

Nutritional Support in the Perioperative Period **Topic 17**

Module 17.2

Nutritional Goals in the Perioperative Period

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Learning objectives

- Necessity of nutritional risk screening in surgical patients
- Definition of "high nutritional risk"
- Indications and concepts for perioperative nutritional support according to the ESPEN guidelines
- Enteral, parenteral, and combined enteral/parenteral nutrition
- Macro-, and micronutrients
- Indication for immune-enhancing diets
- Nutritional monitoring and follow-up after discharge

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Key messages

- Nutritional status is a prognostic factor in surgical patients;
- Nutritional screening is essential in order to identify patients at metabolic risk early before surgery;
- Nutritional support is required if a longer period of inadequate oral intake has to be anticipated;
- The enteral route should be preferred;

- If caloric supply is inadequate, the combination of enteral and parenteral “dual” nutrition will be advantageous.

1. Introduction

Malnutrition is generally considered to be associated with starving and lack of food. Its presence in a modern society with an increasing percentage of obese people is frequently neither realized nor well understood. Undernutrition is more subtle than suggested by the World Health Organization (WHO) definition with a body mass index (BMI) $<18.5\text{kg}/\text{m}^2$. Disease related weight loss in patients with overweight is not necessarily associated with the low BMI of the definition of the WHO. However, this weight loss results in changes of body composition inducing a loss of fat-free mass, thus bearing a „metabolic risk“ which has to be kept in mind for patients undergoing major surgery, especially those with cancer.

Therefore, ESPEN has recently defined diagnostic criteria for malnutrition according to two options:

-option 1: BMI $<18.5\text{kg}/\text{m}^2$

-option 2: combined: weight loss $>10\%$ or $>5\%$ over 3 months and reduced BMI or a low fat free mass index (FFMI).

Reduced BMI means <20 or $<22\text{kg}/\text{m}^2$ in patients younger and older than 70 years, respectively. Low FFMI is <15 and $<17\text{kg}/\text{m}^2$ in females and males, respectively (1).

Because under- and malnutrition are frequently not recognized and therefore untreated, metabolic factors will be usually not considered for the critical analysis of surgical morbidity and outcome. Many retrospective and prospective major trials have elucidated the association with impaired nutritional status and postoperative complication rate and mortality (2-4). Data from the European “NutritionDay” in about 15000 patients clearly showed that “metabolic risk” is a factor of hospital mortality, particularly in the elderly (5).

According to the prospective data from a multicentric trial most high risk patients will be found in hospital in the departments of surgery, oncology, geriatrics, and intensive care medicine. The univariate analysis revealed significant impact on the hospital complication rate from: severity of the disease, age >70 years, surgery and cancer (3). Bearing in mind the demographic development in the western world, surgeons will have to deal with an accumulation of risk in the elderly undergoing major surgery for cancer.

Therefore, nutritional management is an interprofessional challenge, and in times of limitations in health care economy becomes a „must“ for rationalization in order to save resources. As a basic requirement systematic nutritional risk screening has to be considered in all patients on hospital admission. For the surgeon the mechanical approach to the patient has to be added to by the metabolic dimension of surgery.

Table 1
Nutritional aspects in the surgical patient

<ul style="list-style-type: none"> - Nutritional Risk Screening on admission or first contact - Observation and documentation of oral intake - Regular follow-up of weight and BMI

2. Screening Tools

Several screening tools are available. Well validated and officially recommended by ESPEN with wide-spread use is the **Nutritional Risk Screening (NRS)**, the so-called Kondrup-NRS (6). Patients classified at risk by NRS have significantly higher complication rates during their hospital stay (3).

Table 2
Complication rates in patients classified by NRS risk

	no complication % (n)	complication % (n)	Total in % (n)
No risk	88.7 (3021)	11.4 (383)	100 (3404)
Risk	69.4 (1143)	30.6 (504)	100 (1647)
			p < 0.001

According to Sorensen et al, 2008 (3)

Nutritional Risk Score (6):

The pre-screening which takes only a few minutes includes the following items:

- BMI < 20.5 kg/m²
- weight loss within 3 months
- diminished food intake
- severity of the disease

A severe metabolic risk (7)

has to be considered in case of presence of one or more of the following criteria

- weight loss > 10-15 %
- BMI < 18.5kg/m²
- Serum albumin < 30g/l (no hepatic or renal disease)

