How to care for patients undergoing surgery for primary hyperparathyroidism

Hyperparathyroidism is often seen as a silent disease. Nurses need to be able to link pathophysiology to nursing practice to provide safe and effective care.

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Primary hyperparathyroidism is the third most common endocrine condition. Initial symptoms can be vague, leading to problems in other body systems before diagnosis; if it remains undiagnosed, it can lead to a life threatening parathyroid crisis.

This article discusses the pathophysiology of primary hyperparathyroidism and the care of patients with the condition.

Hyperparathyroidism is a condition where the parathyroid glands become overactive and produce too much parathyroid hormone (PTH). As these glands regulate calcium in the blood, this condition can have wide ranging effects.

There are three classifications of hyperparathyroidism: primary, secondary and tertiary (Lewis, 2009; Fraser, 2009; Inabnet et al, 2006). This article focuses on primary hyperparathyroidism – the third most common endocrine condition (Fraser, 2009).

Its incidence varies, and is reported to be higher in the northern than in the southern hemisphere (Fraser, 2009; Inabnet et al, 2006). A recent study in Scotland showed the incidence to be as high as 6.72 per 1,000 people (Donnan et al, 2009). Incidence increases with age and the condition is 2-3 times more common in women than men (Fraser, 2009; Donnan et al, 2009).

ANATOMY AND PHYSIOLOGY
The parathyroid glands are part of the endocrine system. They consist of four small glands that sit behind the thyroid gland in the neck. They regulate plasma calcium levels.

Although the thyroid gland is often associated with metabolism, it also has a role in calcium regulation and produces the hormone calcitonin. Calcitonin is responsible for the uptake of calcium by the bones when plasma calcium levels are high (Tortora and Derrickson, 2009).

Regulation of calcium is the only role of the parathyroid gland (Tortora and Derrickson, 2009). It constantly measures plasma calcium concentration through the parathyroid calcium sensing receptors. When the levels fall below the normal range, PTH is released from the chief cells in the parathyroid tissue. Because the parathyroid gland is highly vascular, PTH is released quickly into the circulation, stimulating the bones to release calcium. It works on the renal tubules to increase the reabsorption of filtered calcium and the excretion of phosphate via the urine. This rapidly returns plasma calcium levels to normal.

In hyperparathyroidism, normal homeostatic mechanisms are affected. In some 87% of cases, this is caused by an adenoma in one of the glands (Moe, 2008; Inabnet et al, 2006). The adenoma secretes an excess of PTH independently of calcium levels, which leads to depletion of calcium from bones and can lead to osteoporosis. This is because high levels of PTH not only inhibit the release of calcitonin from the thyroid gland – which would normally help decrease calcium loss – but also continue to move calcium from the bones, intestines and kidneys into the circulation. This causes bone mineral density loss and can also cause hypercalcaemia (Inabnet et al, 2006).

SIGNS, SYMPTOMS AND DIAGNOSIS
The symptoms – often referred to as “stones, bones, abdominal groans and psychic moans” – relate to the skeletal, cardiac, renal, gastrointestinal and central nervous systems (Table 1). Fatigue is common and experienced by over 80% of people presenting with this condition (Inabnet et al, 2006).

In isolation, these symptoms, which include constipation, indigestion or fatigue, can appear to be due to other minor conditions for which people often self medicate.

As a result, hyperparathyroidism is often seen as a silent disease. Symptoms are subtle until homeostasis becomes disturbed that patients present in crisis – which accounts for 1-2% of new cases – or they are diagnosed coincidentally and have no apparent symptoms, which accounts for up to 80% of cases (Fraser, 2009).

Diagnosis relies on symptoms and blood tests. Raised serum calcium ion levels and elevated intact PTH levels are classic indicators (Fraser, 2009; Inabnet et al, 2006). A single blood test should not be relied on; calcium, magnesium, PTH and phosphate tests should be repeated to ensure correct diagnosis (EndocrineSurgeon.co.uk, 2010a).

ROUTINE MANAGEMENT IN MILD HYPERCALCAEMIA
For patients with mild hypercalcaemia who do not meet the criteria for parathyroid surgery or are unfit for surgery, treatment
with oestrogens or biophosphates can be useful if their bone mineral density has been affected. The focus is on preventing bone loss and normalising calcium levels. Where these methods are contraindicated the calcimimetic cinacalcet can be useful, but Fraser (2009) suggests further research should be undertaken to establish the long term benefits of this approach.

