Osteoporosis is going to have a major impact on our clinical lives

Dr Fahim Khan, Dr Steven Cutts and Dr Rob Stevens

say investigations and treatments should be tailored to the individual patient's risk factors and co-morbidity.

It is tempting to suggest that we should use prophylactic measures against osterporosis.

The skeleton is the only part of the body to survive after death and, as a result, it may be tempting to think of bone as an inert tissue. Yet during the course of life bone is forever being cut away by osteoclastic cells and reassembled by osteoblasts. This process of continuous remodelling enables bone to grow and to survive repeated injury.

In engineering terms, our bones are heavily maintained. The adult skeleton is completely stripped down and reassembled every 10 years. Its metabolism is intimately linked to the endocrine system.

In the course of adult life, the strength and mineral content of bones gradually peak, plateau and then fall. For some patients, such changes may be seen as part of the normal ageing process. In others they represent full-blown diseases.

If the balance between the continuous processes of bone assembly by osteoblasts and bone destruction by osteoclasts breaks down at any time, the skeleton will either become pathologically dense, for example osteopetrosis, or too thin, as in osteoporosis.

Metabolic bone disease

In metabolic bone disease there is a failure of the normal processes of bone maintenance. When viewed on plain x-ray, this can have two possible appearances:

- Osteopaenic bone (less calcium) results from diseases such as osteoporosis, osteomalacia and hyperparathyroidism.
- Osteosclerotic bone (excess mineral content) results from conditions such as Paget's disease of the bone and osteopetrosis.

Note that plain x-rays are not the most accurate measure of bone mineral density. For example, if osteoporosis is noticeable on a plain film, the patient has already lost at least 30 per cent of bone mineral density.

Normal bone mineral density

Bone mass increases gradually during growth. By the age of 20 years it has reached 95 per cent of maximum and then gains an additional 5 per cent, reaching its peak at the age of 30 years.

Bone mineral density (BMD) then gradually decreases by about 0.3 per cent a year in men, and 0.5 per cent a year in women. When women reach the menopause the rate of bone loss may accelerate dramatically to two per cent or three per cent a year. This period of very rapid demineralisation lasts six to 10 years.

The rate of BMD loss in later life is the same for men and women, although women already have far more demineralisation than men by this stage.

Because the rate of demineralisation tends to be the same in everyone, the chances of any one patient developing dangerously low BMD depends in part on the peak bone mass in young adult life. Thus a young adult with a very high bone mass will take longer to reach the threshold for osteoporosis.

Surgical removal of the ovaries precipitates an early menopausal change in BMD.

Normal BMD is within 1 standard deviation of the mean. If the BMD is 1-2.5 standard deviations from the norm, the patient is osteopaenic.

If BMD is more than 2.5 standard deviations from the norm then the patient is osteoporotic. The T score is the number of standard deviations from the norm for that patient. Thus a high T score is a bad result.

The factors known to affect bone loss are listed in Box 1.

Box 1

Factors known to influence bone loss diseases

- Rheumatoid arthritis.
- Cushing's syndrome.
- Hyperthyroidism.

Body weight
- Anorexia, including anorexia nervosa

Drug therapy
- Glucocorticoids.
- Thyroxine.
- Heparin.
- Cytotoxic treatments such as cyclosporin.

Nutrition
- Low protein.
- Alcohol excess.
- Caffeine.

Sex hormones
- Early menopause.
- Postmenopause.
- Amenorrhoea over six months' duration.

Genetics
- Positive family history.
- Female gender.
- Afro-Caribbean race.

Lifestyle
- Inactivity.
- Cigarette smoking.
- Bed rest.

Osteoporosis

Osteoporosis is a systemic skeletal disease characterised by low bone mass and microarchitectural deterioration of bone tissue. It is by far the most common metabolic bone disease, and results in increased bone fragility and fracture risk.

Osteoporosis occurs over a lifetime. Hence, prevention of osteoporosis is lifelong, with treatment occurring later in the course of the disease.

The treatment of osteoporosis has become a major health care challenge. As individuals live longer, the goal is to make sure they have productive years free of the morbidity caused by osteoporosis.

Because of the ageing population, it has been predicted that the number of osteoporotic fractures worldwide will increase exponentially in the near future.[1]

Osteoporosis can be classified as primary or secondary. Primary disease is most commonly due to the post-menopausal state in women, and is generally caused by oestrogen deficiency. It is often associated with fractures of the vertebrae or distal forearm.

Age-related primary osteoporosis affects both men and women, and is due to the slower bone loss that occurs naturally. It is associated with fractures of the proximal femur.

Secondary osteoporosis accounts for about 20 per cent of cases in women and 40 per cent in men.

The causes include:
- endocrine - thyrotoxicosis, hyperparathyroidism, Cushing's syndrome, hypogonadism;
- gastrointestinal – malabsorption syndrome, primary biliary cirrhosis;
- rheumatological – rheumatoid arthritis, ankylosing spondylitis;
- malignancy – multiple myeloma, metastatic carcinoma;
- drugs – corticosteroids, heparin.

Many patients with osteoporosis present with pathological fractures placing a substantial financial burden on the State.

Investigations for osteoporosis

Dual energy x-ray absorptiometry (DEXA) is the gold standard test for osteoporosis. The radiation dose is just 1-3 mrem, compared with 20-50 mrem for a chest x-ray. A DEXA scan of the lumbar spine takes about five minutes.

Treatments for osteoporosis are often assessed by sequential DEXA scans.

Single photon absorptiometry (SXA) is a simpler, more limited investigation for osteoporosis.

Quantitative ultrasound (QUS) is a relatively new technique for measuring bone density.

It is safe, non-invasive and cheap. It is normally used on the heel.

Prevention of osteoporosis

Primary prevention aims to reduce the incidence of osteoporosis in the general population. Secondary prevention is aimed at individuals who are already known to be suffering from osteoporosis.

It is tempting to suggest that we should use prophylactic measures against osteoporosis in the entire population. This would involve millions of people receiving expensive treatments for years, decades even. Many would receive no benefit at all, and it is not clear whether any osteoporosis interventions would be cost-effective at general population level. In addition, compliance could well prove to be a problem.

Vitamin D, calcium and bisphosphonates have all been used as prophylaxis against osteoporosis. Oestrogens are effective in women.

A recent primary prevention study appears to have demonstrated a reduction in the risk of sustaining fractures when patients in the community are treated with oral vitamin D – potentially one of the simplest interventions.[2] The participants received vitamin D 100,000 IU every four months.

The cost of such a treatment is less than €1.50 a year - tiny in comparison with many other treatments and cheap enough to be potentially viable for the bulk of the population. However, the study also showed that it would be necessary to treat 250 people to avoid one fracture per year.

In many studies, vitamin D is given in combination with calcium supplements. However, most studies into the other treatments for osteoporosis are performed using a combination of calcium and vitamin D for both treatment and control groups.

Osteoporosis treatments

Treatment is generally the same whether or not the osteoporotic patient has previously suffered typical osteoporotic fractures.

The main purpose is to prevent further fractures by using therapies that increase the BMD. Generally, treatment should be given once osteoporosis has been diagnosed, ie