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Blood transfusion for an adult patient

– a guide

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Description

Blood transfusion is a crucial and often life-saving procedure, and it is a common care method in Finland. The procedure is not without risks, but most of the errors occur due to a human error. Therefore, it is essential to orientate oneself to the procedure. A good orientation and comprehensive guides are in a central role to guarantee a safe blood transfusion in the health care units.

The aim of the thesis was to create a guide about blood transfusion for an adult patient and include the adverse effects of the procedure. To enhance legibility, the guide was planned to be short and compact. The purpose of this thesis is to provide information to enhance professional expertise and thus ensure the patient safety. The research method was a literature review, and based on the results the guide was compiled. The thesis was written as a development project report. The final work was a report of the results of the literature review and the blood transfusion guide.

The work was written in English. The guide's purpose is to assist the health care staff to orientate the students to blood transfusion. Blood components, blood transfusion and transfusion related adverse effects are reviewed in the thesis. The guide discusses blood transfusions only with adult patients. For this reason, it could be further developed, for instance, by including the principles of children's blood transfusion or by translating the guide into Finnish. The final work was given to the haematology department in Central Hospital of Central Finland where it can be read by anyone interested in the subject, especially students.

Keywords (subjects)

blood, transfusion, blood transfusion, risks

Miscellanous

Attachment 2. Guide for a blood transfusion for an adult patient

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Tiivistelmä

Verensiirto on tärkeä ja usein elämän pelastava toimenpide, ja se on Suomessa yleinen hoitomenetelmä. Toimenpide ei ole riskitön, mutta suurin osa virheistä tapahtuu inhimillisten erehdysten kautta. Siksi onkin tärkeää olla perehtynyt toimenpiteeseen huolellisesti. Tämän tukemiseksi hyvä perehdytys ja kattavat oppaat aiheesta ovat tärkeitä hoitoalan yksiköissä.

Opinnäytetyön tavoitteena oli tehdä opas verensiirron toteuttamiseen aikuispotilaalle ja käydä läpi mahdollisia haittavaikutuksia liittyen verensiirtoon. Lukemisen helpottamiseksi oppaan tuli olla lyhyt ja ytimekäs. Opinnäytetyön tarkoituksena oli antaa tietoa parantaakseen ammattilista osaamista ja täten varmistaa potilasturvallisuus. Tutkimusmenetelmänä käytettiin kirjallisuuskatsausta, jonka tuloksien pohjalta ohjeistus tehtiin. Työ toteutettiin kehittämistyönä. Lopputuloksena oli raportti kirjallisuuskatsauksen tuloksista ja verensiirto-opas.

Työ on tehty englanninkielellä. Se auttaa henkilökuntaa perehdyttämään opiskelijat kyseiseen toimenpiteeseen. Työssä käydään läpi verenosat, verensiirto ja verensiirron haittavaikutukset. Työ käsittelee vain aikuispotilaille tehtyä verensiirtoa, joten sitä voitaisiin työstää pidemmälle esimerkiksi sisällyttämällä lasten verensiirron periaatteet tai kääntämällä opas suomenkielelle. Lopullinen tuotos annettiin hematologian yksikölle Keski-Suomen keskussairaalaan, jossa sitä pääsee käyttämään asiasta kiinnostuneet, etenkin opiskelijat.

Avainsanat (asiasanat)
veri, verensiirto, riskit

Muut tiedot
Liite 2. Guide for a blood transfusion for an adult patient

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1 Introduction

In human system there is approximately five litres of blood; about half of the blood is red blood cells and the other half is plasma. Blood also consists of white blood cells and platelets. Red blood cells are the most common product to be transfused in Finland, approximately 200 000 units are used every year. Whereas platelets and plasma products are used 40 000 units each per year. There are many reasons why a person would need a blood transfusion, for example an accident, cancer or operation. Often nowadays the blood components are separated and only the certain component that is needed is given. (Tietoa verestä 2015.)

Blood transfusion is a crucial and often life-saving procedure and it is a common care method (Gray, Howell and Pirie 2005, 38). The procedure is not without risk but the most of the errors occur due to human error. Therefore, it is essential to orientate oneself with the procedure. A good orientation and comprehensive guides are in a central role to guarantee a safe blood transfusion. (Wilkinson & Wilkinson 2000, 161.)

