Virtual Nutrition Team (VNT) Guidance

your questions answered

Muscle cramps and home parenteral nutrition (HPN)

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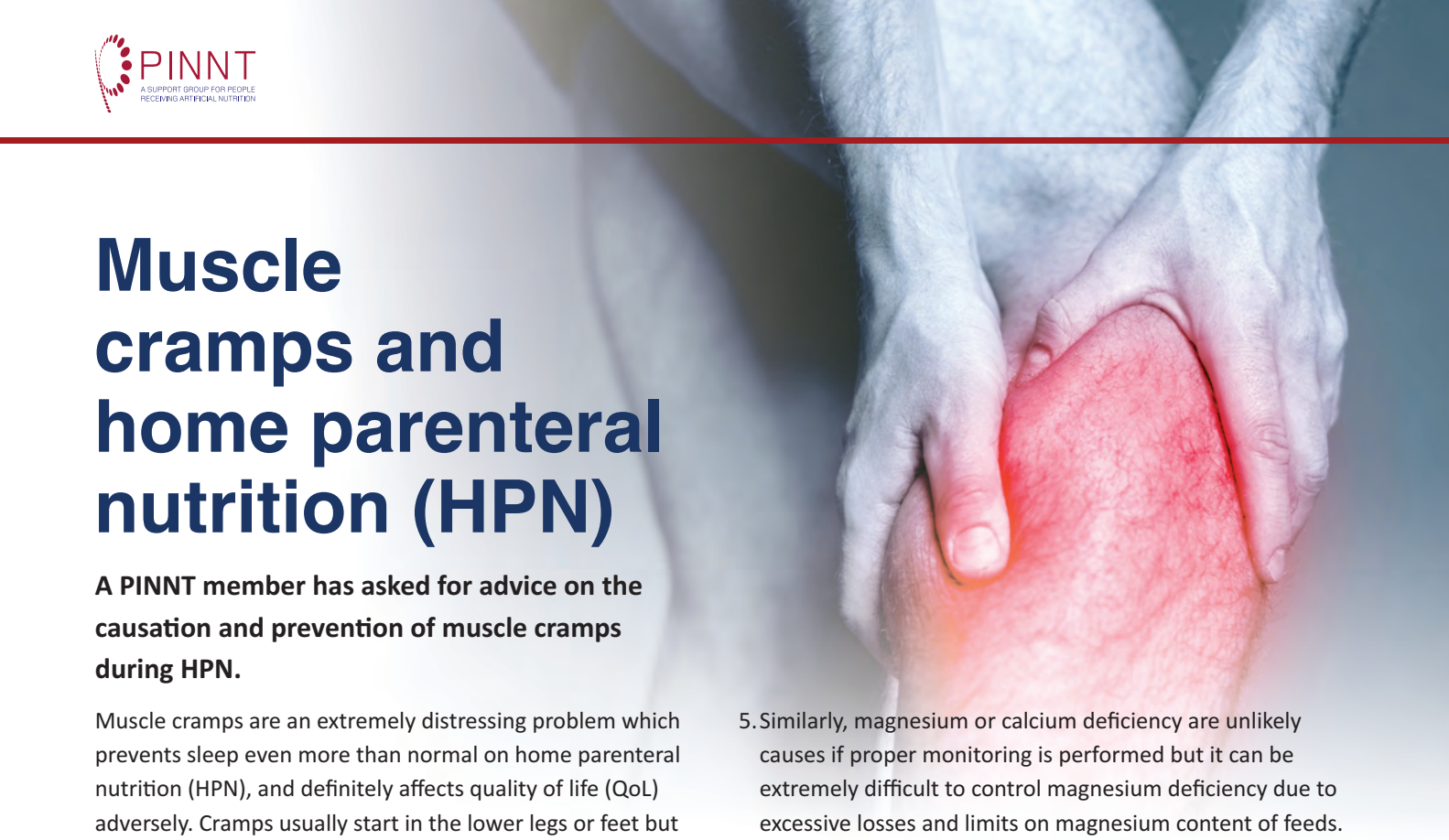

Muscle cramps and home parenteral nutrition (HPN)

A PINNT member has asked for advice on the causation and prevention of muscle cramps during HPN.

