable for developing other forms of phobias and psychopathologies. Wallen et al. .[42] studied hyperacusis in relation to the symptoms of long-term stress (emotional exhaustion) in 338 participants. Their results revealed that people with high levels of long-term stress presented with significantly higher symptoms of hyperacusis in comparison with those who had lower levels of stress. Consistent with this, Hasson et al. [43] reported that women who shown symptoms of long-term stress were more likely to display hyperacusis symptoms after taking part in stressful activities. To sum up, although a causal relationship between anxiety and hyperacusis is not clear, there is a growing body of evidence suggesting a possible link between them. Therefore, in the absence of a cure for hyperacusis, treatment of the anxiety component of the condition could be beneficial.

*Included study on the effect of CBT on hyperacusis*

Juris et al. [44] conducted a randomised controlled trial on the effect of CBT on hyperacusis. 30 patients were randomly assigned to the CBT group and 32 patients were assigned to a waiting list group. Patients in the CBT group received six sessions of CBT delivered by qualified psychologists and patients in the waiting list group received no intervention beyond the assessment of their baseline measures and randomisation. Overall the scores on the Hyperacusis Questionnaires [45] and the average uncomfortable loudness levels (ULLs) in both groups improved significantly. However, there was statistically significant difference between groups in favour of the patients in the CBT group. The effect size of CBT on ULLs was 0.67 and the effect size of CBT on Hyperacusis Questionnaire was 1.13, which are promising.

The limitation of this study is that the patients in the control group were assigned to a waiting list and no active treatment was offered to them. Therefore, it is difficult to work out whether any outcome in the CBT group is due to the target intervention or due to the psychological effect of being treated in some way [46]. This can lead to observation of exaggerated effect for the target intervention. In addition, as most hyperacusis patients are seen at audiology/ENT clinics, future studies should examine whether CBT can be delivered by audiologists with high fidelity to cognitive theory and CBT protocol. The amount of training that audiologists may require in order to achieve appropriate level of competency to conduct CBT should be investigated.

In the section below the clinical implementation of CBT for hyperacusis management is discussed.

*Clinical implementation of CBT for hyperacusis*

*General Components of CBT*

Cognitive behavioural therapy doesn't have a set treatment protocol and clinicians differ in how they formulate their therapy. Nevertheless, all cognitive behavioural therapies share a core set of principles that distinguish them from other therapeutic approaches [47]. The approach is collaborative with a strong emphasis on the clinician and patient working on a problem together. Therapy attempts to test reality through 'collaborative empiricism', whereby the clinician and patient work together to test a range of hypotheses. Throughout, the principle of 'guided discovery' is employed, in that the patient makes discoveries with careful questioning from the clinician rather than the clinician pointing out maladaptive behaviour or

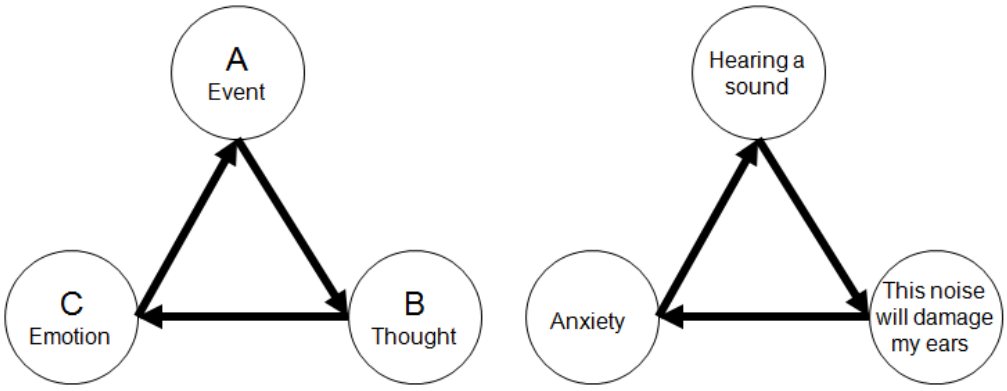


**Fig. 1. ABC model for hyperacusis.**

errors in thinking.

Several techniques and interventional approaches have been used in CBT. These include education, cognitive restructuring (changing people's mistaken beliefs), applied relaxation, positive imagery, experiments in changing behaviour, and exercises to control attention. The CBT program discussed in this paper is consistent with the protocol suggested by Beck for management of emotional disorders [34]. Generally CBT can be completed in a range of 5 to 20 sessions. In more severe cases treatment may need to extend beyond 20 sessions. CBT sessions are structured, time-limited and focused on a specific problem. Homework will be given to be completed between the sessions in order to reinforce learning of CBT concepts [48].

