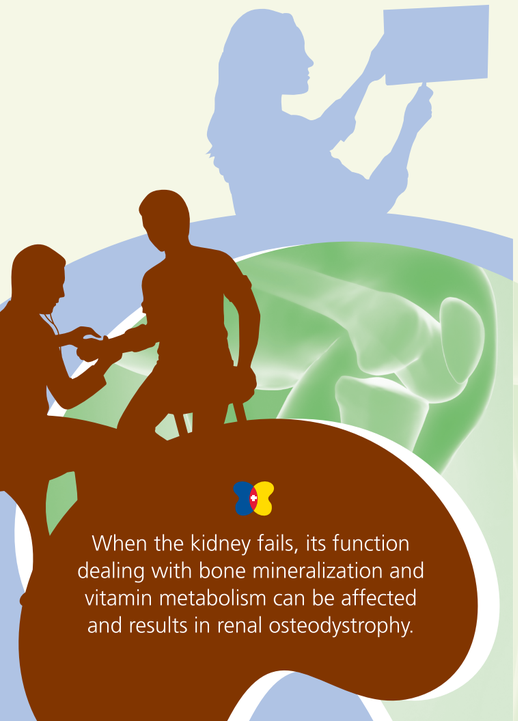
KDF
KIDNEY DIALYSIS FOUNDATION

BONE PROBLEMS IN END-STAGE RENAL FAILURE



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Bone Problems In End-Stage Renal Failure

When the kidney fails, its function dealing with bone mineralization and vitamin metabolism can be affected and result in renal osteodystrophy.

What is renal osteodystrophy?

Renal osteodystrophy is the sum of various bone related effects occurring in a patient with renal failure. There are specific factors relating to kidney failure as well as other factors present in the general population who do not have kidney failure such as aging.

What is osteoporosis?

Osteoporosis means porous bones or thinning of bones. This can be progressive and can lead to increase bone fragility and fractures. This process occurs in normal people as well as kidney failure patients.

Who is more susceptible to osteoporosis?

Bone density increases from birth through childhood and peak around mid 20s to early 30s. From the age of 30-50, bone density declines minimally. However, after the age of 50, in males the rate of bone loss is around 0.2-0.5% per year whereas in females, is around 3-5% per year. This rate of loss however slows down 5-8 years after menopause to 1-2% per year.

Many factors contribute to bone loss these include genetic, nutritional, environmental and hormonal factors. This condition is more common in the elderly and is associated with certain medical conditions such as end stage renal disease (ESRD), Cushing's syndrome, steroid therapy and long term heparin use.

Why do people with renal failure have increased risk of osteodystrophy?

Patients with ESRD have increased bone loss due to the following reasons:

a) Reduced active Vitamin D production from the kidneys

b) Reduced phosphate excretion

c) Increased bone breakdown with increased parathyroid hormone (PTH) levels

These processes are not present in normal people.

Normal healthy bone formation and maintenance requires the production of Vitamin D by the kidneys to maintain normal serum calcium levels. This is closely monitored in normal renal functions via a feedback mechanism through PTH, a hormone produced by the parathyroid glands situated behind the thyroid glands in the neck. When the serum calcium falls, the parathyroid glands are stimulated to produce PTH and this in turn act on the bones to release calcium so that the serum level can be normalized. While this is a good system for the short term, in ESRD, there is a constant deficiency of Vitamin D leading to reduced calcium levels. The parathyroid glands are being constantly stimulated in an attempt to maintain normal serum calcium level and as a consequence, calcium is perpetually being "stolen" from the bone.

Another stimulus to high PTH release is phosphate excretion. It is crucial to calcium metabolism. The normal kidney responds to high PTH levels by increasing the excretion of phosphate through the kidneys. Unfortunately, in ESRD, there are no "good" kidneys to attend to this "message" and the end result is that calcium is released from the bone instead. In this instance, it is therefore important that the phosphate levels be kept within acceptable range so that PTH is not stimulated.