Muscle cramps are an extremely distressing problem which prevents sleep even more than normal on home parenteral nutrition (HPN), and definitely affects quality of life (QoL) adversely. Cramps usually start in the lower legs or feet but can involve arms and hands. These patients do NOT describe similar painful spasms when **off** line.

There is remarkably little in the literature on this subject but a recent British multicentre survey recorded 12/45 (27%) as having cramps. A comparison of HPN patients with a control group of inflammatory bowel disease (IBD) patients not on HPN showed an increased incidence of cramps on HPN (51% v24%). Pharmacological measures (quinine sulphate by mouth) were required in 9/12 and in 2 patients, the rate of infusion was slowed with some benefit. As a result of their study, they stated that this problem is the commonest complication of HPN! Perusal of various textbooks on HPN does not reveal any helpful information but a Google search revealed some centres around the world including the subject of cramps in their advice to patients on HPN.

The crucial facts relating to cramps are:

1. It always occurs during feeding and never off line unless a severe underlying and identifiable metabolic deficiency state is present.
2. It usually occurs earlier during the infusion.
3. Glucose does not need to be in the infusion for cramps to occur.
4. Increasing sodium content of feeds may be appropriate if urinary sodium levels are low indicating sodium deficiency. However, this rarely seems to improve cramps. If sodium deficiency is suggested as a cause, why would symptoms be worsened during infusion when the sodium is being in fused? Those who have had cramps due to sodium deficiency (e.g. during exercise) know that repletion of sodium stocks removes the cramps.
5. Similarly, magnesium or calcium deficiency are unlikely causes if proper monitoring is performed but it can be extremely difficult to control magnesium deficiency due to excessive losses and limits on magnesium content of feeds. Again, why would cramps occur during infusion of these ions? Experience with cramps or tetany due to deficiencies of these ions is that pains improve during infusion of these ions.
6. The same criticisms can be extended to the possibility of phosphate deficiency.
7. Something is happening to the metabolic status of patients during PN infusion which has nothing to do with deficiency of single or multiple nutrients/electrolytes.
8. Sudden metabolic changes across muscle or nerve cell membranes could trigger spontaneous painful contraction of muscle fibres. So what could the change be? Infusion of glucose with electrolytes has long been recognised as a way of shifting electrolytes from outside a cell into that cell (e.g. potassium). However, we have one vital piece of information from an HPN patient who suffers from cramps despite having NO glucose in her feeds. This theory is therefore unlikely to be the explanation.
9. For many years, the normal response of HPN teams to such problems has been to exclude electrolyte deficiencies or treat them. This does not seem to have had much impact on cramps. The next step is an empirical one: to slow the infusion rate. I believe that infusion of high sodium containing HPN fluids may explain this problem. HPN fluids containing sodium chloride as the sole source of sodium have a tendency to cause acidosis. This means that the infusion of NaCl drops the pH of plasma and extracellular fluids to wards acid from the normal of 7.4. It has long been known that changes in extracellular pH occur faster than those in side cells which can resist acidosis longer. Any changes to extracellular pH would be temporary during feeding but could affect muscle membrane function through the effect

on calcium ionisation. The body's ability to control pH within tight boundaries is extraordinarily powerful but could be overwhelmed during non-physiological infusions which bypass the gut and liver. The homeostatic control mechanisms which keep the pH of the body fluids so constant under normal circumstances are severely im paired in many HPN patients (short bowel syndrome, PPIs, fistula losses, vomiting) despite normal renal and respiratory function. Any deterioration in the major organs (kidneys and lungs) controlling acid levels exacerbates pH shifts.