A general therapeutic program for hyperacusis may be formulated in terms of the following steps: a) educating the patient about the auditory system, b) introducing CBT and assessing the patient's motivation and attitude toward the therapy, c) helping the patient to identify their thoughts and emotions in response to sound, d) helping the patient to identify their rules of life and core beliefs, e) educating patients about common errors of judgment or distortions in thoughts, f) helping the patient to challenge their unhelpful thoughts and create counter statements, and g) behavioural desensitization. Below we discuss each step in more detail.

*a) Educating patients about the auditory system*

The aim of this section is to acknowledge patient's condition and affirm that their hyperacusis is real but not necessarily related to damage in their ears or brain. This is achieved through providing patients with explanations of 1) the outcome of their audiological and otological investigations, 2) the underlying cause of their hearing impairment (if there is one), 3) use of earplugs (i.e. hearing protection devices should only be used where recommended by the health and safety guidelines), 4) the role of the auditory pathways in loudness perception and finally 5) the enhanced perception of emotionally significant stimuli in the brain.

In most cases with hyperacusis, there is no demonstrable organic disease or physiological abnormality. Despite this, many patients with hyperacusis may believe that they suffer from some form of ear or brain damage. Patient's incorrect conception of an organic disease may be rectified through an educational session as described above.

*b) Introducing CBT and assessing the patient's motivation and attitude toward therapy*

In this session, the patient will be provided with an overview of the ABC model of human mental disturbance, in which A represents activating events, B underlying thoughts, and C emotional and behavioural consequences [34]. Fig 1, illustrates the relevance of the ABC model to hyperacusis. At this stage, the points

**Table 2. Example of the diary of thoughts and feelings**

| Event | Thought | Feeling |
|---|---|---|
| Meet up with a group of friends and their babies –same ages as my children –on Monday this week. | Can't face it –too much going on with all the children. I will be even less tolerant of the noise other people's children make! I'm being a wimp and missing an opportunity. | Disappointed, sad |
| Travelling on a noisy aeroplane to attend an international business meeting. | The persistently loud noise is going to make me irritable. I should adapt my lifestyle more in keeping with my hyperacusis. I should not have taken jobs which involve too much flying. | Anxiety, guilty |

which need to be made to the patient include: 1) their adverse emotional reaction to sound leads to enhanced perception of the sound or hyperacusis, and 2) the reason for their adverse emotional reaction is not the environmental noises but is the result of their interpretations of that sound and subsequent heightened attention. The patient will be asked in detail about distressing situations and several ABC formulations will be drawn out. This will help to socialize the patient to the cognitive-behavioural model, build motivation for change and help the patient decide whether CBT would be beneficial for them or not.

*c) Helping patient to identify their thoughts and emotions in response to sound*

The aim of this section is to enable patients to identify their thoughts and feelings in relation to sound based on the ABC model. This can be achieved through in-depth interviews with the patient during therapy sessions. In addition, patients can be encouraged to complete a diary between the sessions in order to keep a record of noise-related events, their thoughts as well as their corresponding emotional reaction. See Table 2 for an example of a diary for 2 patients.

*d) Helping patient to identify their rules of life and core belief*

According to Beck [34] there are three layers of cognitions: automatic thoughts, rules of life, and the core beliefs. Fig 2, illustrates the relevance of cognition levels to hyperacusis. It is the automatic thought that links directly to the patient's emotional reaction. They spontaneously arise, without any prior reasoning, and flow rapidly through the person's mind [48]. In people who suffer from anxiety, depression and other psychological disorders automatic thoughts could become distorted [48]. Cognitive distortions are systematic errors in logic derived from maladaptive attitudes or rules of life [34,48,49]. During the course of cognitive development individuals create various rules of life in order to regulate their emotions and behaviour. Rules of life are tied to an individual's core belief. Core beliefs are the deepest level of cognition and the most basic assumption about our identity, which are formed in childhood [48]. Core beliefs are created based on the child's interpretation of their life events. Early life experiences lead to the development of positive (e.g. "I am good", "I am worthy") and negative core beliefs (e.g. "I am unlovable", "I am incompetent") [48]. Although some core beliefs appear dysfunctional and negative, they may have been adaptive for children during their early years when managing a negative or hostile environment. However, taken outside of this environment, these core beliefs become maladaptive and lead to the dysfunctional application of rules for living and consequent maladaptive behaviours [50]. Positive core beliefs can allow flexible application of rules of life and may be more likely lead to a more realistic appraisal of threat [51]. Some of the common dysfunctional rules listed by Beck are: "I should never feel hurt. I should always be happy and serene. To be happy I must be accepted, liked, admired by all people at all times. If I am not on top, I am a flop. My value as a person depends on what others think of me. I should always be spontaneous. I should always

