LETTERS TO THE EDITOR

IMPULSE NOISE

SIR—Dr. K. Hedges (Hedges 1977), commenting on Major Moore's excellent article in this Journal on impulse noise and hearing loss (Moore 1976), gives a summary of ACGIH guidelines on threshold limit values in terms of peak pressure levels. As we read them, these guidelines indicate that peak pressure in excess of 140 dB should not be permitted for unprotected hearing. However, the ACGIH Standards appear to refer to industrial impulse noise (from such sources as drop forges), rather than to gunfire where duration is very much less.

Measurement of noise for hearing conservation is considered in detail by British Standard 5330:1976. The use of conventional sound lever meters is considered unsuitable for irregularly fluctuating or impulse noise. However, the use of an energy integrating meter is recommended for peak levels up to 150 dB; this would include most industrial impulse noise but not gunfire noise. In this context, the use of an (A weighted) energy integration method is much to be preferred to a measurement of peak pressure which takes no account of impulse duration.

Measurement and evaluation of gunfire and similar impulse noise has also been the subject of a considerable amount of recent research. Because of the very high pressures and short durations encountered with gunfire noise, conventional noise measuring equipment is inadequate. Instead, microphones or pressure transducers specifically designed for use at high pressures, and having a very wide frequency response are employed, together with recording equipment (such as oscilloscope) which displays instantaneous pressure at a function of time. Measured using such equipment, the 7.62 mm L.I.A.I. rifle gives a peak pressure at the firer's ear of 161 dB, with an 'A' duration (i.e. time between zero crossings on the main pulse) of 0.33 ms, and a 'B' (overall) duration of 5 ms (Croton 1971). Peak pressures from mortars, howitzers and infantry anti-armour weapons may easily exceed 180 dB (3 psi approximately) with 'B' durations between 10 and 40 ms.

A number of criteria have been formulated relating peak pressure, duration, number of rounds and risk of hearing loss; two of the best known are due to Coles, Garinther, Hodge and Rice (1968), and Ward (1968). The latter requires a very conservative limit on potential hearing loss and the permitted exposures are correspondingly low. Using such criteria, the risk of hearing loss associated with any source of gunfire or similar noise can be evaluated from physical measurements of the noise. These criteria were based originally on measurements of temporary hearing threshold shifts (TTS's), and measurement of TTS under very carefully controlled conditions still forms an alternative method of noise hazard evaluation. Use of suitable forms of energy integrating meter can also give results in good agreement with measurements of peak pressure and duration.

At present there is no definite standard whereby gunfire noise exposures in the British Army can be judged as being acceptable or unacceptable, although the criterion described by Coles et al (1968) is generally used as a guide. The United States (U.S.) Army does have a definite standard (U.S. MIL-STD-1474A(M1)) which specifies maximum permissible noise levels, together with methods of measurement, for military equipment. Such a standard could be an invaluable aid to hearing

conservation. Unfortunately, many items of equipment, including some of U.S. origin, fail to meet, admittedly stringent, impulse noise requirements of this standard, even where the use of hearing protection is assumed.

Use of hearing protection—ear plugs, ear muffs or noise-excluding helmets such as the A.F.V. Crewman's Helmet—gives an attenuation equivalent to a reduction in peak pressure of 20-25 dB (Forrest 1976). This is sufficient to protect hearing adequately in the great majority of cases—provided that the protection is properly fitted and carefully used on all occasions of exposure, which it frequently is not!

We are, etc.

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REFERENCES

BRITISH STANDARDS INSTITUTION (1976). Method of test for estimating the risk of hearing handicap due to noise exposure. B.S. 5330:1976.

COLES, R. R. A., GARINTHER, G. R., HODGE, D. C. and RICE, C. G. (1968). *J. acoust. Soc. Amer.* **43,** 336-343.

CROTON, L M. (1971). *J. roy. Army med. Cps.* **117,** 9-15.