The health care procedures must be safe, high quality and appropriately executed (L 30.12.2010/1326 8§). According to the Finnish blood service law (L 1.4.2005/197 9§) the product must be traceable back to the donor and vice versa. The health care unit must store this documentation for 30 years (L 1.4.2005/197 15§). According to the article 19 in the Finnish constitutional law (L 11.6.1999/731) everyone has a right for basic livelihood and care if they are not able to acquire it themselves. This also includes the access to adequate health care services and support from social services. In practice, this means that everyone has a right for care. According to Yhlen and Ashton (2006), the

patients have a right to refuse the offered treatment. These reasons include personal and religious reasons. Personal reasons can be for instance based on fear of disease or the procedure. (3-4.) Jehovah's Witnesses' religion denies the blood transfusion, although this must always be individually checked (Effa-Heap 2009, 174).

The aim of this thesis is to create a guide for students about blood transfusion for an adult patient and include the adverse effects of the procedure. The purpose of this thesis is to provide information to enhance professional expertise and thus ensure the patient safety. The final work is given to the haematology department at the Central hospital in Central Finland to use especially by students.

2 Blood transfusion

2.1 Safety of the patient

There are differences between adult and child blood transfusion. In this thesis the focus is on blood transfusion for an adult patient. According to World Health Organization (2013.), to be considered as an adult one must be at least nineteen years of age, unless national law determines otherwise. In Finland, a person reaches the age of majority at eighteen years (Age of majority 2016). A patient is defined as a person using health care and social services or a person who is an object to care (L 785/1992 2 §).

Patient safety is defined as principles and actions of individuals and organizations to ensure the safety of the care and to protect patient from harm. From patient's point of view, it is that they are receiving the right

treatment, at the right time, in the correct way and cause as little harm as possible. (Mitä on potilasturvallisuus? 2014.) To ensure patient safety, health care professionals must correctly perform identity checks, record widely about state of the patient and the transfusion procedure, and maintain knowledge and skills up-to-date (Oldham, Sinclair & Hendry 2009, 318-320). Before a transfusion of any blood component it is crucial that the benefits outweigh the risks (Watson & Hearnshaw 2010, 43).

2.2 Administration of blood components

About half of the blood in the human body is red blood cells and the other half is plasma. Blood also consists of white blood cells and platelets. New blood cells are formed constantly in bone marrow of a healthy human being. Blood is rarely transferred as a whole but usually only a specific part is given as needed. (Watson & Hearnshaw, 2010, 41-42.) Blood group is an inherited characteristic. It is essential to transfuse correct blood type because incorrect blood's antibodies destroy transfused red blood cells in circulation, causing haemolysis (McClelland 2007, 16). ABO and RhD systems are the most common classification of blood groups. The most common blood group in Finland is A positive. (Tietoa verestä 2015.)

A blood transfusion is defined as administration of a blood product to the patient (Gray, Hearnshaw, Izatt, Kirwan, Murray, & Shreeve 2007, 40). It is a high risk form of therapy (Casey 2011, 20). The blood transfusions are used to fix deficiencies of blood components caused by disease or other conditions, such as a massive blood loss. In addition, blood components can be given before or during surgeries to enhance or replace lost fluids. The blood transfusion can be divided into two; emergency and urgent transfusion.

(Verensiirrot – yleisohje 2015.) The difference is that for the emergency transfusion there is no time to wait for the results of the tests but the transfusion is started with universal blood; the O blood in case of red blood cells. (Parris 2010, 19.) Whereas with urgent blood transfusion the tests and their results can be properly made and correct blood ordered. After the results have been analysed the blood product can be switched to a product according to the patient's blood type (Verensiirrot – yleisohje 2015). Usually, blood does not need to be warmed unless clinically indicated. Blood must not be warmed in an uncontrolled way, but it is warmed using specific devices with a thermometer and audible alarm (Gray et al. 2007, 43). In this thesis the focus is on the urgent blood transfusion.

2.3 Adverse effects

Adverse effect is described as an unwanted side effect of a treatment. It causes a patient medical harm, prolongs the care or increases the costs of the treatment. (Potilasturvallisuussanasto, Lääkehoidon turvallisuussanasto 2007, 7.) Severe adverse effects are unwanted reactions that may lead to death, major morbidity or disability (Hellstén 2006, 80). They are most likely to occur within the first fifteen minutes of the blood transfusion (Watson & Hearnshaw 2010, 47). Therefore, for the first fifteen minutes of the blood transfusion the patient is to be monitored closely for any signs of adverse effects. During this time the nurse should stay with the patient. After the fifteen minutes the patient can be left alone, yet still monitoring their state. (Hellstén 2006, 40.) The patient is asked to tell any changes in their condition to the staff (Watson & Hearnshaw 2010, 46). On the other hand, mild adverse effects are mild fever and allergic reactions, without drop in blood pressure, caused by the

transfusion. The cause of these mild adverse effects is usually unknown. (Hellstén 2006, 80.)