3. Indications for Nutritional Support

The key issues of perioperative nutritional care include avoidance of long periods of pre-operative starving and re-establishment of oral feeding as early as possible after surgery. Nutrition is an integral part of the Enhanced Recovery After Surgery (ERAS) or so-called multimodular "Fast Track"- concept, which has been widely accepted as the primary goal (8, 9). Implementation may still be improved. It is evidence-based that early oral/enteral nutrition will diminish postoperative ileus and accelerate solid food tolerance (10). Early oral nutrition is a key issue for re-establishing bowel motility and therefore an important step for enhanced recovery (9, 11). From a metabolic view, catabolism will be attenuated and nitrogen spared (12). Ideally, oral nutrition can be re-established within a few hours after surgery (7-9, 10-12). Those patients do not require artificial nutritional support or infusion therapy. However, the tolerance and the amount of food intake should be carefully observed. In the case that tolerance to oral fluid and food intake is limited for more than 4 days, it is recommended to start hypocaloric peripheral parenteral nutrition (e.g. two-chamber bag with glucose and aminoacids).

Despite convincing and clear metabolic advantages of the ERAS concept, there is also a risk from hypocaloric nutrition and delay of adequate nutritional support in unidentified patients at metabolic risk and those developing postoperative complications.

The indications for nutritional support in surgery are the prevention and treatment of undernutrition. During the perioperative period this is primarily the substitution of calories for preservation of the nutritional status and prevention of undernutrition. Nutritional intervention may also focus on improvement in outcome – for this indication the criteria of success are complication rates, mortality, hospital length of stay and cost-benefit ratio.

The following recommendations are in accordance with the ESPEN Guidelines for Enteral and Parenteral Nutrition in Surgery from 2006 and 2009 (7, 13, 14). The algorithm is also based on these recent guidelines.

Inadequate oral intake for more than 14 days is associated with a higher mortality. Nutritional support is therefore indicated even in patients without obvious undernutrition, if it is anticipated that the patient will be unable to eat for more than 7 days

perioperatively. It is also indicated in patients who cannot maintain oral intake above 60-75% of recommended intake for more than 10 days. In these situations nutritional support (by the enteral route if possible) should be initiated without delay. Combination with parenteral nutrition should be considered in patients in whom there is an indication for nutritional support and in whom energy needs cannot be met (<60% of caloric requirement) via the enteral route, e.g. in upper GI fistulae (7, 13, 15).

Whenever possible the enteral route is preferred. (7, 16-18). If necessary in the case of limited gastrointestinal tolerance, enteral nutrition should be supplemented by combined enteral / parenteral support. Parenteral nutrition is beneficial in undernourished patients in whom enteral nutrition is not feasible or not tolerated, as well as in patients with postoperative complications impairing gastrointestinal function who are unable to receive and absorb adequate amounts of oral / enteral feeding for 7 days or more (13).

4. Preoperative Nutrition

There are different concepts of patient conditioning which may be combined as well. These are:

- substitution of caloric deficiency in severe metabolic risk,
- metabolic conditioning (carbohydrate loading),
- immunological preconditioning.

4.1. Caloric Deficiency

It is still true, that "most patients will benefit from prompt surgery" (19). In order to restore caloric deficiency delaying surgery may only be justified in the case of severe undernutrition and metabolic risk. If nutritional support is indicated the enteral route is to be preferred. Whenever possible enteral nutrition should be performed as an outpatient before hospital stay in order to avoid nosocomial infections (7). Parenteral nutrition is recommended in severely undernourished patients who cannot be adequately orally or enterally fed (13).

Usually nutritional support will be administered for 7 to 14 days.

4.2. Metabolic Conditioning

Preoperative starving is unnecessary for most patients. The metabolic burden of perioperative hypoglycaemia related to overnight fasting has been clearly shown. Oral food intake in the night and fluids until 2-3 hrs before surgery do not increase the risk of aspiration during anaesthesia. Preoperative carbohydrate drinks can be recommended for most patients without significantly impaired gastric emptying. There are clear advantages for this "carbohydrate loading" on the subsequent early postoperative period. In the rare situation of patients who cannot be fed by the oral/enteral route a glucose infusion should be administered intravenously (7, 13). In several PRCT significant advantages were shown from carbohydrate loading. These included less postoperative discomfort as well as shortened length of hospital stay after colorectal surgery (20). A meta-analysis showed significantly shorter hospital length of stay in patients undergoing abdominal surgery (21).

