Measurements of nutritional status and impact of malnutrition in polytrauma patients

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Chapter 9

Summary

The primary aim of this thesis was to analyze the prevalence and incidence of malnutrition and nutritional risk, and its relation with adverse in-hospital outcomes in polytrauma patients. The second aim was to study new biomarkers and body composition parameters for the assessment of the nutritional status in polytrauma patients.

In **Chapter 1** the different types of malnutrition, the pathophysiology of malnutrition specifically in polytrauma patients, and the adverse outcomes of malnutrition were discussed. In addition, the existing nutritional screening and assessment tools, the lack of a 'gold standard' in polytrauma patients, and the need for new objective measurements of the nutritional status were stated.

In order to analyze the prevalence and incidence of malnutrition and nutritional risk, and its relation with adverse in-hospital outcomes, our study group initiated a multicenter international observational prospective cohort study in the Netherlands and the United States. In this study, called the Malnutrition in Polytrauma Patients (MaPP) study, adult polytrauma patients (Injury Severity Score ≥16) suffering from blunt trauma were included. In **Chapter 2** and **Chapter 3**, we focused on the first aim of this thesis. **Chapter 2** states the prevalence and incidence of malnutrition and the relation with complications in polytrauma patients. Malnutrition was assessed using the Subjective Global Assessment (SGA) score, which is developed in surgical patients and validated in critically ill patients. In this study, the prevalence of pre-existing malnutrition was 12%. This study showed that 50% of the severely injured patients developed malnutrition during their ICU stay, and an additional 20% developed malnutrition during admission to the ward. Malnutrition was found to be related to an increased risk of complications. **Chapter 3** showed the prevalence of high nutritional risk at ICU admission and the relation with adverse in-hospital outcomes in polytrauma patients. The nutritional risk at ICU admission is assessed with the modified Nutrition Risk in Critically Ill (mNUTRIC score). 18% of the polytrauma patients admitted to the ICU had high nutritional risk. The mNUTRIC was not found to be related to developing malnutrition during hospital admission, as assessed with the SGA score. On the other hand, high nutritional risk was found to be related to complications, especially pneumonia and systemic complications, and mortality.

In conclusion, these studies together showed that both SGA-diagnosed malnutrition and high nutritional risk as assessed with the mNUTRIC score, were found to be related to an increased risk of developing complications in polytrauma patients. Recognition of sub-optimally nourished polytrauma patients, assessment of their nutritional needs, and preemptive nutritional strategies are crucial to optimize their clinical outcomes.

In the second part of this thesis, we aimed to analyze several biomarkers and body composition parameters for the assessment of the nutritional status. **Chapter 4** gives an overview of the current knowledge about the value of metabolites and vitamins for the assessment of nutritional status in hospitalized patients. Several metabolites involved in the metabolism of methionine, purine, glutathione, carnitine, phenylalanine, and tryptophan, as well as some vitamins seem to be associated with malnutrition in hospitalized patients. This systematic review was the foundation for our prospective study of polytrauma patients. As part of the MaPP study, our study group initiated a study on the relevance of plasma lipoproteins and small metabolites in the assessment of nutritional status in polytrauma patients, which was discussed in **Chapter 5**. In this study, the MaPP patients who were admitted to a Dutch hospital and of whom plasma samples were available for biomarker analysis, were included. In these 51 patients, increased triglyceride in several lipoprotein subfractions and decreased levels of other lipoprotein subfraction lipids were found to be related to malnutrition risk. Furthermore, several small metabolites involved in the homocysteine cycle, ketone body formation, and muscle metabolism may be indicative of malnutrition risk. Following validation in larger cohorts, these indicators may guide institution of preventive nutritional measures in patients admitted to the ICU with severe injuries. The second study on the analysis of nutritional biomarkers is discussed in **Chapter 6**. In this study, the patients from **Chapter 5** who were well-nourished at ICU admission were included. In these 49 polytrauma patients, the trends of plasma vitamin A, D, and E levels during hospital admission were analyzed, and their relation to the development of malnutrition and complications, taking into account the protocolized multivitamin supplementation during ICU admission. We demonstrated that these fat-soluble vitamin levels increased during hospital admission, despite the critical illness following severe trauma. This could be potentially related to the fact that all patients received the protocolized multivitamin supplementation during ICU admission. Vitamins A, D, and E did not seem to be valuable biomarkers for the assessment

of nutritional status. Subsequently, no correlation with complications could be demonstrated in polytrauma patients.

In **Chapter 7**, computerized tomography-derived body composition parameters (CT-BCPs) were investigated in relation to the nutritional status of polytrauma patients. Patients who were admitted to a Dutch hospital or one of the three participating trauma centers in the US, and had an abdominal CT scan made for trauma assessment at admission to the emergency department, were included. In these 65 patients, three CT-BCPs were examined, namely, muscle density (MD), skeletal muscle index (SMI), and visceral adipose tissue (VAT). A higher MD and SMI correlate with better muscle quality, and a higher VAT indicates more visceral adipose tissue surrounding the intra-abdominal organs. To assess the nutritional status, the SGA score was used to diagnose malnutrition at ICU admission and on day 5 of admission, and the mNUTRIC at admission was used to assess the nutritional risk. We found that CT-BCPs were not related to malnutrition at ICU admission and on day 5. Low MD and high VAT were found to be related to high nutritional risk for polytrauma patients that were admitted to the ICU. Given that CT scans are routinely conducted on polytrauma patients, it allows for easy integration of these parameters in clinical practice as a routine assessment. In this way CT scans can provide valuable information on body composition in polytrauma patients in addition to conventional nutritional assessment and screening tools, identifying those polytrauma patients with increased risk of malnutrition at the moment of hospital admission.

Chapter 8 presents a discussion on the prevalence and incidence of malnutrition in polytrauma patients, the pathophysiological process of the development of malnutrition, and the related increased risk of developing complications in this patient group. It is suggested that both the mNUTRIC and the SGA are useful tools to assess nutritional risk and malnutrition, respectively, in polytrauma patients. Furthermore, these tools can prove their value in indicating which polytrauma patients might be more prone to developing complications during admission. This information can be used to start nutritional therapy earlier during admission or to intensify nutritional therapy in specific polytrauma patients. Additionally, several small metabolites and lipoproteins seem to be related to the nutritional status of polytrauma patients, but more research is needed to investigate the clinical relevance and to provide guidelines for its use in determining nutritional

status. Fat-soluble vitamin supplementation appears to be adequate in polytrauma patients, potentially obscuring the relationship between vitamin levels, nutritional status, and complications. Body composition parameters might prove their value in assessing the nutritional status in addition to the conventional nutritional assessment tools. This chapter further discusses the future perspectives and potential implications of the findings in this thesis.