How can we assess and monitor renal osteodystrophy?

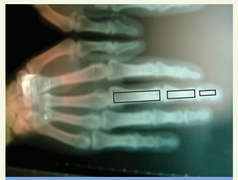
We can do it in the following ways:

a) Blood tests

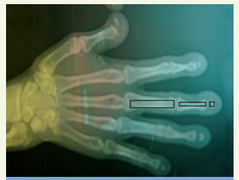
Regular testing of serum calcium, phosphate and alkaline phosphatase. Higher amounts of the enzyme alkaline phosphatase is formed from bones and released into the blood stream when the bones are stimulated by PTH to increase the rate of bone formation and breakdown. Based on the results, medications are adjusted.

b) Dual-energy X-ray absortiometry (DEXA) scan

This method gives an estimate of bone density in relation to the normal population. Measurements are taken from the vertebral bodies and femoral head. Serial measurement can be done to monitor progression of bone disease at a yearly or 2 yearly interval but is costly.



Normal Hand



Affected Hand with Bone Problem

c) X-Rays

X-ray are generally not good for monitoring bone diseases as they are only able to detect it in the later stage.

What is the consequence of poorly controlled bone disease?

In severe renal failure, the automatic control of serum calcium and phosphate is lost and therefore we rely on medication to normalize these levels and maintain bone density. This leads to:

a) Symptoms such as bone aches, joint pains and itch.

b) Fragile and thin bones. This predisposes to fractures with less trauma than normal bones.

c) The maintenance of normal bone structure and skeletal shape becomes deranged. The patient soon assumes a characteristic posture in time because of changes in shape in the spine and chest cage.

d) When serum calcium and phosphate level exceeds a certain level it will cause deposition of calcium in blood vessels or muscles. Calcification of blood vessels can lead to blockage of smaller blood vessels. The surgeons may find it difficult to get a successful arteriovenous fistula for dialysis because the blood vessels have been hardened or blocked by calcium.

How can it be prevented?

Renal osteodystrophy can be prevented in the following ways:

a) Keeping to strict dietary advice. This will help by reducing phosphate intake and reduce intake of phosphate binders.

b) Do regular weight bearing exercise to stimulate bone growth and maintain bone integrity.

c) Optimization of body weight.

d) Compliance with medication especially phosphate binders and vitamin D supplements.

Prevention is very important because once the parathyroid gland has been stimulated for some time, it becomes very difficult to treat even if the patient is compliant subsequently.

How can it be treated?

Every patient with renal failure will have some degree of bone disease at entry into dialysis. Treatment is aimed at minimizing and retarding the disease's process.

a) Vitamin D is frequently prescribed to supplement reduced production. This is usually given in the form of 1-alphacalcidol or calcitriol 2-3 times per week. However, this also encourages phosphate absorption in addition to calcium and aggravates the high phsophate level. So it is stopped when phosphate levels are high.

b) Phosphate binders e.g. Calcichew, Calcium Acetate and Alutab. Calcium containing phosphate binders bind phosphate present in food to form calcium phosphate, a compound which is subsequently excreted in the stools. The binders have to be taken with the meal otherwise there is no phosphate in the stomach or intestine to bind. Some patients dislike the taste of Calcichew and prefers Calcium Acetate which does not require chewing. By weight, Calcium Acetate contains less calcium and is more suited to patients who also have higher calcium levels with the use of calcium containing phophate binders. Both are just as effective. Alutab is also a very effective phosphate binder. However, it contains Aluminium and too much of it can prevent proper bone growth and cause bone thinning by a different mechanism from that previously discussed. Doctors seldom prescribe Alutab continuously and often limit its use to 2 to 4 weeks at a time when needing to stop calcium phosphate binders for a while because of high calcium levels.

c) Parathyroidectomy, the surgery to remove the parathyroid gland is needed when medical treatment has failed to suppress PTH production. As this is a more drastic measure needing hospitalization and general anaesthesia for the operation, only severe cases are sent for surgery.