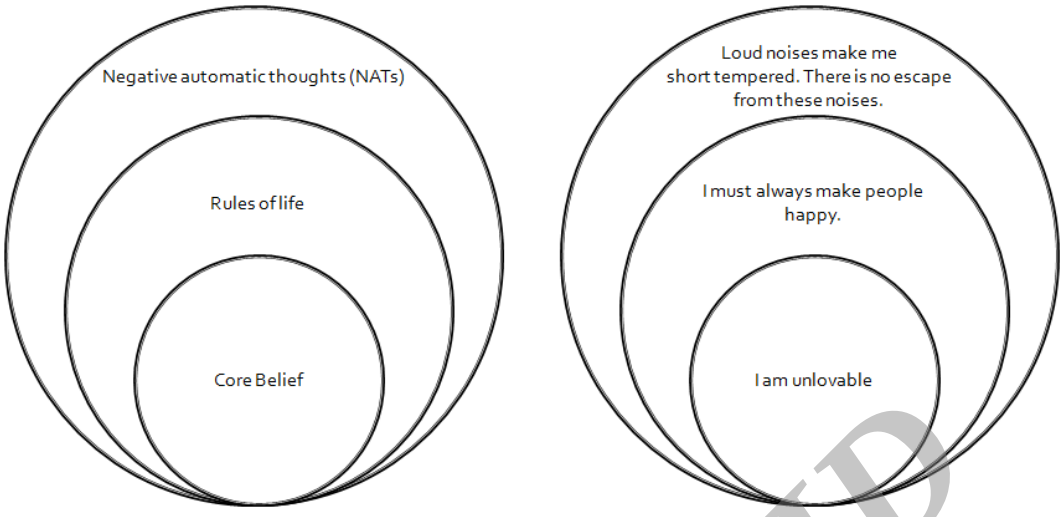


**Fig. 2. Levels of cognitions and their relevance to development of hyperacusis.**

control my feelings. I should never be tired or get sick. I should assert myself. I should never hurt anybody else. I should always be at peak efficiency. If I make a mistake, it means that I'm inept. I should be a perfect lover, friend, parent, teacher, student, and spouse" (1976, p. 255 and 257). As shown in Table 3, when automatic thought about the environmental noises violates the rules of life it could cause adverse emotional reaction.

*e) Educating the patient about common errors of judgment or distortions in thoughts*

The aim of this section is to teach patients the skills needed to assess the validity of their thoughts. This can be achieved through giving a presentation about the characteristics of automatic thoughts and their common distortions. Automatic thoughts arise with little awareness as to why they arise; they are perceived as strong effects that are not under direct control [34,52]. Beck suggested that human emotional disturbances are related to a number of distortions in automatic thoughts [34]. These include arbitrary inference (drawing conclusions without enough evidence), selective abstraction (taking things out of context and focusing on negative experiences), overgeneralization (drawing broad conclusions from a limited amount of information), magnification (exaggerating the importance of negative events), minimization (rejecting the importance of desirable qualities and positive experiences), personalization (self-blame even if the person was not at fault), and dichotomous thinking (all or nothing thinking) [34].

*f) Challenging unhelpful thoughts and creating counter statements*

The therapist should encourage the patient to look for any errors of judgment in the thoughts identified in their diary. Therapists should use skilful questioning to elicit doubt in relation to negative thoughts and analyse them to uncover distorted and erroneous assumptions in their interpretation of life events [34]. Together with their clinician, the patient should consider the validity of their beliefs and whether they are consistent with their life experiences. Finally the therapist should help the patient to create counter statements for their negative thoughts. Counter statements should be simple, easily remembered, believable, in the patient's own words, an alternative to the negative thought, and used immediately after the troublesome thought goes through their mind [52]. The patient's responsibility is to suggest the counter statements and the therapist should make