Regular monitoring of renal function, calcium levels and bone mineral density is required to ensure the patient’s condition does not deteriorate. If this does occur, parathyroidectomy can be offered; this is often undertaken as a day case, depending on the patient’s condition.

PRESENTATION AND MANAGEMENT IN CRISIS
Asmall percentage of people with this disease can have life-threatening symptoms related to hypercalcaemia (Inabnet et al, 2006). Patients who present in crisis are often acutely confused or psychotic and, in rare cases, this is initially attributed to mental health problems (see Box 1).

Acute arrhythmias are often seen due to high calcium levels and other symptoms such as dehydration, abdominal pain, vomiting and poor urine output may also be present. These can be attributed to more common conditions, which is why it is easy to overlook the possibility that the patient might have primary hyperparathyroidism.

Initial management of hyperparathyroid crisis involves correcting plasma calcium levels to safe limits. Depending on presentation, this takes different forms. Lewis (2009) suggests four approaches to restoring normal calcium levels: lowering intestinal absorption; decreasing bone resorption; increasing urinary excretion of calcium; and, in excessive hypercalcaemia, dialysis.

High levels of plasma calcium can be addressed in several ways. Fluid management with intravenous saline to correct dehydration and stimulate the kidneys to excrete calcium is often first line management (Fraser, 2009; Inabnet et al, 2006). In the non-dehydrated patient, IV furosemide can be given as this increases urinary excretion of calcium; and, in excessive hypercalcaemia, dialysis.

If calcium levels are extremely high, further medical management may be required with biophosphonates, such as pamidronate, to reduce the calcium level further and reduce bone turnover, thereby improving bone mineral density.

For patients who have had treatment for parathyroid crisis, surgery should be planned carefully because treatment with biophosphonates has a maximum effect in around five days. This can have a negative effect in the postoperative period, where patients can become hypocalcaemic as a result of preoperative treatment for hypercalcaemia (Fraser, 2009).

SURGICAL TREATMENT
Once a diagnosis has been made, surgery is curative in 97% of patients (Adamek, 2007). The surgical approach is decided by criteria set by the National Institute of Health in 2002 (Bilezikian et al, 2002); the criteria, which are being updated, include:

- Serum albumin adjusted calcium levels >0.25mmol/L above local laboratory ranges;
- Urine calcium levels >10mmol in 24 hours;
- Younger than 50 years of age;
- A T score of ≤-2.5 at any site on a bone mineral density scan;
- A reduction of 30% or more in creatinine clearance;
- Patient request, especially if follow-up may prove to be challenging.

Fraser (2009) suggests that 85% of cases have one adenomatous gland, while up to 15% have multiple adenomas. For this reason, surgical procedure depends on diagnosis. The most common surgical approaches consist of the following:

- A total parathyroidectomy – a traditional approach comprising a bilateral exploration of all four glands, where the surgeon can see and remove them. If the affected glands can be identified, one or more may be retained;
- A total parathyroidectomy with auto transplant – all four glands are removed and a small amount of parathyroid tissue is transplanted into the forearm. Placement here has the benefits of ready access should the transplanted tissue begin to enlarge and require surgery to reduce its size;
- A subtotal parathyroidectomy – minimally invasive, targeted surgery that can be done under a local anaesthetic for single localised enlarged glands.

Imaging the enlarged glands can facilitate minimally invasive, targeted surgery. This
has the advantage of requiring less time under anaesthetic, which can be particularly useful when treating older patients; it also requires less time in hospital and better recovery. Several methods can be used, such as:

- Ultrasound;
- Computerised tomography;
- Magnetic resonance imaging;
- Sestamibi scans (EndocrineSurgeon.co.uk, 2010b).

Intraoperative assays of intact PTH can be useful to determine if affected glands have been removed. Because PTH levels fall rapidly, testing while the patient is still under anaesthetic can be a reliable method of determining whether the problematic gland has been removed (Fraser, 2009).

Some specific complications can arise as a result of parathyroidectomy. In less than 1% of cases, paralysis of the vocal cords or damage to the laryngeal nerve can occur, while postoperative bleeding occurs in one in 750 cases.

A more common complication is severe hypocalcaemia, known as hungry bone syndrome (HBS), which is present in 42% of cases (Mittendorf et al, 2004). This is more common in patients who have large parathyroid adenomas, are over 60 years of age and have high preoperative levels for calcium, PTH and phosphatase. In HBS, removal of the enlarged parathyroid gland reduces the amount of PTH released into the vascularity system. This subsequently increases the uptake of calcium into the bones causing hypocalcaemia, and often requires calcium supplementation (Mittendorf et al, 2004).

