Aseptic bone necrosis in commercial divers
WHAT IS UEG?

UEG is the research and information group for the underwater and offshore engineering industries. Its main function is to provide a means of cooperation between its members, including government, in solving common technical problems, obtaining and sharing information and in providing an industry-based focus for research.

UEG is non profit making and its financial base is provided by the annual subscriptions of its members. Additional finance for individual projects is obtained from industrial and government organisations interested in any of the specific project areas.

Membership of the Group is open to any organisation with an interest or involvement in underwater or offshore engineering. Each member's subscription is set in relation to their size and involvement in underwater or offshore engineering.

To ensure its industrial relevance, UEG's programme is defined and selected by a number of committees through which member representatives are able to put forward their future research needs. Currently four Working Groups advise the UEG staff on research requirements in the following areas: Diving and Man Under Water; Offshore Structures; Underwater Engineering; and Maintenance of Offshore Installations.

The UEG Committee determines the Group's policy and overall programme, and authorises expenditure on individual projects. The Committee is responsible to the Council of UEG's parent organisation CIRIA (the Construction Industry Research and Information Association) and operates within limits set by the Council.

UEG projects are managed by the full-time staff and industrial involvement is provided by Steering Groups with membership drawn from the relevant sector of the offshore industry.

UEG implements its projects by placing contracts with those best able to undertake the work, and has no laboratory facilities of its own. By avoiding the constraints and long-term commitment of specialised staff and laboratories, the Group offers the flexibility of operation required to undertake research work associated with the changing needs of the offshore industry.

The results of all UEG projects are published in reports which are issued free of charge to members. Selected reports are later sold at a very much higher price to non-members. The proceeds of additional sales are used to assist in financing the future research programme.

In addition to contact with its members, UEG maintains links with many other research and technical organisations concerned with offshore and underwater engineering. It is the official channel for the release to industry of the Royal Navy Diving Tables and other related information.

The activities of UEG are outlined in the UEG Annual Report available free of charge from the address below.

Requests for further information about UEG, including enquiries about membership, should be sent to the Manager, UEG, 6 Storey's Gate, Westminster, London SW1 P 3AU.
ASEPTIC BONE NECROSIS IN COMMERCIAL DIVERS

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FOREWORD

This Report has been prepared by the Decompression Sickness Central Registry and its Radiological Panel.

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- Dr J K Davidson
- Dr P D Griffiths
- Surgeon Vice-Admiral J A B Harrison, QHP
- Dr P Jacobs
- Dr C K Warrick CBE

The data on which the report is based stems from the use of the standard forms for the medical examination of commercial divers which have been supplied to the Registry by UEG since 1972. The report is therefore published by UEG as a part of its continuing activities concerned with diving safety. The UEG Research Manager responsible for its production was Mr R W Barrett.