3 Aim and purpose

The aim of this thesis is to create a guide for students about blood transfusion for an adult patient and include the adverse effects of the procedure. The purpose of this thesis is to provide information to enhance professional expertise and thus ensure the patient safety. The final work is given to the haematology department at the Central hospital in Central Finland to use especially by students.

In this study the research questions are: how to perform a safe urgent blood transfusion for an adult? What are the risks and possible consequences of blood transfusion?

4 Implementation

4.1 The criteria for the literature review

A literature review is a search and analysis of existing knowledge and its rearrangement into a new form (Rowley & Slack, 2004, 31). The goal is to provide timely information on a certain topic. For the literature review, many different sources are used to find the information about the subject. The writer needs to be aware of their opinions, as in literature review there can only be few personal biases, if any. (Cronin, Ryan, Coughlan 2008, 38.) For this thesis, literature review was chosen in order to summarize up-to-date and relevant

information on the topic to develop instructions for a specific ward. Scientific texts were analysed for this thesis. A literature review was conducted based on these texts.

In addition, a good literature review is well written with correct terminology and clear structuring to enhance the flow of the text. The references must be used accurately (Cronin et al. 2008, 38). In this thesis, terminology was carefully studied by searching the internet and dictionaries. The structure and referencing were formed based on Jyväskylä University of applied sciences instructions.

For literature review it is essential to create a good strategy for literature search and selection with the help of research questions (Aveyard 2010, 5-6). At the beginning, it is pivotal to form research question to keep the focus on the aims and purpose of the study. With correct and well-formed questions, the writer is able to find the most relevant information for their study. Keywords are formed based on the research questions, and they reflect the main points of the study. They are used to find relevant material with the same main concepts. (Aveyard 2010, 23-24, 77.) In this thesis, there were two research questions, which aid focusing on the aim of the thesis. The keywords were based on the research questions. With these keywords, relevant literature was found.

It is essential to select databases that provide reliable and scientific information. Without any criteria for acceptable references, there comes a considerable amount of studies that may not be suitable for the researcher's text. (Cronin et al. 2008, 40.) The databases used in this thesis were chosen based on accessibility and relevance. CINAHL and PubMed were chosen because they have nursing and health related publications. Whereas Ebrary

was used to find books related to the topic. Lastly, databases Aleksi and Janet were searched to find Finnish articles and books to support the practice policies provided in the thesis.

Distinct inclusion criteria for acceptable references are essential to find data that is precisely suitable to the review. For example, the timeframe and languages are important to consider in the search criteria. (Aveyard 2010, 71-72.) For this thesis, only the publications released between the years 2000 and 2016 were considered. In the thesis the timeframe for the articles is wide. After searching different articles, a conclusion was made that there had not been any major changes in the procedure or the safety cautions. The articles that were available in full and in English or in Finnish were selected. In addition, the articles included abstract and references and the main focus was on blood transfusion. The inclusion criteria are presented in Table 2.

Published between the years 2000 and 2016
Published in English or in Finnish
The online texts are available in full text
The articles are focused on blood transfusion
The articles have abstract and references available

Table 1. Criteria for acceptable references

4.2 Literature search

The databases used for searching the articles and books were Aleksi, CINAHL, Ebrary, Janet and PubMed. Two different searches were conducted to find comprehensive information about the subject. The keywords were chosen based on the research questions. The keywords in CINAHL, Ebrary

and PubMed were “blood” AND “transfusion”, “blood transfusion” AND “risks”. In Aleksi and Janet, the keywords were in Finnish: “veri [blood]” and “verensiirto [blood transfusion]”. The searches were specified to years 2000 to 2016, availability online in full text and the text must include abstract and references. See table 2.

Keywords were entered to the databases mentioned above and from the researches that come up with the most relevant information for this study were used. The articles or studies that were read further were chosen by the title and then by the content of abstracts. Considering this work, relatively recent studies and other resources and studies that are closely related to this study, were chosen. There were plenty of information available on this subject, the earliest resources that were used are dated back to 2000 whereas the most recent ones were from the year 2016. It is important to use relevant and up to date sources of information. The reason for this is to ensure the validity of the information. Sources that do not provide answers to the research questions, are not used. (Aveyard, 2010, 43.) The material was searched both in English and in Finnish. The articles that did not answer the research questions were not used.