TABLE 1. SYSTEMS AFFECTED BY PRIMARY HYPERPARATHYROIDISM

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>CAUSE</th>
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<tbody>
<tr>
<td>Cardiac (angina,</td>
<td>Deranged calcium, phosphate and magnesium levels that occur in the</td>
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<tr>
<td>myocardial infarction,</td>
<td>condition, affecting the myocardium</td>
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<td>arrhythmias)</td>
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<tr>
<td>Renal (calcium calculi)</td>
<td>High serum calcium levels are removed by the kidneys. Often polydipsia</td>
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<tr>
<td></td>
<td>and polyuria is present in an attempt to remove the excess calcium,</td>
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<td></td>
<td>which can lead to dehydration. This occurs in 20-30% of patients and</td>
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<tr>
<td></td>
<td>is a common symptom. Patients are often diagnosed with primary</td>
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<tr>
<td></td>
<td>hyperparathyroidism after admission with renal colic (Fraser, 2009)</td>
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<tr>
<td>Gastrointestinal</td>
<td>Dehydration can lead to constipation and nausea. Acid secretion increases</td>
</tr>
<tr>
<td></td>
<td>leading to epigastric pain. This can go on to cause peptic ulcer disease</td>
</tr>
<tr>
<td></td>
<td>(Inabnet et al, 2006)</td>
</tr>
<tr>
<td>Skeletal</td>
<td>Excess parathyroid hormone causes skeletal changes such as osteoporosis</td>
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<tr>
<td></td>
<td>and pathological fractures. Patients initially presenting with these</td>
</tr>
<tr>
<td></td>
<td>symptoms are rare; however, osteoporosis is present in 44% of patients</td>
</tr>
<tr>
<td></td>
<td>referred for surgery (Mazzaglia et al, 2008)</td>
</tr>
<tr>
<td>Neuropsychiatric</td>
<td>Depression and anxiety is a common symptom, which relates to raised</td>
</tr>
<tr>
<td></td>
<td>serum calcium levels (Fraser, 2009). Serum calcium levels of &gt;3mmol/L</td>
</tr>
<tr>
<td></td>
<td>are known to cause confusion, psychosis and even coma (Lewis, 2009)</td>
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PREOPERATIVE NURSING CARE IN ELECTIVE SURGERY

For many, parathyroidectomy can be done as an elective day case, depending on the patient’s coexisting problems. Most patients need only a preoperative assessment before surgery. This involves taking routine nursing observations, which give a postoperative baseline, preparing patients for theatre and offering psychological support and information about what to expect.

Preoperative care for patients in crisis is important to be able to plan and implement nursing care for those in crisis. This should be based on holistic assessment, while taking into account the specific challenges, such as knowledge of pathophysiology is vital. This can be an extremely frightening time for the patient and family members, and nurses must be empathetic and provide psychological support to all concerned.

Nurses have a vital role in haemodynamic monitoring and fluid balance measurement to ensure patient safety. Their extended role in some acute areas may involve ordering blood tests; daily bloods should be taken for calcium, urea and electrolytes, and for phosphates in the preoperative period. Using a track and trigger monitoring system, such as a modified early warning system (MEWS), is an essential part of the nursing role. NICE (2007) suggests that:

- **Hypocalcaemia and PTH:** High serum calcium levels are removed by the kidneys. Often polydipsia and polyuria is present in an attempt to remove the excess calcium, which can lead to dehydration. This occurs in 20-30% of patients and is a common symptom. Patients are often diagnosed with primary hyperparathyroidism after admission with renal colic (Fraser, 2009).

- **Hypocalcaemia and PTH:** Dehydration can lead to constipation and nausea. Acid secretion increases leading to epigastric pain. This can go on to cause peptic ulcer disease (Inabnet et al, 2006).

- **Hypocalcaemia and PTH:** Excess parathyroid hormone causes skeletal changes such as osteoporosis and pathological fractures. Patients initially presenting with these symptoms are rare; however, osteoporosis is present in 44% of patients that are referred for surgery (Mazzaglia et al, 2008).

- **Hypocalcaemia and PTH:** Depression and anxiety is a common symptom, which relates to raised serum calcium levels (Fraser, 2009). Serum calcium levels of >3mmol/L are known to cause confusion, psychosis and even coma (Lewis, 2009).

