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Tuz, Mariusz Adam and Mitchell, Aby (2021) The influence of anaemia on pressure ulcer healing in elderly patients. British Journal of Nursing, 30 (15). S32-S38. ISSN 0966-0461

10.12968/bjon.2021.30.15.S32

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The influence of anaemia on pressure ulcers (PU) healing in elderly individuals

Abstract

Anaemia is a common and multifactorial blood disorder in the elderly individuals. This condition may be a significant barrier to pressure ulcers healing as it is associated with decreased level of oxygen being supplied to body tissues. Some nutritional deficiencies such as iron, cobalamin and folate may also cause anaemia and have negative impact on pressure ulcer healing. An increased iron demand in chronic pressure ulcers is a significant factor associated with the risk of anaemia of chronic disease in elderly patients. Anaemia screening and correction may need to be considered as well as iron supplementation if required in pressure ulcer prevention and management.

Key words: anaemia, pressure ulcers, elderly.

Introduction

Anaemia is a common condition in the elderly patients (Beghé, Wilson & Ershler, 2004; Gaskell et al, 2008; McCormick and Stott, 2007; Rivilla Marugán et al, 2019) and its prevalence is strongly associated with an individuals socioeconomic status, psychological state and available support (Gupta et al, 2020; Lamba et al, 2019; Styszynski et al, 2018; Andreev et al, 2020; Hosseini et al, 2018). Anaemia in elderly patients is often multifactorial; however, the most common cause of this condition is iron deficiency due to malnutrition, decreased iron absorption, chronic gastrointestinal blood loss and chronic inflammatory conditions (Andrès et al, 2008; Cappellini, Musallam & Taher, 2020; Thomas, 2017; Girelli, Marchi & Camaschelli, 2018; Thomas, 2017).

The prevalence of pressure ulcers (PU) is significantly increased in the elderly individuals and is also related to other factors such as dementia, socioeconomic status, long term conditions, malnutrition low oxygen level and tissue ischemia (Jaul et al, 2018; Børsting et al, 2018; Margolis, 2002; Olivo et al, 2020; Azevedo Macena

et al, 2017; Liao et al, 2019; Galivanche et al, 2020; Lenche et al, 2016; Neloska et al, 2016; Kim et al, 2019).

Anaemia and decreased haemoglobin levels have been identified as significantly associated with PU development in the elderly population (Bailey et al, 2011; Gengenbacher et al, 2002; Jaul et al, 2018; Nadukkandiyil et al, 2019). There is a need to investigate the impact of anaemia on the process of PU healing and consider possible improvements in PU management as the current guidelines do not directly include any measures and actions associated with anaemia and only consider the impact of oxygenation deficits and impaired nutritional status on the risk of PU as a recommendation (European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel, 2019; Fletcher & Hall, 2018; NICE, 2014, 2015, 2020; Stansby et al, 2014).

A significance of aetiology and pathophysiology of anaemia in the PU development and healing

Anaemia is defined by the World Health Organisation as a blood disorder in which haemoglobin levels are below 120 g/l in females and 130 g/l in males (WHO, 2011). This is a condition associated with a decreased ability of erythrocytes to transport oxygen from lungs to body's tissues (Cappellini & Motta, 2015). Erythrocytes accommodate an iron – containing protein – haemoglobin, which is able to bind oxygen molecules to heme groups (Kosmachevskaya & Topunov, 2018; Marengo-Rowe, 2006). A diminished oxygen supply to body's tissues due to a low concentration of haemoglobin may lead to local hypoxia which has a destructive impact on certain tissues depending on their metabolic activity and oxygen demand (Hare et al, 2013; McLellan & Walsh, 2004; Thomas & Lumb, 2012). A significant decrease of oxygen concentration may also cause tissue continuity disruption and cell necrosis which can result in PU initiation. The prevelance of this is higher in the elderly population due to altered skin elaciticity and increased fragility (Blackburn et al, 2020; Gefen, 2008; Sree et al, 2019).

A PU caused by sustained pressure decreases the oxygen supply to the tissue which leads to tissue ischemia and necrosis (Edsberg et al, 2016; Lumbers, 2019; Mervis & Phillips, 2019). The significant factor is the length of time pressure is applied during specific occurrences. For example, when a patient needs to be in the same position such as proning (Stephen-Haynes & Maries, 2020) or positioning for surgical purposes (Walton-Geer, 2009). Anaemia in patients can significantly increase the development of a PU as oxygen concentration is already lower due to diminished haemoglobin and oxygen supply, resulting in tissue thypoxia (Thomas & Lumb, 2012; Sree et al, 2019).