In CINAHL, after considering the criteria for references, 111 articles were left for closer analysis. Of these 80 articles were eliminated according to the relevance of the heading, leaving 31 articles for further consideration. Out of these 31 articles 24 were fitting according to their abstracts. The main reason for elimination of articles was that the article did not answer to the research questions. In addition, some articles were very specific to a certain country or disease. The final 22 articles were read and if the article did not fully answer the research question, it was left out. In the end, twelve articles were chosen from CINAHL to be used in the literature review.

In Ebrary, two separate searches were done. Both were searches in fields "Title" and "Text and key fields". First search resulted in 45 books, and based on the title, four met the criteria. These four were given a closer look on the contents list and two were chosen to be used in the study. The second search in Ebrary resulted in seven books, from which two met the criteria based on the title, and these two were chosen based on the contents. It turned out that the two separate searches resulted in the same books.

Due to lack of Finnish material, two searches in Janet were conducted in Finnish. After applying the criteria, the first search resulted in nine books. Based on title and content, two of them were selected for a closer look. These two were also chosen to be used in the literature review. Four additional books were found with the second search, from which two books were elected to be used in the literature review. The two books selected from the second search were the same ones found in the first search.

Aleksi and PubMed were also searches through. These searches resulted into zero additional articles. In Aleksi, the first search resulted in four and the second in two articles; these were cut out based on their abstract. The search done in PubMed resulted in total of 31 articles but based on the heading, none of them were chosen.

In addition to searches in Aleksi, Ebrary, CINAHL, Janet and PubMed, a manual search was conducted. The references of the chosen articles were carefully gone through using the criteria for acceptable references. This way, one additional reference was found.

Database	Limitations	Search words	Results in total	Based on the heading	Based on the abstract	Based on the full text
Aleksi	2000-2016, full text, in Finnish abstract and references available	Verensiirto [Blood transfusion]	39	4	0	0
	2000-2016, full text, in Finnish, abstract and references available	Verensiirto [Blood transfusion] riskit [risks]	5	2	0	0
CINAHL	2000-2016, full text, abstract & references available	Blood AND transfusion	82	26	17	9
	2000-2016, text, abstract & references available	Blood transfusion AND risks	29	5	5	3
Ebrary	2000-2016, full text, references available	Blood AND transfusion	45	4	2	2
	2000-2016, full text, references available	Blood transfusion AND risk	7	2	2	2 (2 of them are the same)=0
Janet	2000-2016, Finnish, blood, book, in library's collection	Veri [Blood]	9	2	2	2

	2000-2016, Finnish, blood transfusion, book, in library's collection	Verensiirto [Blood transfusion]	4	2	2	2 (2 of them are the same)=0
PubMed	2000-2016, full text, references and abstract available, humans	Blood transfusion AND risk	31	0	0	0
Manual search	2000-2016, full text, references available	Blood transfusion AND risk	201	42	12	5 (4 of them are the same)=1
		In total	377	84	42	17

Table 2. Literature search

4.3 Constructing a good guide

It is essential to recognise who the guide is made for (Vilkka & Airaksinen 2004, 129). Moreover, it is useful to get comments from the unit the work is made for. They might have some demands on the layout, pictures or choice of words. (Vilkka & Airaksinen 2004, 129.) A good heading is short but informative, and it arises interest. The sub-headings divide the text into clear sections: they are constructed one topic per paragraph. The guide can be in the form of a list; the relevant points stand out and are easy and fast to read. It is logical to present the instructions in chronological order. (Torkkola, Heikkilä & Tiainen 2002, 25, 39-43.) In this thesis, the guide was meant to be in a short and compact form to enhance legibility. The text was in clear English and in imperative form. The headings were planned in order to separate the topics

from one another. The stages of the blood transfusion procedure were listed in consecutive time order thus making it easier and faster to read.

A good guide tells only the essential matters in a clear and spacious manner that eases the reading and understanding (Torkkola et al., 2002, 29, 55-56). Font, colouring and layout have an effect on the legibility and appearance. Font should be large enough and neutral. (Vilkka & Airaksinen 2004, 52-53.) Pictures compliment and ease the understanding of the text. They are to demonstrate and give further details on the subject. (Torkkola et al. 2002, 40-41.) The used font was Arial, size 11 and the headings were in size 13 and in the colour red. A table was created for the adverse effects of blood transfusion to ease the legibility and to make it more appealing. The picture of the blood bag was added to clarify the written text. The information was summarized for the guide in order to highlight the main points.