ACKNOWLEDGEMENT

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<table>
<thead>
<tr>
<th>Glossary Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aseptic</td>
<td>Not due to infection</td>
</tr>
<tr>
<td>Bone Islands</td>
<td>An oval or circular dense area with a well defined margin usually measuring 2 to 3mm at the widest point seen on the radiograph of a bone</td>
</tr>
<tr>
<td>Bone Scintigraphy</td>
<td>The study of bone based on its ability to incorporate radioactive isotopes</td>
</tr>
<tr>
<td>Cyst</td>
<td>A cavity enclosed by a membrane often containing fluid</td>
</tr>
<tr>
<td>Distal</td>
<td>Distant with reference to the body trunk</td>
</tr>
<tr>
<td>Femur</td>
<td>Leg bone from hip to knee</td>
</tr>
<tr>
<td>Head, Neck and Shaft (HNS) Lesions</td>
<td>Lesions which occur at a distance from a joint surface, often in the shaft of a bone</td>
</tr>
<tr>
<td>Head (of femur or humerus)</td>
<td>The end of the bone nearer to the body trunk</td>
</tr>
<tr>
<td>Histology</td>
<td>The structure of tissue as seen under the microscope</td>
</tr>
<tr>
<td>Humerus</td>
<td>Arm bone from shoulder to elbow</td>
</tr>
<tr>
<td>Incidence</td>
<td>That proportion of a group at risk developing a condition within a specified period</td>
</tr>
<tr>
<td>Juxta-articular (JA) Lesions</td>
<td>Lesions which occur in the head of the humerus or femur close to the joint surface</td>
</tr>
<tr>
<td>Lesion</td>
<td>A localised area of aseptic necrosis of bone, usually identified on a radiograph</td>
</tr>
<tr>
<td>Necrosis</td>
<td>The death of tissue</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>Degenerative disease of the joints causing pain and limitation of movement</td>
</tr>
<tr>
<td>Packed Cell Volume (PCV)</td>
<td>Volume of cellular constituents of blood expressed as a percentage of total volume. An indicator of the oxygen-carrying capacity of the blood.</td>
</tr>
<tr>
<td>Pathology</td>
<td>The study of the causes of and changes produced in the body by disease</td>
</tr>
<tr>
<td>Prevalence</td>
<td>That proportion of a defined group having a condition at a specified time</td>
</tr>
<tr>
<td>Proximal</td>
<td>Close with reference to the body trunk</td>
</tr>
<tr>
<td>Radiograph</td>
<td>A photographic negative resulting from the passage of X-rays through the tissues</td>
</tr>
<tr>
<td>Radiology</td>
<td>The production and assessment of radiographs</td>
</tr>
<tr>
<td>Skeletal survey</td>
<td>One set of eight radiographs of the shoulders, hips and knees</td>
</tr>
<tr>
<td>Tibia</td>
<td>Leg bone from knee to ankle</td>
</tr>
</tbody>
</table>
1. **INTRODUCTION**

Aseptic necrosis of bone is a long-term complication of diving or working in compressed air. Its onset is insidious and as bone lesions do not give rise to symptoms in their early stages, or in most cases at any stage, it is necessary to examine radiologically those at risk. If radiological examination is not routinely carried out collapse of the joint surface adjacent to a symptomless lesion of the shoulder or hip may be the first indication to a man that there is a problem.

Bone necrosis in divers was first reported in 1941 from Germany, and since then there have been reports from many other countries including Norway, the United States of America, France, Italy, China and Poland, of individuals seeking treatment for painful joints.

Radiological surveys of the bones of small groups of symptomless divers have been reported from a number of countries and the proportion of men with bone lesions has varied from 23% to 65%. In 1974 Ohta and Matsunaga surveyed a group of 301 Japanese professional shell-fish divers and found the overall prevalence of bone lesions to be 50.5%.

Harrison investigated 383 divers of the British Royal Navy and found that 18 men had definite bone lesions; a prevalence of 4.7%. In a similar study undertaken in US Navy divers the overall rate for definite bone necrosis was found to be 1.7% (16 out of 934).

The skeletal survey, medical data and records of diving experience of divers have been collected in the Decompression Sickness Central Registry which was formed in 1966 at the University of Newcastle upon Tyne. Previous surveys of British professional divers whose records are held in the Registry have shown that the proportion of divers with definite bone lesions increased from 1.9% (35 divers out of 1830) in December 1975 to 2.6% (75 divers out of 2873) in March 1977.

2. **CENTRAL REGISTRY RECORDS**

The aims of the Registry include a study of the natural history of bone necrosis and an attempt to define the circumstances in which it occurs.

British Regulations require that commercial divers must be medically examined annually for their fitness to dive by doctors approved for this purpose by the Health and Safety Executive and the Secretary of State for Trade. Special forms for recording the information from this examination have been available since 1972 from UEG, a part of the Construction Industry Research and Information Association.

Two forms are used for each diver's annual medical examination. The first is a questionnaire completed by the diver and gives details of date and nature of training, type and frequency of diving experience and greatest depths attained. The second form, completed by the Approved Doctor, gives medical information including physical respiratory and cardiovascular measurements.