Prevention is Better than Cure

It is far better to prevent bone disease than to try and treat bone disease when permanent changes have set in. We cannot remodel the skeletal shapes back to the original once severe bone disease has taken root. Thus, the old adage of "prevention is better than cure" definitely holds true in this case.

You may visit these websites for more information:

http://www.kdf.org.sg/health.aspx
http://www.davita.com
http://www.uptodate.com/patients/index.html

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肾脏透析基金

末期肾衰竭的骨骼问题

当肾脏一旦衰竭，它在骨骼的矿物质平衡和维生素的新陈代谢功能将受到影响，进而导致肾性骨营养不良。

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什么是肾性骨营养不良?

肾性骨营养不良是肾衰竭病患者对各种骨骼病变的总称。除了肾衰竭的特定因素，常人也会拥有导致骨骼疾病的其他因素，如年龄的增长。

什么是骨质疏松症?

骨质疏松症是指骨质流失或骨质稀疏。这是种持续性的病症，它会削减骨骼的硬度，并造成骨折问题。这疾病不仅会发生在常人的身上，更会发生在肾衰竭病患的身上。

骨质疏松的自然形成过程

从婴孩诞生的那刻开始，骨质的密度便会随着成长岁月而逐年增加，并在约25岁至33岁间到达高峰期。从30岁至50岁，骨质的密度则会微缓地疏减。在50岁后，男性骨质每年的流失率则会增加到大约是0.2–0.5%，而女性则是约3–5%。然而女性的流失率却会在更年期的5至8年后开始减低至每年1–2%。

哪些人最容易患有骨质疏松症?

造成骨质流失的因素很多，如遗传、营养、环境和荷尔蒙等。这种情况在年长者中最为普遍。此外，这病症也常见于患有某些疾病的人士，如末期肾疾病，库欣综合症(Cushing's syndrome)，类固醇治疗和对肝素的长期使用。

为什么肾衰竭会增加病患的骨质流失风险?

以下的因素会增加肾衰竭病患的骨质流失：

a) 肾脏的活性维生素D分泌的递减
b) 磷质排泄量的递减
c) 因体内促甲状旁腺激素的增加而使骨质分解加速

没有肾衰竭病症的普通人士是不会有这些问题的。

健康骨质的形成和维持需要肾脏所分泌的维生素D来保持血钙的正常水平，并由肾功能的反馈机制通过促甲状旁腺激素进行严密监控。这激素是由位于颈部甲状腺后面的甲状旁腺所分泌的。当血钙水平一旦下降，甲状旁腺就会受到刺激分泌激素，促使骨头释放钙质，维持血钙的正常水平。对短期性的缺血钙问题，这的确是个好系统，但对持续性缺乏维生素D的肾衰竭病患来说，甲状旁腺不停地被刺激，也意味着骨头内的钙质将不断地被“窃取”。

另一个刺激甲状旁腺分泌激素的因素是高血磷水平。磷质的排泄与钙质的代谢有着关键的影响，正常的肾功能对高促甲状旁腺激素的反应是增加磷质的排泄量。然而肾衰竭病患的肾脏却无法发挥这方面的本能，最终导致骨头释放钙质。因此为了防止甲状旁腺增加激素的分泌，必须把血磷维持在正常的水平。

如何诊断和监测肾性骨营养不良?

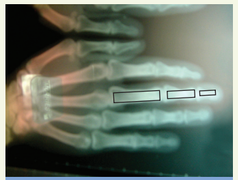
可通过下几个方法进行测断：

a) 血液检验

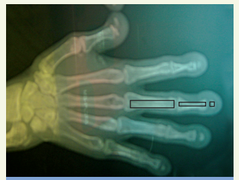
定期进行血钙、血磷和碱性磷酸酶水平的检测。由于促甲状旁腺激素会刺激骨头加速骨质的新陈代谢，致使骨细胞所形成的碱性磷酸酶大量释放入血液里。医生会根据验血报告调整药物服用的分量。

b) DEXA扫描

这方法可推断正常人的骨质密度。每年或每两年通过对脊椎骨和股骨头的扫描，可以监测骨骼病变的进展，但这扫描的费用相当昂贵。



正常的手



骨骼形状变异的手

c) X光摄片

这不是好的监测方法，因为当X光摄片显示骨骼病变时，病情早已是到了末期。

不良的肾头疾病控制会有怎么样的后果?

