Forté Trauma™

Science-based, Targeted Nutritional Support for Trauma Recovery
Trauma incites a stress response—a variety of physiologic and metabolic responses, including decreased immunity, increased inflammation, increased levels of stress hormones, increased catabolism, and decreased anabolism. All of these stresses contribute to increased protein and energy requirements after acute traumatic injury—whether accidental or secondary to surgery—and may increase the risk of poor nutrition status, which is also linked to poorer outcomes and an increase in complications such as infection and slow wound healing.\(^1\)\(^2\) Supporting trauma patients with key nutrients post-injury or post-surgery may help them recover more quickly.

Figure 1. Systemic responses to surgery or trauma\(^3\)

<table>
<thead>
<tr>
<th>Sympathetic nervous system activation</th>
<th>Endocrine ‘stress response’</th>
<th>Immunological and haematological changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• pituitary hormone secretion</td>
<td>• cytokine production</td>
<td></td>
</tr>
<tr>
<td>• insulin resistance</td>
<td>• acute phase reaction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• neutrophil leucocytosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• lymphocyte proliferation</td>
<td></td>
</tr>
</tbody>
</table>

Importance of Post-Traumatic Nutritional Support

The stress response to trauma or surgery is characterized by increased secretion of pituitary hormones and activation of the sympathetic nervous system.\(^4\) These pituitary hormones exert downstream effects on target organs, increasing cortisol secretion from the adrenal cortex and stimulating glucagon release from the pancreas, among other responses. Cortisol promotes gluconeogenesis, lipolysis, and protein breakdown and inhibits the accumulation of macrophages and neutrophils in areas of inflammation. The net metabolic effect of stress response-related hormonal changes is increased catabolism, which mobilizes substrates for energy and triggers mechanisms to maintain cardiovascular homeostasis.\(^3\)

The increased nutritional needs associated with trauma may be exacerbated among elderly patients who have an increased baseline risk for malnutrition due to decreased lean body mass and a variety of other factors that may compromise nutrient and fluid intake. For these patients, oral nutritional supplements may enable an immediate and significant increase in energy and nutrient intake. While the elderly may be at higher risk for malnutrition, nutritional deficiencies are common among the general population as well, underscoring the need for appropriate nutrient support following surgery or other trauma.

And yet, physicians often forget to consider nutritional status or dietary supplementation...

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to facilitate the recovery of patients from trauma. In fact, surgeons routinely advise their patients to stop taking nutritional supplements at least two weeks prior to scheduled surgery. This is due, in part, to the popularity of complementary and alternative medical treatments such as herbal supplements that may have serious and potentially harmful side effects when combined with medications commonly prescribed for surgical and trauma patients. However, studies in gastrointestinal surgery and other surgical situations have shown the importance and benefits of nutritional support.

Figure 2. Hormonal responses to surgery or trauma

<table>
<thead>
<tr>
<th>Endocrine gland</th>
<th>Hormones</th>
<th>Change in secretion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior pituitary</td>
<td>ACTH</td>
<td>Increases</td>
</tr>
<tr>
<td></td>
<td>Growth</td>
<td>Increases</td>
</tr>
<tr>
<td></td>
<td>TSH</td>
<td>May increase or decrease</td>
</tr>
<tr>
<td></td>
<td>FSH and LH</td>
<td>May increase or decrease</td>
</tr>
<tr>
<td>Posterior pituitary</td>
<td>AVP</td>
<td>Increases</td>
</tr>
<tr>
<td>Adrenal cortex</td>
<td>Cortisol</td>
<td>Increases</td>
</tr>
<tr>
<td></td>
<td>Aldosterone</td>
<td>Increases</td>
</tr>
<tr>
<td>Pancreas</td>
<td>Insulin</td>
<td>Often decreases</td>
</tr>
<tr>
<td></td>
<td>Glucagon</td>
<td>Usually small increases</td>
</tr>
<tr>
<td>Thyroid</td>
<td>Thyroxine, tri-iodothyronine</td>
<td>Decrease</td>
</tr>
</tbody>
</table>

Key Nutritional Needs for Trauma Patients

Post-surgical wound healing and other acute trauma represent an anticipated drain on a patient’s nutritional stores, which may already be suboptimal. In a prospective study of 500 patients admitted to a teaching hospital, including 200 surgical patients, 40 percent of patients were found to be undernourished at the time of admission. Supplementation with a targeted combination of critical vitamins, minerals, amino acids and trace elements can help patients recover from the physiological and metabolic stress of surgery or other trauma.

Vitamin C

In addition to acting as an antioxidant to protect cells from free radical damage, vitamin C is essential for normal immune system function, iron absorption, and production of collagen, a critical protein for wound healing. Due to its many biochemical functions, vitamin C is considered not only an essential micronutrient for maintaining health, but also an important therapeutic supplement in a variety of clinical conditions.

According to the U.S. Centers for Disease Control and Prevention’s most recent National Report on Biochemical Indicators of Diet and Nutrition in the U.S. Population, approximately six percent of Americans are deficient in vitamin C. Acute trauma compounds this problem by lowering blood vitamin C concentration, likely due to increased demand caused by redistribution and increased oxidative stress. In a small study of patients who underwent uncomplicated

gastrectomy for gastric cancer, blood concentration of vitamin C decreased post-operatively and the reduction persisted for at least seven days following surgery. As a result, doses much higher than the recommended daily allowance may be needed to normalize plasma and tissue vitamin C concentration in trauma patients.