10. In my unit, we observed a number of patients with long term problems affecting acid-base balance on HPN. As a result, we started to use sodium acetate instead of sodium chloride to reduce the stress on the control mechanisms. I have no data to indicate whether this approach works as far as cramps are concerned but as a working hypothesis, I think it demands further examination and study. Interestingly, one virtual nutrition team (VNT) member stated that cramps were not a significant problem in her centre where sodium acetate is used regularly. Reducing flow rates would accord with this hypothesis as it would lower the acid stress on homeostatic control mechanisms. Another VNT member comments that they use sodium acetate to reduce acid-base stress but they still see cramps.
11. At least one major unit advises an INCREASE in sodium intake for cramps, going as far as advising licking salt off the back of the hand. The specialist nurse from that unit does not recall anyone benefiting from this approach! Another nurse reports some improvement with a salt lick but maybe from the slowing of the infusion and the addition of quinine sulphate by mouth too. This is a time honoured treatment for muscle cramps particularly at night in people who suffer night cramps for no obvious reason. There is thus little objective evidence of what really works or does not.
12. As children are smaller than adults, one might expect cramps to be a common problem in children but one VNT member with great experience has not heard of this in children.
13. A patient from the USA, writing on the Oley foundation blog, records that she had bloods checked before and during HPN to see if there was an explanation for her cramps. Although some nutrient deficiencies were note prior to infusion, and excesses during infusion, no details are given as to which electrolytes were involved. Nor is there any mention of blood pH or acidity before or during infusions. She does detail her symptoms which sound most unpleasant and clearly intruded on her sleep pattern and QoL. Interestingly, she noted that changing her pump to a slower infusion rate at the beginning of the infusion did help.
14. An alternative theory could be that infusion of a 3 litre bag over night could temporarily LOWER levels of critical extracellular electrolytes such as sodium, calcium or magnesium. If the concentration of sodium is 200mmol in 3 litres or 66.6mmol/litre, dilution of the plasma sodium would be inevitable and this would be transferred to the rest of the extracellular fluids. If the total extracellular fluids amount to 15 litres, an extra 3 litres would dilute electrolyte contents by 20% and with lower sodium content in the HPN, the effect on sodium would be even greater. I calculate that after 3 litres of HPN containing 200mmol sodium have been infused, this would result in a theoretical drop in sodium concentration from around 140mmol/l to 127.7mmol/litre. This could be enough to cause transmembrane potential changes sufficient to cause cramps. If this is so, increasing sodium content in the feeds or by mouth is not the answer. Only slowing the rate would work thus giving opportunity for redistribution of fluids and electrolytes and offsetting the potentially adverse effect of dropping sodium levels. Similar effects can be calculated for sudden drops in calcium and magnesium levels.
15. Could acidosis also contribute to this scenario? Perhaps - but studies are needed to look into this in detail.

In conclusion, cramps are a common and very distressing complaint experienced by our HPN patients, often over long periods of time. No single cause appears to explain this problem and the prevailing theory that a deficiency state is the most likely is illogical and not evidence based. It seems that it is time for HPN centres to get together and consider how best to study this challenging question – what causes on line HPN related cramps and what can be done to alleviate them? In the meantime, slowing the infusion rate or addition of quinine sulphate by mouth are the only two options which seem to work. Slowing the infusion might improve cramps but will itself intrude on QoL by prolonging time online.

Dr Barry Jones, PINNT – VNT lead

For further details on the VNT and its members visit:
http://pinnt.com/About-Us/Virtual-Nutrition-Team-VNT.aspx

References:
1. "Muscle cramps are the commonest side effect of home parenteral nutrition" Clinical Nutrition, 2009, 28; 351-4. Elphick DA, Baker M, Baxter JP, Nightingale JMD, Page KB and MacAlindon ME.
2. Acid – base disturbances in home parenteral nutrition. Jones BJM, Chopra P, Deel – Smith P. e-SPEN, the European Journal of Clinical Nutrition and Metabolism 6(2011) pp.e31-e35

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