A decreased level of oxygen at cellular level caused by anaemia has a negative impact on the PU healing rate. Oxygen plays specific roles in all of the stages of the wound healing process (Gordillo & Sen, 2003; Hopf & Rollins, 2007; Kimmel, Grant & Gitata, 2016) and is essential in the cell metabolism which may be altered in the elderly (Catic, 2018; Giorgi et al, 2018). Oxygen is also converted into ROS (reactive oxygen species) in the mitochondrial oxidative phosphorylation process which reduces as the person gets older (Ray et al, 2012; Lesnefsky & Hoppel, 2006). ROS regulates different cellular signalling pathways associated with each phase of the healing process (Gordillo & Sen, 2003; Kimmel, Grant & Gitata, 2016; Ray, Huang & Tsuji, 2012). For example platelet aggregation and vasoconstriction in the haemostasis phase (Masselli et al, 2020; Peters et al, 2000). Vasodilation, chemotaxis for phagocytic cells, and anti-inflammatory response in the inflammatory phase and angiogenesis, proliferation and differentiation of cells, and extracellular matrix formation in the proliferation phase. ROS also reglates formation and maturation in the remodelling phase (Mittal et al, 2014; Staiculescu et al, 2014; Day & Suzuki, 2006; Staiculescu et al, 2014; Saxena et al, 2019). Additionally, the PU healing process is compromised by both instristic and extrinsitc factiors as a result of the ageing process (Mitchell, 2020).

Anaemia may also affect PU healing differently in each individual. Some difficulties and problems may depend on the PU aetiology and pathophysiology, the staging of the PU damage and physical, psychological and socio – economic factors. These

need to also be considered according to the biopsychosocial model as the PU impact on patient's quality of life is always multidimensional (Mervis & Phillips, 2019; Morton & Phillips, 2016; European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel, 2019; Kurtz and Silverman, 1996),.

There are the following three groups of anaemia on the basis of the mean corpuscular volume (MCV) of erythrocytes (table 1).

Groups of anaemia

Group	Example
Microcytic	Iron deficiency, thalassaemia or some chronic diseases such as (MCV is decreased to below 82 fL);
Macrocytic	Megaloblastic, B12 and folate deficiency, liver disorders or alcohol related (MCV is increased to above 98 fL
Normocytic	renal insufficiency, haemolytic or related to some chronic diseases (MCV is within normal range of 82 fL – 98 fL)

(Moreno Chulilla et al, 2009; Thomas, 2017)

The classification of anaemia may also be based on pathogenic mechanisms related to production and loss of red blood cells (RBC) which allows to divide anaemia into the two groups (table 2)

Hypo-regenerative (bone marrow production of appropriate RBC is diminished which may be caused by lack of iron, B12 or folic acid)
Regenerative (production of RBC is increased by an appropriate respond by bone marrow to low RBC level)

(Moreno Chulilla et al, 2009).

There can be some dissimilarity in the influence of specific types of anaemia on PU healing and the appropriate treatments may need to be considered depending on the aetiology of anaemia as many factors can affect the wound healing process (Guo & Dipietro, 2010).

Anaemia associated with nutritional deficiencies and PU healing

Iron deficiency anaemia (IDA) is the most common form of anemia in the elderly (Cappellini, Musallam & Taher, 2020; Halawi, Moukhadder & Taher, 2017). This is microcytic anaemia caused by a reduced value of MCV (Thomas, 2017) and is associated with a decreased ability of haemoglobin production due to an insufficient level of iron in the body (absolute iron deficiency) or diminished iron supply to bone

marrow (functional iron deficiency) (Lopez et al, 2016). This can affect PU healing differently than other types of anaemia. Iron deficiency is an additional factor that negatively influences wound healing. Iron is required to assist with various molecular mechanisms in the skin such as oxidative stress processes and ultraviolet induced damages in the skin, cell apoptosis. In the wound healing process iron differencacy can affect cellular proliferation and differentiation, protein synthesis, and regulation of macrophage function during the inflammatory phase (Recalcati, Gammella & Cairo, 2019; Soares & Hamza, 2016; Wright, Richards & Srai, 2014; Kurz et al, 2008; Wlaschek et al, 2019; Wright, Richards & Srai, 2014).