4.3. Immunological Preconditioning

The so-called "immunonutrition" refers to the use of formulae enriched with arginine, omega-3-fatty acids, glutamine and/or nucleotides.

Patients with obvious severe nutritional risk, those patients undergoing major cancer surgery of the neck (laryngectomy, pharyngectomy) and of the abdomen (oesophagectomy, gastrectomy, and pancreatoduodenectomy) as well as after severe

trauma may benefit most from these formulae. This recommendation was emphasized in the ASPEN Guidelines for adult cancer patients (22), because immune modulating formulae contributed to a decreased rate of postoperative infections and consequently to a decreased length of stay in the hospital.

However, recent meta-analyses have brought up concerns about their superiority in comparison to standard oral nutritional supplements and the most appropriate "timing" (23-25). While significant benefit cannot be shown anymore for their preoperative use alone, it may still be expected for their perioperative and postoperative administration (26-28).

A National US Database evaluation (29) as well as data from Braga et al (30), and Chévrou-Severac et al (31) showed the cost-effectiveness of these formulae. In order to reduce resource consumption and total cost, a break-even infection rate was calculated for wellnourished (0.91%) as well as undernourished patients (>3.31%) (29).

5. Postoperative Nutrition

In general, interruption of nutritional intake is unnecessary after surgery. Oral intake should however be adapted to individual tolerance and to the type of surgery carried out. Usually, oral intake can be initiated within hours after surgery (7).

It is evidence based, that early oral and/or enteral food intake diminishes the risk for infectious complications and favours a shorter hospital length of stay (16-18). After surgery to the gastrointestinal tract no increase in the risk of developing anastomotic leakage can be found. Therefore, there is no reasonable rationale for longer periods of fasting after surgery. There is evidence that even after colorectal surgery with bowel anastomoses oral nutrition can be started without delay. When anastomoses of the upper GI tract have been performed, patients may drink as well as receiving enteral nutrition delivered via a tube whose tip is placed distal to the anastomosis (7).

Even if oral feeding can be started within short term after surgery patients may benefit from supplementary postoperative tube feeding: those after major cancer surgery of the abdomen and head and neck – laryngectomy, pharyngectomy, oesophageal resection, gastrectomy, pancreato-duodenectomy – as well as those after severe trauma. In these patients it is reasonable to create safe enteral access by naso-jejunal tube or fine needle catheter jejunostomy (NCJ) at the time of surgery. It has been shown that decompression after gastrectomy with a nasojejunal tube, bears considerable discomfort for many patients, and may be unnecessary (31). This is therefore another argument for NCJ for feeding (33).

Enteral tube feeding can be started with low rates (5-10ml/h) within 24 hrs after surgery. The administration rate should be cautiously increased stepwise by (for example) 10-20ml/h each day. Gastrointestinal tolerance has to be monitored carefully, observing gastric residual volume, the abdomen and peristalsis. In the case of haemodynamic instability in the ICU the administration rate should be reduced to 5-10ml/h or even stopped for a few hours.

For early enteral nutrition, especially in the Intensive Care Unit, a slow increase of administration rate is recommended: for example, 50ml/h with incremental small steps of 10-20ml/h over four days observing the enteral tolerance by abdominal distension and gastric aspiration. Standard enteral (polymeric) diets may be used which have to be appropriately added to by sufficient volumes of intravenous fluid (34). In high-risk patients - as outlined before - immunonutrition should often now be preferred (7, 22, 35).

6. Indications for Parenteral Nutrition (PN)

Parenteral nutrition is indicated in undernourished patients in whom enteral nutrition is not feasible or not tolerated, including patients with postoperative complications

impairing gastrointestinal function who are unable to receive and absorb adequate amounts of oral/enteral feeding for seven days or more. Combined enteral and parenteral feeding should be considered in all patients in whom there is an indication for nutritional support and in whom >60-75% of energy needs cannot be met via the enteral route. This may occur in high output enterocutaneous fistulae or short bowel syndrome. In completely obstructing lesions in which surgery should not be postponed because of the risk of aspiration or severe bowel distension leading to peritonitis parenteral nutrition is also of key importance (13).

The main contraindications for enteral nutrition in surgical patients are

- Bowel obstruction or ileus
- Severe shock with haemodynamic instability

In patients with prolonged gastrointestinal failure (short bowel syndrome - SBS) parenteral nutrition will be the life-saving treatment (13).