4.4 Inductive content analysis

Development project report was chosen as the research method based on the desire to enhance the knowledge of blood transfusion thus ensure patient safety. A guide seemed an appropriate way to do achieve that. Development project report consists of a report of the work and the product (Vilkka & Airaksinen 2004, 65). The haemotology department was interested in an electronic form of a guide, therefore, the guide was made into a sheet form so that it works both in electronical and physical form.

The method that was used to analyse the material was inductive content analysis. Inductive content analysis is a subtype of content analysis that aims to find meanings in text. It consists of three parts: preparation, organizing and

reporting. In the first part, the material is selected and the main idea of them is figured. In the organizing part, the material is coded and categories are created. The coding meant that headings are written in the margins of the material to describe the content or colour coding is used. Next, the headings are gathered and higher themes are formed. Thus, resulting into the main themes of the development content report. Lastly, the analysis report and its results are reported. (Elo & Kyngäs 2007.)

In this thesis, the material was gathered as described in the previous chapter. After choosing the material, colour coding and headings were used to describe various aspects of the material. These aspects were clustered into bigger groups according to their similarity in the content from which the main themes were found. In this thesis, the main themes were patient safety, clinical aspects of blood transfusion and adverse effects.

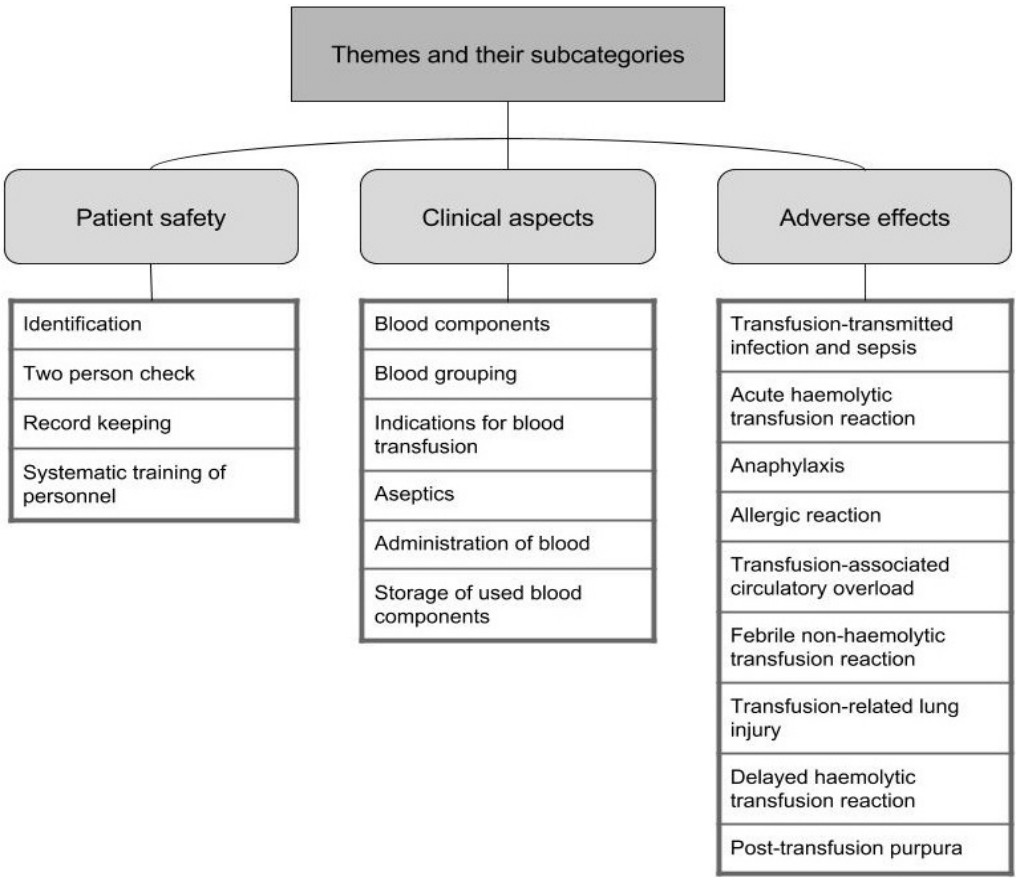

Table 3. Themes and their subcategories

5 Patient safety

A patient must be informed about their condition, different approaches and the proposed treatment. In addition, possible risks and benefits must be explained (Yhlen & Ashton 2006, 3). The patient's understanding of the procedure, risks and benefits must be verified. The patient must be given an opportunity to ask questions and express any concern they may have regarding the procedure. (Gray et al. 2007, 42.) Only after this, the patient is able to make an informed decision on whether or not to have the transfusion (Yhlen & Ashton 2006, 3).