Iron concentration is elevated in damaged tissue when a wound is healing (Coger et al, 2019) and there is an increased local iron deposition in chronic wounds (Tchanque-Fossuo et al, 2017). This specifically increased iron demand may also be a contributing factor to anaemia in patients with a chronic PU. Fuoco et al., (1997) found a significant association of anemia patients with PU during the inflammatory phase of wound healing which disappeared after healing. In addition, chronic PU (an inflammatory condition) may lead to anaemia of chronic disease (ACD) (Fraser, 2010).

There are other significant nutritional deficiencies which may cause anaemia such as a vitamin B12 (cobalamin) and a vitamin B9 (folate). Both are common nutritional disorders in the elderly caused by malnutrition, malabsorption, some chronic conditions and medication and may lead to macrocytic anaemia associated with an increased value of MCV and an impaired development of abnormally large erythrocytes - megaloblasts (Thomas, 2017; Marchi et al, 2020; Vadakattu et al, 2019; Watson, Lee & Garcia-Casal, 2018; Nagao & Hirokawa, 2017). However, macrocytic anaemia may also be non-megaloblastic if caused by specific conditions such as liver dysfunction, hypothyroidism or myelodysplastic syndrome but not by cobalamin or folate deficiency (Nagao & Hirokawa, 2017). PU healing may be specifically affected by cobalamin and folate deficiencies in addition to a negative influence by impaired oxygen transportation to tissues in patients with megaloblastic anaemia. These vitamins play important roles in vascular functions such as cellular

homocysteine metabolism, nitric oxide bioavailability and vasodilation (Stanhewicz & Kenney, 2017; Blom & Smulders, 2011; Gilfix, 2005). Cobalamin and folate deficiencies may lead to vascular dysfunction and occlusions (Haloul et al, 2020; Haynes, 2002). Psychological functions of the elderly individuals may also be affected in terms of cognitive deficits, depression, and pain (Julian et al, 2020; Baroni et al, 2019; Khosravi et al, 2020).

Recommendations for practice

A full holistic assessment is necessary to effectivey treat elderly patients and nurses need a good understanding of the causes and implications of anemia on pressure ulcer healing to inform long-term management. Risk assesments for pressure ulcers should be carried out as soon as possible (within a maximun of eight hours) of the patient admitted to hospital or community caseload and repeated as often as required based on patient acuity (Epuap, 2014) or if a change occurs in the patient's condition (Mitchell, 2018). There are several validated risk assessment tools used, the Waterlow score is the most commonly used in the UK, despite the lack of conclusive evidence of one score over another (Anthony et al., 2008, Mitchell, 2018). These tools are not directly associated with anaemia or risk assessment of anemia. The Waterlow assessment tool involves haemoglobin level only as the one of many risks factors of PU development (Waterlow, 2005). The Malnutrition Universal Screen Tool (MUST) which is an accurate and valid malnutrition assessment tool for the elderly (Poulia et al, 2012) concentrates on the body mass index (BMI) and the weight loss over time than significant nutritional deficiencies associated with anaemia (Bapen, 2011).

The prevention and management of PU in the elderly patients needs to involve anaemia assessment and correction in addition to diet supplementation and repositioning according to (Nadukkandiyil et al, 2019); however, a holistic risk assessment on admission and at any significant change in patient's condition always should be carried out according to the NICE guidelines (NICE, 2014). This may also need to involve any risks associated with anaemia and an approach based on the

biopsychosocial model by considering all the physical, psychological and social factors associated with anaemia as early recognition and management of this blood disorder can have a great impact on an elderly individual's health condition (Burney, Ahmad & Masroor, 2016; Kurtz & Silverman, 1996)).

Recommendations summary

- More primary research is needed on associations between anaemia and PU development and healing;
- Anaemia screening and correction may need to be implemented in PU prevention and management;
- An iron supplementation may need to be considered in elderly patients with PU as they are at risk of ACD due to increased iron demand.

Conclusion

The elderly individuals are at an increased risk of anaemia of multifactorial aetiology and a higher risk of ACD due to an increased iron demand associated with PU. This blood condition influences negatively PU healing. Anaemia screening and correction, as well as an iron supplementation, may need to be considered in the prevention and management of PU in elderly individuals. Physical, psychological and social factors are significant in association between anaemia and pressure ulcer healing based on the biopsychosocial model (Kurtz & Silverman, 1996) (Fig. 1).

Declaration of interests: none.

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