Anxiety reaction in children during removal of their plaster cast with a saw

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We have had experience of an 18-month-old boy with a cardiomyopathy who died a few minutes after removal of his cast with a saw, apparently from a malignant cardiac arrhythmia triggered by anxiety. We therefore examined the anxiety reaction to this method of removal of a plaster cast in 20 healthy children; ten were provided with hearing protectors and ten were not. The level of anxiety was assessed by measuring the heart rate, a known physiological indicator of anxiety, before, during and five minutes after removal of the cast. The noise level was also measured. The results showed a mean increase in heart rate during the procedure of 27.9 beats per minute (bpm) (26.9%) in the children with no hearing protectors and 10.4 bpm (11.1%) in children who used hearing protectors ($p < 0.001$). Five minutes after the procedure the heart rate had returned to the baseline rate in all patients.

We recommend that hearing protectors should be used in children undergoing removal of a plaster cast to decrease the anxiety reaction. If possible, clinicians should avoid the use of a saw for this purpose in children with a cardiomyopathy.

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The removal of a plaster cast with a saw is accompanied by a fluctuating level of high-frequency noise which may be associated with an anxiety reaction in children.¹ Signs and symptoms of anxiety include tachycardia, transient increase in blood pressure, increased respiratory rate, increased perspiration, and tremor.²

We recently treated an 18-month-old child with a cardiomyopathy and no previous arrhythmias or a prolonged QT segment on the ECG, who underwent posteromedial release to correct a clubfoot deformity. After operation he was treated by serial plaster casts for three months. On removal of the last cast with a plaster saw, he was frightened and cried. After a few minutes, he collapsed and died. No post-mortem was performed because the parents refused permission on religious grounds. Israeli law requires the consent of both parents for the post-mortem examination of children. This prompted us to review the literature on children's reactions to removal of plaster casts with a saw. We were able to find only one subjective study addressing this issue.¹ We have therefore assessed the anxiety reaction to the noise of the saw during removal of such casts in children, and evaluated the usefulness of hearing protectors in reducing this reaction.

Patients and Methods

We studied 20 healthy children aged from five to six years who had a fracture of the forearm and had been treated conservatively by a plaster cast to above the elbow. Based on studies showing that anxiety is associated with an increased heart rate,² we assessed the anxiety reaction to the fluctuating noise of the saw by recording the heart rate with an electrocardiograph before, during and five minutes after removal of the cast.

The children were divided into two groups: ten were given hearing protectors (Viking No. 2421; Bilson, Bill-esholm, Sweden) during the procedure and ten were not. The mean heart rate of the two groups was compared.

The plaster casts were removed with an electric plaster saw (Aesculap GP 104, Tuttlingen, Germany). The noise level of the saw was recorded by a dosimeter (Quest Electronics Model M27/M28; Quest Electronics, Wisconsin). After calibration, a microphone was positioned near the child's ear, and the overall and peak sound levels during

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Table I. Heart rate (bpm) before, during and after removal of plaster cast in ten children with hearing protectors and ten without

Age (yr/mth)	Before removal	During removal	After removal	Increase in heart rate* (%)
Hearing protectors				
5 10	101	117	108	15.84
5 1	88	95	106	7.95
5 5	91	98	88	7.69
5 9	96	114	96	18.75
5 8	96	107	90	11.46
5 4	87	95	90	9.19
5 9	90	99	92	10.00
5 2	88	96	91	9.09
6 8	92	100	96	8.70
4 9	97	109	98	12.37
Mean				
5.5	92.6	103	95.5	11.10
No hearing protectors				
6 1	113	138	114	22.12
4 9	105	158	132	50.48
6	100	110	108	10.00
4 7	120	148	131	23.33
6	108	128	100	18.52
5 9	91	127	113	39.56
5 6	96	131	100	36.46
4 9	105	136	110	29.52
5 5	97	121	100	24.74
5 7	101	118	102	16.83
Mean				
5.4	103.6	131.5	111	26.9

* during removal of plaster cast

removal of the plaster cast were obtained. In children using hearing protectors, the microphone was placed inside the muff, at the external auditory canal.

The data were recorded in a 'Microsoft Excel' file and submitted for independent statistical analysis using Student's *t*-test for paired data.

Before removal of the cast the children and parents were given a full explanation of the use of the saw. Parents stayed near their children during the procedure in all cases.

Results

Noise measurements from the saw, taken at approximately 5 cm from the ear, showed that during removal of the plaster casts, levels ranged from 98.5 to 112 dBA which is equivalent to an extremely loud shout, with a peak of 114 dBA. In the children wearing hearing protectors which seal the area around the ear, measurements performed with the microphone inside the external auditory canal showed levels of 68 to 72 dBA, with a peak of 88 dBA.

The measurements of heart rate in the two groups are shown in Table I. The mean heart rate in the children who did not use hearing protectors was 103.6 beats/minute (bpm) (91 to 120) before removal of the cast and 131.5 bpm (110 to 158) during the procedure, a mean increase of 27.9 bpm or 26.9% (10 to 50). In children who used hearing protectors, the corresponding rates were 92.6 bpm

(87 to 101) and 103 bpm (95 to 117), with a mean increase of 10.4 bpm or 11.1% (7.6 to 18.7). In both groups the heart rate returned to the baseline rate five minutes after removal of the cast. These data showed a significant difference in the increase in heart rate between the two groups ($p < 0.001$).

There was no evidence of cardiac abnormality or arrhythmia on any of the ECGs.

Discussion

Sound levels above 85 dBA are considered to be loud. Our findings have shown that during removal of the plaster cast, the level rose to 112 dBA in the unprotected children. The heart rate increased during the procedure in both groups. The increase was significantly less ($p < 0.001$), however, in children provided with hearing protectors. Studies have shown that anxiety is accompanied by an increase in heart rate.² The noise of the saw frightens children and is associated with an anxiety reaction.¹ We believe that the anxiety shown during removal of the plaster cast in our study was mainly attributable to the noise of the saw, although other factors, such as damage to the skin or the heat generated by the saw blade, may have contributed.

Anxiety causes increased sympathetic activity, which increases conduction velocity and decreases refractory periods throughout the heart.³ Arrhythmias are more easily induced with high sympathetic activity.³ In patients with

impaired cardiac output, mainly in those with dilated or hypertrophic obstructive cardiomyopathy, physical or emotional stress which increases the sympathetic activity may cause arrhythmias and/or decrease the cardiac output.⁴ We believe that this may have occurred in the patient with a dilated cardiomyopathy who died a few minutes after removal of the plaster cast. Based on our study we would suggest that in children who suffer from severe cardiomyopathy with significantly low cardiac output, or from malignant arrhythmias, removal of a plaster cast should be performed if possible without using a saw. To facilitate the removal of the cast, we suggest making a groove in the plaster during its application. If a saw is required, the procedure should be medically supervised and carried out in a room suitably equipped for the management of complications.

In conclusion, we recommend the use of hearing protectors during the removal of plaster casts in all children, decreasing the associated anxiety reaction. Clinicians may also make use of the new 'quiet' saws.

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