Oldham, Sinclair and Hendry (2009) emphasize the importance of the patient identity check in the following situations: when the blood sample is taken, the blood product is collected and right before administration of the product. The confirmation of the identity must be done both verbally and by checking the identification band. The patient must state their full name and social security number; this ought to match the identification band, information on the blood bag label and patient documentation. (314 & 318.) The identification band must be attached firmly, and must include a minimum of surname, first names and social security number (Gray et al, 2007, 42). Parris and Grant-Casey (2007, 36), as well as Gray, Howell and Pirie (2005, 40), state that gender and hospital identity number are required as a minimum information. With an unconscious patient, or person who is otherwise unable to state their name, all the written information must be used to identify the patient (Parris & Grant-Casey 2007, 37). However, Oldham, Sinclair and Hendry (2009, 318) emphasizes that the identity of the patient must also be verified with another member of the staff.

It is recommended that the blood product is checked by two registered practitioners (Wright 2010, 18; Watson & Hearnshaw 2010, 45). Although, Bradbury and Cruickshank (2000) note that double-checking may lead to either of the practitioners performing the checks to take the responsibility noticing errors. The blood component must be checked for best before –date, signs of leakage, unusual colour and patient's details, such as blood types. The details of the unit are checked against the prescription and patient's identification. (Wilkinson & Wilkinson 2000, 167.) In case there is any interruption during the checking, the procedure must be started over (Casey 2011, 22).

Wilkinson and Wilkinson (2000) state that the health care staff is accountable to record all stages and adverse reactions during the procedure. The records include indication for transfusion, date of transfusion, start and end time of each transfused component, vital signs and adverse reactions. In addition, it is crucial to present in records the number and type of previous transfusions, and adverse reactions and their interventions. (168.) The records are stored for 30 years (Gray et al. 2007, 44.)

Blood transfusion must be performed only by health care professionals with appropriate training and authorization (Parris 2010, 19). Using up-to-date and best available information to keep skills and knowledge, is the nurse's responsibility (Oldham et al. 2009, 320). By offering training and education for health care professionals, the chances for errors to occur during blood transfusion decrease (Gray et al. 2005, 42).

6 Clinical aspects of blood transfusion

6.1 Blood components

Transferring carbon dioxide from the tissues to the lungs and oxygen from the lungs to the tissues is the primary duty of red blood cells. (Watson & Hearnshaw, 2010, 42). According to McClelland (2007, 7) transfusion of red blood cells is indicated when replacing acute blood loss or correcting anaemia. The red cell blood product must be stored at temperature between +2 and +6 Celsius, and it is usable for 35 days after donation (Oldham, Sinclair & Hendry 2009, 316). According to Hellstén (2006, 40), the blood component must be transfused within six hours after taking it out of the refrigerator.The rate of the transfusion is approximately 90 minutes per package. (McClelland 2007, 20.)

Another blood component is platelets. The main purpose is the role in blood coagulation, also known as haemostasis. The main indication for platelet transfusion is thrombocytopenia due to major haemorrhage or bone marrow failure. This blood component must be stored and transfused at temperature 22° Celsius ±2. (McClelland 2007, 8 & 20). Platelet components must never be put in the refrigerator. After the donation, platelets last for five days in an agitator (Watson & Hearnshaw 2010, 43). Without an agitator, platelets last for 24 hours after they have been sent from the Blood service (Aroviita, Auvinen & Mäki 2007, 19). Platelets are infused within 30 to 60 minutes per package (McClelland 2007, 18).

The third component of blood is plasma. The functions of plasma are involvement in immunization, clotting of blood and transportation of nutrients and heat. Plasma is processed into fresh frozen plasma (FFP), after it can be stored up to two years at temperature -30° Celsius. (Watson &

Hearnshaw 2010, 43.) Defrosted unit of FFP must be used in 24 hours. Transfusion of FFP is indicated to replace clotting factors because of major haemorrhage or coagulation deficiencies. (McClelland 2007, 9 &18.) Octaplas is a pharmaceutical fresh frozen plasma product. Nowadays, it is surrogate for FFP. (Hellstén 2006, 38.)