Consumption of fruits, vegetables and plant foods is typically the main source of vitamin C. Relatively high doses of supplemental vitamin C, combined with other trace elements, have been shown to dramatically accelerate wound healing. Most multivitamin preparations available in the U.S. contain approximately 200 mg of vitamin C. However, in uncomplicated surgery patients, more than 500 milligrams per day of vitamin C supplementation may be required to support wound healing. In cardiac surgery patients, vitamin C supplementation may prevent post-operative atrial fibrillation. Recently, it was shown that oral vitamin C supplementation, in association with beta-blockers, was more effective in preventing post-operative atrial fibrillation than beta-blockers alone.

**Vitamin D and Calcium**

Vitamin D and calcium are the key nutrients for musculoskeletal development, maintenance and function, which are vital for the success of bone-related surgeries. Low vitamin D and poor bone mineral density may be significant factors in instrumentation failure, loss of deformity correction, adjacent fractures and the need for revision surgery. Research has shown that the active form of vitamin D—cholecalciferol, or 1,25-dihydroxyvitamin D₃— may help to enhance wound healing. In addition, calcium plays an important role in skin homeostasis and studies have shown an increased need for calcium to promote key events in the wound healing cascade.

The body can produce vitamin D when exposed to sunlight, but calcium must be absorbed from food and requires vitamin D for absorption. While the Food and Nutrition Board (FNB) recommends a daily Vitamin D requirement of 600 IU, recent research indicates that the body needs at least 1000 IU per day to support optimal bone health and the Institute of Medicine has determined a safe daily upper limit of 4000 IU.

Nearly one-third of the general population, and more than 50 percent of general medicine patients, have been found to have vitamin D inadequacy. Studies demonstrate that the majority of patients undergoing elective orthopedic surgery are deficient in vitamin D. Restoring vitamin D to appropriate levels may significantly improve outcomes following surgery.

**Protein**

As part of the stress response to acute trauma, protein catabolism is stimulated by increased cortisol concentrations, resulting in the breakdown of skeletal and visceral muscle to release amino acids, which may be further catabolized for energy or used in the liver to either form acute

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phase proteins or be converted into glucose, fatty acids, ketone bodies, or other substrates. Since the stress of surgery or other trauma creates a hypermetabolic state with increased protein and energy demands, supplemental protein is also beneficial for post-operative and acute trauma patients. Essential amino acids play a crucial role in protein synthesis and muscle tissue repair. These amino acids are not produced or stored in the body, so they must be obtained through diet or supplementation. Specifically, L-arginine is an amino acid that has been shown to stimulate wound healing, while L-glutamine restores cellular energy stores and enhances the bactericidal function of neutrophils. In clinical studies, patients given L-arginine supplementation after major surgery benefited from a faster recovery of immunological parameters and fewer infectious complications.

Randomized clinical trials of patients undergoing surgery for hip fracture demonstrated that providing post-operative energy-protein supplements resulted in better recovery plasma proteins and fewer post-operative complications, even among patients with normal pre-operative nutrition status. In addition, a recent study showed that amino acid supplementation assisted with surgical recovery in patients who had undergone total knee arthroplasty, as demonstrated by attenuated muscle atrophy and accelerated return to functional mobility.

**Other Nutrients**

Other vitamins, trace elements, and compounds are also important for trauma patients:

- Vitamin A supports immune system function and contributes to collagen strength, a necessary component of tissue repair.
- The complement of B vitamins are needed for cellular metabolism, tissue repair, and immune support.
- Zinc is an essential trace mineral used in enzymatic reactions and biochemical pathways involved in wound healing and tissue regeneration.
- Copper and selenium are antioxidant minerals that support cell damage repair.
- Bromelain (a pineapple enzyme with anti-inflammatory properties) and quercetin (a phytoflavonoid with antioxidant and anti-inflammatory properties) may help reduce bruising, swelling and scarring.

Meeting the Need for Appropriate Nutritional Support in the Trauma Setting

Poor nutrition status has long been linked to increases in post-operative complications and adverse outcomes in trauma patients. Despite the evidence validating the role of nutritional elements in recovering from the stress of trauma, there is a significant unmet need for high-quality, pharmaceutical-grade nutritional supplements specifically designed to support the nutritional needs of trauma patients. Mediceutical supplements address this significant unmet need by tailoring nutritional products to address specific clinical and medical conditions, using nutrients and dosages that have been validated by evidence-based research.

Forté Elements Trauma Drink is a Mediceutical developed by physicians specifically to support patients recovering from surgery or other acute trauma. Unlike nutritional supplements or nutraceuticals that lack regulatory oversight or a rigorous testing, mediceuticals are produced using pharmaceutical-grade ingredients and manufacturing practices, and undergo a scientific, transparent testing process. Forté Elements Trauma contains vitamins A, B, C and D, as well as key trace elements and a proprietary blend of amino acids, at the supplemental doses that clinical research indicates will be beneficial in trauma patients. For example, Forté Elements Trauma Drink contains 1500 mg of vitamin C to address the deficiency related to oxidative stress and surgery, as well as appropriate doses of vitamin D and L-arginine to support wound healing.

Forté Elements Trauma Drink

A significant body of research supports the relationship between nutritional status and quality of patient care, and improved attention to nutritional status may positively affect clinical outcomes. The nutritional density of hospital food is often poor and not well-targeted for specific clinical situations. Even among patients who are given nutritional support and dietary supplementation, studies have shown that conventional approaches still provide most patients with an inadequate diet. Various Forté Elements Trauma Drink helps to bridge this gap by providing the right blend of micronutrients to support repair, recovery and restoration of the body from the myriad physiological effects of trauma.

A fusion of science and practical medical experience unlike anything that has come before.