DEPARTMENT OF DEFENCE (1975). Noise limits for Army material. MIL-STD-1474A(M1). Washington, D.C.

FORREST, M. R. (1976). Paper 'Protecting the soldier's hearing' presented at the 1976 Annual Conference of the Ergonomics Society.

HEDGES, K. M. (1977). *J. roy. Army med. Cps.* **123,** 53.

WARD, W. D. (1968). Ed. NAS-NRC Committee on Hearing, Bioacoustics and Biomechanics (CHABA). Report of Working Group 57.

HYPOKALAEMIA DURING THE TREATMENT OF DIABETIC KETOACIDOSIS

SIR—I read with interest Major Johnston's and Colonel Crook's paper on the treatment of ketoacidosis in the January number (*J. roy. Army med. Cps.* 1977. **123,** 32-36).

I was surprised to see the small amounts of potassium used in their cases, and that two out of the seven cases developed hypokalaemia. Although hypokalaemia is less likely with small doses of insulin (Alberti, Hockaday and Turner 1973, Alberti 1974), it is still a definite risk during the treatment of ketoacidosis.

In this study, the mean plasma glucose was 524 mg/100 ml with a mean plasma potassium of 5.3 mEq/1 and a mean potassium replacement of 30 mEq in 24 hours. In Alberti, Hockaday and Turner (1973) study, mean plasma glucose was slightly higher at 626 mg/100 ml, mean potassium slightly lower at 4.5 mEq/1 and the

mean potassium replacement was 163 mEq in the first 24 hours, with a range of 85 to 284 mEq/24 hours. Intravenous potassium was usually started with the first insulin injection and given at the rate of 14 mEq/hour over the first 6 hours (i.e. a total of 72 mEq in 6 hours). On this regime only one patient's plasma potassium fell below normal limits, from an initial 3.7 mEq/1 to 3.2 mEq/1 after 3 hours.

Similar studies with low dose insulin by continuous intravenous infusion have shown that large amounts of intravenous potassium are required. Page et al (1974) used a mean of 89 mEq in the first 12 hours. Out of 38 patients, two were hypokalaemic on admission and two developed hypokalaemia during treatment. Semple, White and Manderson (1974) used a mean of 122 mEq in the first 24 hours and had one case of hypokalaemia out of 13 patients.

It would seem from these articles that intensive potassium replacement is extremely important in the prevention of hypokalaemia during the treatment of ketoacidosis.

The fundamental importance of Alberti's regime is that within a narrow range, dependent upon specified criteria, the insulin dosage and potassium replacement are fixed while still allowing flexibility of fluid replacement and supportive therapy.

I am, etc.,

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REFERENCES

ALBERTI, K. G. M. M., HOCKADAY, T. D. R. and TURNER, R. C. (1973). *Lancet* **ii**, 515-522.

ALBERTI, K. G. M. M. (1974). 10th Symposium on Advanced Medicine. Ed. J. G. G. Ledingham. Pitman Medical, London. p. 68

PAGE, M. McB., ALBERTI, K. G. M. M., GREENWOOD, R., GUMAA, K. A., HOCKADAY, T. D. R., LOWY, C., NABARRO, J. D. N., PYKE, D. A., SONKSEN, P. H., WATKINS, P. J. and WEST, T. E. T. (1974). *Brit. med. J.* **ii**, 687-690.

SEMPLE, P. R., WHITE, C. and MANDERSON, W. G. (1974). *Brit. med. J.* **ii**, 694-698.

Relevant Literature

CLUMECK, M., DE TROYER, A., NAEIJE, R., SOMERS, G., SMEKENS, L. and BALASSE, E. O. (1976). *Brit. med. J.* **ii**, 394-396.

HOCKADAY, T D. R. and ALBERTI, K. G. M. M. (1972). *Brit. J. Hosp. Med.* **7**, 183-198

LEADING ARTICLE (1977) *Brit. med. J.* **i**, 405-406.

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