6.2 Blood grouping

The most basic classification of blood groups is the ABO system. Humans develop antibodies against the antigens that they do not have. (McClelland 2007, 16.) This means that the AB blood group has both antigens A and B but has no antibodies. O group has no antigens, however it has antibodies against A and B. Therefore, person with the blood type O is a universal donor, which means they are able to donate blood to any blood group. (Parris 2010, 18.) On the other hand, person with AB blood type is called universal recipient; they can receive blood from any other blood type but can be donated only to AB group. (Watson & Hearnshaw 2010, 45). Another grouping system is by determining whether or not a person has RhD antigen on their red blood cells. A person who does not have RhD antigen is known as RhD negative, and those who do have it are RhD positive. RhD positive can receive blood from either groups. (Parris 2010, 18.) In an emergency situation, RhD positive blood can be given to RhD negative blood group but in that case anti-D shot must be give (Aroviita 2007, 42).

Person blood group	Antigens	Antibodies	Can receive red cells from	Can donate blood to
O	None	A and B	O	AB, A, B, O
B	B	A	B, O	B, AB
A	A	B	A, O	A, AB
AB	A and B	None	AB, A, B, O	AB

Table 4. Blood group suitability for red cell transfusion (Watson & Hearnshaw 2010, 45)

The blood group, ABO and RhD type, of the patient must be determined and any irregular antibodies must be identified before blood transfusion (McClelland 2007, 17). The laboratory must be ordered to take the blood sample and carry out the testing. The patient must be identified before taking the sample. (Watson & Hearnshaw 2010, 44.) Crossmatching is testing compatibility of red cells between patients own blood and the unit of blood to be transfused (McClelland 2007, 17).

After confirming the patient identity, the required blood sampling is done; blood group testing and crossmatching. The request form for blood components includes identity of the patient, details of previous transfusions, obstetric history, the amount, and timing of blood components and where they are sent to. (Transfusion medicine handbook 2016, 23-24.) Ordering blood products, any special requirements and instructions must be taken into consideration, such as use of blood warmer, need for gamma-irritated products or if any medication is needed prior or following the transfusion (Guidelines for the administration of blood products 2011, 19). Blood must not be warmed unless it is clinically indicated. Indications include rapid infusion

and exchange transfusion in neonates. (Transfusion medicine handbook 2016, 30-31.)

6.3 Administration of blood

An intravenous access must be established. Standard cannulas are used for transfusions that must be done at a slow rate, for example 21 G. For accelerated transfusions, larger cannulas are needed, for example 14 G. (McClelland 2007, 21.) The size of the cannula also depends on the size of the vein (Gray et al. 2007, 42). After inserting the cannula, a see-through dressing is placed on the cannula in order to detect early signs of infection and extravasation. It is essential to prepare the transfusion set in strict aseptic manner in clean environment to avoid bacterial contamination. In addition, the sets are changed after each transfusion. (Bradbury & Cruickshank 2000.) A sterile transfusion set with a specific filter (170-200μm pore size) must be used when transfusing blood products (Gray et al. 2007, 43). Although, Hellstén (2006, 40) states that filter size can be 150-200μm. Any medication is not to be added to the blood product (Gray et al. 2007, 43).

The transfusion is started with a biological test. During the test, the flow rate of the blood product is 10-15 drops per minute and the test lasts for 10-15 minutes. (Hellstén 2006, 40.) If there are no complications after the 15 minutes, the flow rate is increased to the level the doctor has prescribed (Aroviita et al. 2007, 51).

Before beginning of each transfusion, vital signs are recorded. The vital signs in question are temperature, pulse, and blood pressure. (Oldham et al. 2009, 319.) Casey (2011, 25), as well as Watson and Hearnshaw (2010, 46), add

respiratory rate as part of the baseline observations. A patient is closely monitored for the first 15 minutes since severe adverse reactions most commonly happen during that time (Bradbury & Cruickshank 2000). The most of the sources agree on that pulse and temperature are to be taken after 15 minutes; however, some articles add blood pressure and respiratory rate to be taken as well (Casey 2011, 25; Watson & Hearnshaw 2010, 46). At the end of the transfusion, the baseline observations are taken. If there are any signs of adverse reaction, further observations are taken. (Gray et al. 2005, 40.)

After the transfusion, segments of red cell component's compatibility tubing with unique unit number are stored in refrigerator for three days, whereas platelets and plasma products for a few hours. In case the blood transfusion must be stopped, the transfused product and the transfusion set are stored in a plastic bag in the refrigerator for 24 hours. (Aroviita et al. 2007, 51.) In case severe adverse reactions occur, they are sent to Blood bank for further investigation. (Hellstén 2006, 43.)