严重的肾衰竭，可丧失血钙和血磷的自动调控功能，因此需要借助药物来平衡它们的水平，以维持骨质的密度。不良的骨头疾病控制将导致以下问题：

a) 产生症状，如骨痛、关节疼痛和皮肤瘙痒等。
b) 骨质变薄，易折。与正常骨头相比，患者只须轻微的碰撞即可导致骨折。
c) 骨头结构和骨骼形状的维持受到干扰。骨质长期的稀削，导致脊柱和胸廓的形状变异，病患将持有特定的形态。
d) 若血钙和血磷的水平超出一定的范围，就会使钙沉积在血管和肌肉中。血管钙化可导致小血管阻塞。由于血管的硬化或阻塞，对外科医生的动静脉瘘管手术造成一定的困难，影响了手术的成功率。

有什么预防措施?

以下措施可预防肾性骨营养不良：

a) 严格遵守饮食忠告。这能协助减少磷质的摄取和磷结合剂的服用。
b) 定时的举重运动能刺激骨质的新陈代谢，并维持它的完整性。
c) 保持适宜的体重。
d) 按时服用药物，特别是磷结合剂和维生素D补充剂。

预防是很重要的，因为甲状旁腺一旦变得活跃，病患就算在过后有按时服药，也不容易获得良好的治疗效果。

如何治疗?

每位肾衰竭病患在开始接受洗肾治疗时，都已患有某些程度的骨头疾病。治疗主要是减缓和延缓骨头疾病的发展。

维生素D制剂是补充钙产量不足的常用药物。患者每周只须服用二至三次，常用的维生素D制剂有1–alphacalcidol 或calcitriol。然而维生素D的补充也会促使血钙吸收更多的磷质，提高血磷的水平。因此，当血磷水平升高时，就必须停止服用。

磷结合剂，如Calcichew, Calcium Acetate 和 Alutab。含钙的磷结合剂会与食物中的磷结合，形成一种磷酸钙化合物，然后通过粪便排出体外。磷结合剂必须在进食时服用，否则肠胃中不会有磷质可供结合。有些病患不喜欢Calcichew的味道，而较喜欢无需咀嚼的Calcium Acetate，然而两者都有同样的效果。对必须服用含钙磷结合剂的病患来说，钙含量较少的Calcium Acetate会较适合那些血钙水平偏高的病患。Alutab也是一种非常有效的磷结合剂。但是由于含有铝，而过多的铝会阻碍骨质的形成，造成骨质变稀，这机制与先前所提的不一样，是属于另外一种不同的形成机制。所以当血钙水平过高，需要暂停服用含钙磷结合剂，改服Alutab时，医生很少会配予长期服用Alutab的处方，通常每次只会限制在二至四周的用量。

甲状旁腺切除术：当药物治疗无法控再抑制促甲状旁腺激素的分泌，就必需接受甲状旁腺切除术的治疗。这不是项小手术，病患需要住院和接受全身麻醉，所以除非病情严重，否则医生是不会施予这项治疗的。

预防胜于治疗

在疾病造成骨骼永久性的变异前，先做好预防措施，是很重要的。因为骨头疾病一旦变得严重，要重整骨骼恢复原状是不可能的了。所谓“预防胜于治疗”确实是很实在的警世名言。

欲知详情，可参阅以下的网址：

http://www.kdf.org.sg/health.aspx
http://www.davita.com
http://www.uptodate.com/patients/index.html

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