**Table 3. Examples of emotional reactions to environmental sounds, corresponding automatic thoughts and underlying rules of life. Rules of life are adapted from Beck (34)**

| Emotional reaction to sound | Automatic thought | Rules of life |
|---|---|---|
| **Fear** | Noises hurt my ears. | "I should never feel hurt." |
| **Depression** | Listening to loud noises make me short tempered and I become angry with others. People will get fed up with me. | "To be happy I must be accepted, liked, admired by all people at all times." |
| **Angry** | Noises interrupt my sleep at nights, hence I feel tired. | "I should never be tired or get sick." |
| **Anxiety** | Noises affect on my concentration. | "If I make a mistake, it means that I'm inept." |
| **Fear** | Loud noises make me feel angry and I may hurt people. | "I should never hurt anybody else." |

sure that they meet the criteria described above. Negative thoughts and dysfunctional rules of life also can be challenged through empirical demonstration [34]. The patient can be instructed to write down the likelihood of their thoughts to be true. They should rank the likelihood of their predictions (e.g. "noises take half of my hearing capacity away") on a scale from 0 to 10. Nil would be very unlikely and 10 would be highly likely. Then the therapist and patient should set up activities to give the patient an opportunity to reappraise the validity of their thoughts through real life experiences. During each activity the patient should gather empirical evidence regarding the possible errors of judgment in their thoughts (e.g. overgeneralization, all or nothing thinking etc.). Then they would need to use this evidence in order to contradict their self-defeating predictions. This technique of identifying, testing, and challenging negative thoughts, rules of life and core belief can be applied within the therapy sessions or through the homework assignments.

Generally, the activities should start from relatively easy tasks (e.g. meeting with couple of friends and their children in a less noisy place) to more difficult ones at a later stage (e.g. attending larger groups).

*g) Behavioural desensitization*

There are various methods in behaviour therapy such as systematic desensitization, response prevention, exposure training, flooding, and thought stopping which are designed in order to reduce the anxiety response to feared stimuli. In this paper we focus on systematic desensitization [53], which has been one of the most widely used methods in behaviour therapy. Desensitization procedure is based on the principle of counter-conditioning and consists of producing a hierarchy of situations relevant to the patient's presenting fear and helping the patient to replace their negative emotions aroused by a specific stimulus (e.g. anxiety aroused by loud noises) with a state of relaxation [53]. The hierarchy starts from weak to progressively stronger anxiety producing situations. Prior to the procedure, the therapist teaches the patient relaxation techniques, such as progressive muscle relaxation, visualization, and deep breathing. For a patient with hyperacusis, the first step is to imagine exposure to relatively quiet noises. Patient should report how they feel in reaction to the imaged situation. If they feel anxious, the therapist will help them to apply relaxation techniques. When they feel comfortable with this situation and no longer present with anxiety, they move on to the next stage in the hierarchy. In the subsequent steps they would imagine increasingly noisier and louder situations. When the patient becomes anxious, relaxation is applied in order to neutralize the arousing stimuli. At each step in the progression, the patient is desensitized to the noises through the use of the relaxation

techniques. This way, the original conditional response (e.g. anxiety) to a specific stimulus (e.g. loud noise) is extinguished by reinforcing a competing response (e.g. relaxation) to it. The therapist may also encourage the patient to listen to the disliked or feared sounds and practice relaxation whenever the patient feels anxious.

Another way of creating a gradual exposure to noise is through fitting wideband noise generators (WNGs). The WNGs are assumed to facilitate the therapy by desensitising the auditory system [28]. There are several research studies in the literature supporting the effectiveness of WNGs in temporarily improving sound tolerance [10,54]. Use of WNG's enables the patient to engage in real life activities and attend the noisy places. This gives them an opportunity to test the validity of their negative thoughts. Once the patient modifies their negative ideas about noise and produces less emotional reaction to sound, they can gradually reduce the use of WNG's.

Beck described that techniques of behavioural therapy may be used as a subset of cognitive therapy to enhance the treatment [34]. He argued "Desensitization is effective because it provides a practice session in which the patient is able to experience his reactions to the feared situation, label them inappropriate, and gain some inner conviction that his basic fear is irrational" (Beck 1976, p. 328). Wells [55] suggested that any behavioural exposure should follow four steps to allow maximum changes in people's beliefs: 1) prepare the patient prior to exposure by identifying dysfunctional cognitions and verbally questioning them, 2) exposing the patient to the feared situation, 3) testing the identified thought during exposure, and 4) asking the patient to summarise their learning and any alternative belief they have discovered.

## Conclusion

There is a growing body of evidence suggesting a possible link between hyperacusis and anxiety. As CBT seems to be effective in management of anxiety disorders, it is reasonable to suggest that CBT could be a beneficial intervention for people experiencing hyperacusis.

In this paper we reviewed various CBT techniques that could be applied in the process of rehabilitation for hyperacusis. However, the evidence-base for the effect of CBT on hyperacusis is limited and there is a need for more randomised controlled trials. Future studies should examine whether CBT can be delivered by audiologists and explore the amount of training that audiologists may require in order to achieve appropriate level of competency to conduct CBT.

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