In most patients individualized nutrition is unnecessary, but special attention has to be attributed to patients with serious comorbidity (13). Standardization may follow a protocol, and "All-In-One" mixtures (AIO) (two-chamber-bags with glucose and aminoacids, three chamber bags with glucose, aminoacids and lipids) may be used. The advantages of AIO mixtures are shown with regard to feasibility, time and cost saving, and from the lower risk of contamination (36, 37).

6.1. Amino Acids

For the catabolic patient with proteolysis and loss of body cell mass the supply of amino acids is essential. Because protein synthesis is an energy consuming process appropriate utilization of amino acids will be only realized if glucose and lipids are supplied at the same time. In order to limit nitrogen losses during illness and perioperative stress the ESPEN guidelines recommend a supply of aminoacids up to 1.5-/kg of ideal body weight (IBW) (about 20 % of total energy requirement) (13). A higher supply bears the risk that the amino acids will be utilized only for gain of energy. In the case of TPN or near-total PN meta-analyses favour the supplementation with intravenous glutamine in a standard dosage of 0.35-0.4g/kg BW/d (13, 38). No data have been available with regard to glutamine supplementation for combined enteral and parenteral nutrition.

6.2. Glucose

"Intensified insulin therapy" has brought new metabolic awareness regarding hyperglycaemia. A meta-analysis including data from 38 studies clearly showed the evidence of insulin therapy for the decrease of mortality, in particular in surgical and diabetic ICU patients (39). However, intensified insulin treatment bears a considerable risk of hypoglycaemia and should be continuously performed with the equipment of an ICU (40). On the normal ward for the avoidance of hyperglycaemia reduction of glucose supply should be considered. At present, the optimal serum glucose level is considered to be about 140 - 150 mg% (13, 14).

6.3. Lipids

Nowadays, administration of lipid emulsions is considered to be an integral part of PN, especially in long-term ICU patients (15).

For a long time there were major concerns over administering lipids earlier than 10 days after the start of PN (41). This was related to a study in trauma patients, in whom the patients with lipid infusion had shown a significantly higher rate of infections, respiratory failure, and length of ICU stay (42). In this study a soy-bean based lipid emulsion with

long-chain-triglycerides (LCT) had been used. These LCT have a high content of polyunsaturated omega-6 fatty acids which are involved in the synthesis of leukotrienes and prostaglandins with a high inflammatory potential. This may induce adverse effects during the systemic inflammatory response syndrome (SIRS) and sepsis.

In order to reduce the dependence on omega-6-fatty acids mixed emulsions with medium- and long-chain triglycerides were developed. The tolerance of mixed LCT/MCT lipid emulsions in standard use is now sufficiently documented. (14). Another approach is with omega-9/olive oil based lipids, which are well tolerated in critically ill patients (14). In another formula MCT and LCT are combined with omega-3-fatty acids and olive oil. A ratio of omega-6 : 3 of 3:1 is considered to be immunologically neutral (43, 44). It could be shown, that supplementation of PN with omega-3 fatty acids may decrease mortality in critically ill patients with abdominal sepsis (45). The recent ESPEN guidelines state: The optimal PN regimen for critically ill surgical patients should probably include supplemental omega-3-fatty acids (13, 14). Fish oil-enriched lipid emulsions probably decrease length of stay in critically ill patients (14). For surgical patients advantages have been shown in meta-analyses with regard to infection rate, and length of hospital and intensive care unit stay (46, 47).

6.4. Ratio of Macronutrients

The protein:fat:glucose calorie ratio should approximate to 20:30:50 %. At present, there is a tendency to increase the glucose:fat ratio from 50:50 to 60:40 or even 70:30% of the non-protein calories, due to the problems encountered regarding hyperlipidaemia and fatty liver (13).

6.5. Caloric Amount

In the acute phase of critical illness limited substrate tolerance reflects the severity of the disease. Equally an inadequate amount of macronutrients is an additional burden for the body and may negatively influence outcome. Therefore, in the acute phase calorie supply should relate to individual tolerance but should not initially exceed 25kcal/kg of IBW. The recommended rates of supply are glucose 3-4g/kg IBW (blood glucose level about 140-150mg%), lipids 0.7-1.5g/kg IBW (serum triglyceride <300mg/dl) and amino acids 1-1.5/kg/IBW.

During the phase of recovery substrate tolerance will be normalized. In this period the amount of administered calories should be 1.2 to 1.5 fold higher than the calculated energy requirement. In this phase indirect calorimetry will provide useful information to guide the optimal energy supply in selected patients (14).

