Rehabilitation After Critical Illness

A report on the presentation by Professor Paul Wischmeyer (Intensive Care Consultant, Duke University, USA) that featured as part of the Rehabilitation After Serious Illness – From community to the hospital and back... where?' Symposium at the 2017 BAPEN Conference.

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"Are we creating ICU survivors or victims?" was Paul Wischmeyer's question to the extensive audience staying to the very end of the 2017 BAPEN Annual Conference in Birmingham. More and more people are surviving in intensive care units (ICU) but, subsequently, have a very poor quality of life due to the debilitating loss of muscle mass and function caused by critical illness. With the potential to lose up to 1 kg muscle mass per day, up to 33% of patients may never return to work after time in the ICU and, for this reason, rehabilitation probably has to start much earlier than it does at present – ideally, on admission to the ICU. Appropriately timed nutrition support plays a vital role in this.

Although the greatly increased numbers of patients surviving the ICU has been hailed as a great success, little attention has been given to the very low quality of life and short life expectancy that occurs post the ICU. Some studies have shown up to 40% mortality in the first year after ICU discharge and even Olympic athletes in peak physical condition are not immune from the incapacitating effects of critical illness on muscle function. Studies have shown that where weight gain does occur in the first year after ICU, a significant proportion is adipose tissue meaning that even those who return to their premorbid weight have significantly less muscle and more fat than they did. Dr Wischmeyer firmly believes that expertly guided nutrition support, in conjunction with physiotherapy and pharmacological strategies, has the ability to significantly improve these extremely worrying findings.

Adequate protein delivery at the right time is a fundamental part of Wischmeyer's strategy, as amino acids are the building blocks of muscle. Although excess macronutrients, including protein, may be harmful in the acute phase of critical illness that classically occurs in the first week of ICU admission. Protein intakes should be increased from around day four to meet a target of 1.2-2 g protein/kg by day seven onwards. This should continue into the chronic phase of critical illness and subsequent recovery and rehabilitation phases. During the chronic phase, excess energy may be harmful and the input of a skilled healthcare professional, such as a dietitian, using the right products to achieve the optimum protein delivery without excess calories is vital. Once off the ICU and into the true rehabilitation stage, very high intakes of energy and protein may be required for muscle recovery. Dr Wischmeyer believes it is extremely unlikely that patients will be able to achieve this without the use of oral nutritional supplements (ONS).

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Evidence for the benefits of ONS in the general hospital population is growing, with Wischmeyer quoting studies from the UK and USA. Meta-analyses of ONS in hospitalised patients by Stratton *et al.* in 2003[1] showed a 6% drop in mortality and a 23% reduction in complications. A study of 724,000 ONS patient episodes in the USA demonstrated an impressive 21% reduction in length of stay (LOS) and 21.6% reduction in hospital costs, with every $1 spent on ONS saving $52.60.[2] A recent 78-centre randomised control trial of high protein ONS in 625 patients demonstrated a reduction in 90-day post hospital discharge mortality (Clinical Nutrition Online First 1/2016) and Wischmeyer now gives high protein ONS to all his post major surgery patients on discharge.[3]

Wischmeyer's next question was what other nutrients are ICU patients likely to be deficient in? There is evidence that they may well be lacking in vitamin C, vitamin D, thiamine, zinc and selenium and supplementation can be of benefit. He measures all patients' 25 OH vitamin D levels on admission to the ICU, and if levels are less than 12 ng/ml they get a one-off oral dose of 540,000iu cholecalciferol (D3) as studies have shown this leads to a significant reduction in mortality.[4] All of his patients get thiamine (vitamin B1), a vital co-factor in the Krebs cycle.

Although appropriate nutrition is of primary importance, Wischmeyer believes some pharmacological agents may also help to reverse muscle loss, prevent muscle dysfunction and improve outcomes. Beta-blockers have the potential to attenuate critical illness hypermetabolism, reduce energy expenditure, improve muscle mass[5] and lead to a 40% decrease in mortality in septic shock.[6] More controversially, he also uses testosterone analogues or anabolic steroids, such as oxandrolone. Although anabolic agents should be avoided in the acute phase of critical illness, they show promise in recovery with reduced length of stay and mortality in burns.[7] Hydroxmethyl butyrate (HMB) is a leucine derivative supplement that has anabolic properties and could be useful in aiding muscle recovery.

As part of his highly innovative approach to treating and preventing ICU-related muscle dysfunction, Wischmeyer has worked with former Tour de France cyclist Christian Vande Velde using ultrasound scanning to assess muscle glycogen levels. Glycogen depleted muscle can never achieve an anabolic state and synthesise new tissue as it will utilise amino acids as an energy source. Critical illness has been shown to completely deplete muscle glycogen and this may explain why very high carbohydrate and protein intakes are required in rehabilitation to regain lost muscle. In addition, mitochondrial dysfunction post critical illness prevents muscles from using fatty acids as an energy source. Wischemeyer and Vande Velde have rehabilitated a severely burnt cyclist who could barely ride his bike post ICU back to competition through exercise that targets mitochondrial recovery.

Wicshmeyer has summarised much of the groundbreaking work in his latest article[8] which, once again, stresses the importance of timing of nutrition support in critical illness. This in turn highlights the need for skilled healthcare professionals, such as dietitians, in determining the right amounts of the right nutrients to be given at the right time for optimum outcomes. Interestingly, he believes that everyone should take exercise and an optimum diet to maintain lean mass in case of an ICU stay or need for major surgery – a concept known as *'prehabilitation'*. Preoperative carbohydrate loading should always be utilised. On the ICU lower energy and protein loads should be given in the acute phase, with protein requirement increasing gradually after around four days. Vitamin D and beta-blockers should be given but anabolic agents, such oxandrolone or HMB, should be avoided. In the chronic phase, on the ICU, more protein is required (1.2-2 g/kg) with modest energy intakes, beta-blockers, HMB, oxandrolone, vitamin D, exercise, physiotherapy and possibly glutamine. In the rehabilitation phase, post ICU, very high protein and energy intakes are required in combination with beta-blockers, oxandrolone, creatine (an amino acid that increases intracellular ATP), possibly growth hormone, probiotics, physiotherapy and exercise.

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