POSTOPERATIVE NURSING CARE

Haemodynamic monitoring, including fluid balance, is vital in the postoperative period. It is important to remember that pain control and wound care also require consideration. For patients undergoing elective surgery, discharge on the same day with strong analgesia is possible, while those who have had surgery following crisis – especially if thoracic surgery was required – can be provided with patient controlled analgesia (PCA). The importance of physiological monitoring for patients on PCA cannot be...
overstated because of the risk of respiratory depression. This must be recorded on MEWS charts and pain scoring systems used to ensure adequacy of the method of pain control (McArthur-Rouse and Prosser, 2007). While wound management is relatively straightforward, nurses play a crucial role, particularly in supporting patients who are dealing with altered body image issues following surgery. Initially, scars can be quite visible and can cause distress, so good communication skills are vital. Scars at the neck and the mediastinum can cause a sense of loss, and counselling can be beneficial. Scarring is not only a biological issue – it impinges on psychological and social wellbeing, and can lead to depression and isolation (Rumsey and Harcourt, 2005). There are also the risks of laryngeal nerve damage and paralysis of the vocal cords, so patients need good psychological care. As mentioned above, patients can develop HBS postoperatively, so nurses should observe for signs of hypocalcaemia. Classic observable signs include tetany, where patients exhibit neuromuscular excitability. Trousseau’s sign – where carpopedal spasm occurs after the inflation of a blood pressure cuff on the arm above systolic pressure for three minutes – or Chvostek’s sign – where tapping the facial nerve causes the facial muscles to spasm – can indicate the beginning of tetany (Lewis, 2009).

The reduction of bone mineral density often caused by the pathophysiological changes associated with primary hyperparathyroidism means patients may need long term care. Those with low bone density should have bone mineral density scans every two years to ensure there is improvement in bone mass; bone density can be determined by dual-energy X-ray absorptiometry. Successful treatment is essential for patients and families. There have been several developments in the treatment of hyperparathyroidism over the past three decades. As mentioned above, patients can develop hypocalcaemia in the postoperative period, but also during surgery. A subtotal parathyroidectomy is performed, only for the calcium levels to rise again on the third postoperative day.

**CONCLUSION**

Primary hyperparathyroidism can be a challenging condition for both patients and nurses, and can be life threatening. The treatment options that are available in crisis enable patients to be managed successfully to prepare them for surgery. Nurses need to be able to link pathophysiology to nursing practice to provide safe and effective nursing care. Nurses should be able to care for patients in the acute phases, and care for them holistically. This condition affects not only the biological domain but also, in many cases, the psychological, social and economic aspects of a person’s life.

**REFERENCES**

Endocrine Surgeon.co.uk (2010a) How is Primary Hyperparathyroidism Diagnosed? tinyurl.com/endoendocrine
Endocrine Surgeon.co.uk (2010b) Prior to Parathyroid Surgery What Tests must be Performed? tinyurl.com/endoendocrine2

**BOX 1. CASE STUDY: THE THORACIC APPROACH IS ESSENTIAL**

Karen Parker, aged 18, presents with longstanding fatigue, polydipsia, polyuria, constipation and worsening depression. Her initial presentation is at accident and emergency following an overdose of paracetamol. She is treated for the overdosage and discharged the following day.

At this early point, it is easy to forgo diagnosis and to only treat the presenting problem. Her depressed state is linked to rising calcium levels which, if remain untreated, can lead to a psychotic episode.

Several months later, Ms Parker is readmitted to A&E following a psychotic episode where she attempted to injure herself severely. Here, the worsening mental state is clearly linked to increasing hypercalcaemia.

After three days of consultations between the mental health crisis and medical teams, hypercalcaemia is noted with high parathyroid hormone levels, and a referral for possible surgery is made. The length of time taken to make a diagnosis is linked to Ms Parker being outside the usual presenting picture in terms of age, and the fact that PTH levels are not routinely investigated.

Two weeks of drug and fluid therapy normalise her calcium levels. This is essential to improve safety, not only in the preoperative period, but also during surgery. A subtotal parathyroidectomy is performed, only for the calcium levels to rise again on the third postoperative day.

Further investigations, including a thoracic MRI scan, confirm the presence of a further parathyroid gland in the mediastinum and more surgery is required to remove this. Although Palazzo and Saddler (2004) suggest that multiple imaging using both ultrasound and sestamibi scans can have up to a 98% success rate of identifying a single adenoma, in up to 16% of cases an extra gland is situated in the mediastinum and a few patients require a thoracic approach to remove the gland (Fraser, 2009). The thoracic approach is essential for Ms Parker. Even if preoperative scanning had been performed, without a thoracic MRI, it is unlikely this gland would have been located.

*Name has been changed.*