6.6. Vitamins and Trace Elements

In well-nourished patients who recover with oral or enteral nutrition by postoperative day 5 there is little evidence that intravenous supplementation of vitamins and trace elements is required. In those patients after surgery who are unable to be fed via the enteral route or in whom total or near total parenteral nutrition is required a full range of vitamins and trace elements should be supplemented on a daily basis (14, 15). Vitamins and other micronutrients should be adjusted separately.

With special regard to the critically ill surgical patient the supplementation with antioxidants - in particular selenium, and vitamins C and E as single nutrients or in combination - has proven advantages in clinical studies. New lipid emulsions containing alpha-tocopherol which is the biologically active vitamin E component provide an additional supply of vitamin E. Although it has to be assumed that the present ranges underestimate requirements in the critically ill, so far, there is no clear evidence to support the administration of higher dosages of single micronutrients, because toxicity cannot be excluded.

7. Monitoring

After major abdominal surgery follow-up of nutritional status (minimum BMI) including documentation of the amount of oral food intake is necessary. Dietary counselling is recommended as well which is usually appreciated by the patient.

Typical short term problems of parenteral nutrition are:

- hyperglycaemia
- hyperlipidaemia
- reversible micro- and macrovesicular steatosis of the liver
- cholestasis

Long term problems:

- non-alcoholic steatohepatitis (NASH)
- liver fibrosis and cirrhosis with impairment of liver function and liver failure

Table 3
Blood chemistry

- | |
|---|
| <ul style="list-style-type: none">- electrolytes- blood glucose- triglycerides- creatinine- liver enzymes- serum lactate in the critically ill |
|---|

8. Follow up

Although follow up of the nutritional status can be easily performed by the BMI this is not sensitive for differences in body composition without change of BMI. Bioelectrical Impedance Analysis (BIA) is a feasible noninvasive tool which is also convenient for outpatients. The intraindividual course can be well documented in a three-compartment-model including extracellular (ECM) and body cell mass (BCM) as well as fat mass (FM). From body impedance, the fat free mass (FFM), the ratio of ECM/BCM and the phase angle may be easily calculated providing reasonably reliable information about the cell content in the body. Ideally, the first measurement will be performed before surgery.

9. Post Discharge Nutrition

After major abdominal surgery dietary counselling will be reasonable and appreciated by most patients. In a considerable number of patients after major gastrointestinal or pancreatic surgery the oral calorie intake will be inadequate for several months. Possible reasons may be a decrease in appetite, impaired enteral tolerance with dumping symptoms, meteorism and diarrhoea. There is a guideline recommendation for insertion of a fine needle catheter jejunostomy (NCJ) at the time of surgery in the case of oesophageal resection, total gastrectomy, and pancreato-duodenectomy (7). The NCJ should not be removed at the time of discharge from the hospital (48, 49). If necessary supplementary enteral nutrition can be continued e.g. with 500 or 1000kcal/d via the NCJ. After teaching most patients will be able to administer jejunostomy tube feeding themselves. Although further weight loss cannot completely be avoided, attenuation of weight loss is shown as well as by oral nutritional supplementation (49, 50). Other authors have found a significantly better quality of life in these patients with nutritional supplementation (51). However, further data from controlled studies are needed to elucidate the precise benefits.

10. Concluding Remarks

Nutritional risk screening and, if indicated, nutritional support are essential parts of the perioperative management in ERAS programmes. With special regard to the elderly the early identification of patients at metabolic risk remains essential. According to the ESPEN guidelines those patients should undergo nutritional support very early if a longer period of inadequate oral intake has to be anticipated. The enteral route should be preferred whenever possible.

11. Summary

Aiming enhanced recovery and the reduction of postoperative morbidity ERAS programmes do not preclude the necessity of appropriate perioperative nutritional and metabolic care. Early detection and observation of patients with nutritional risk remains an essential part of perioperative management. Whenever possible, artificial nutritional support should be avoided. However, if in high risk patients inadequate oral intake has to be anticipated nutritional support should be started early via the enteral route, perhaps in combination with parenteral nutrition. Long-term total parenteral nutrition will be limited to special indications. This review includes support for the guideline recommendations for surgical patients of the European Society for Clinical Nutrition and Metabolism (ESPEN) (www.espen.org) from 2006 and 2009, of which update is in progress.

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