7 Adverse effects of blood transfusion

Risk for adverse effect exists in every transfusion, and many of these reactions occur as a result of mistakes made during preparation, collection or the actual administration of blood. The adverse reactions can be classified based on the severity of the symptoms, mild or severe, or the time of onset, acute or delayed. (Gray et al. 2007, 45-46.)

In case a mild adverse effect is suspected, the transfusion is stopped. The intravenous access is maintained with normal saline (0,9%). (Casey 2011, 23-24.) Patient's baseline observations are monitored and recorded. The doctor

must be informed and further instructions are requested. The severe reactions are managed the same way with the exception of preparing for resuscitation. (Guidelines for the administration of blood products 2011, 44.) Adverse effects must be recorded in patient's documentation (Gray et al. 2005, 40).

Transfusion-transmitted infection (TTI) is a severe and rare adverse effect of blood transfusion (Casey 2011, 24). TTI is caused by bacterial contamination of a blood component (McClelland 2007, 59). Infection is thought to be transfusion origin when it did not exist before the transfusion and other causes of infection are ruled out (Watson & Hearnshaw 2010, 47). The symptoms include high fever, rigors, tachycardia, hypotension and ultimately shock with multi-organ failure. Bacterial contamination of platelets does not have as severe symptoms as contamination of red cell products. The onset of the reaction is within minutes of the beginning of blood transfusion. (Casey 2011, 24-25.) If TTI is left untreated, a serious risk of sepsis arises. Sepsis is rare but lethal condition. (Transfusion medicine handbook 2016, 146.)

Acute haemolytic transfusion reaction (AHTR) is caused by transfusion of incompatible blood product, it is most commonly due to incorrect actions and identification of the patient. The symptoms may arise within a few minutes of starting the transfusion. (Transfusion medicine handbook 2016, 145-146.) However, Casey (2011) states that the onset of the adverse effect can be anytime during the blood transfusion, or up to 24 hours. Signs and symptoms of AHTR are restlessness, fever, flushing, abdominal or chest pain, nausea, jaundice, oliguria, breathlessness and hypotension. In a severe reaction, most of the previously symptoms are present, whereas in a less severe adverse reaction, only a few symptoms arise. Many of the signs and symptoms of AHTR are similar in other adverse effects. (23-24.)

Allergic reaction is a mild adverse effect of blood transfusion. The symptoms include urticaria, itching, cyanosis, stridor and oedema. Allergic reactions can occur during or within 4 hours of transfusion. (Transfusion medicine handbook 2016, 144.) Casey (2011) adds that the allergic reaction can appear up to 24 hours after the transfusion. The origin of reaction is the allergic reaction between donated blood's plasma protein and recipient antibodies. (23.) Anaphylacic shock is a severe allergic reaction. In addition to mild allergic symptoms, this includes dyspnoea, hypotension, cardiovascular collapse, bronchospasm, and rapid pulse. Resuscitation may be needed. (McClelland 2007, 60.)

According to McClelland (2007, 60) transfusion associated circulatory overload (TACO) is caused by transfusing the product too fast for the patient to tolerate. The symptoms of this adverse effect are dyspnoea, tachycardia, hypertension, jugular venous pressure, worsening pulmonary oedema and acute respiratory distress. This is a severe adverse reaction that may occur after the first fifteen minutes but within six hours of transfusion. The best treatment for TACO is to prevent overload. (Casey 2006, 24.)

Febrile non-haemolytic transfusion reaction (FNHTR) occurs usually 30-60 minutes after the beginning of transfusion with shivering followed by fever (Transfusion medicine handbook 2016, 144). The interaction between recipient's blood antibodies and donor plasma's white cell antigens is thought to be the cause of the reaction (Casey 2011, 23). The transfusion is stopped but if after 30 minutes the symptoms have not progressed, the transfusion can be continued at slow rate. (Transfusion medicine handbook 2016, 144.)

Transfusion-related acute-lung injury (TRALI) is a severe adverse effect that occurs within six hours of transfusion. It is caused by human leucocyte

antigen antibodies, from the donated plasma, which are reacting with the patient's neutrophils. Hypotension, tachycardia, dyspnoea and fever are symptoms of TRALI. (Casey 2011, 24.)

Delayed haemolytic transfusion reaction (DHTR) occurs more than 24 hours after the transfusion (Watson & Hearnshaw 2010, 47). The most common cause for DHTR is secondary immune response that affects the Rh system's antibodies (Transfusion medicine handbook 2016, 146). Symptoms include fall in haemoglobin level or the level does not rise as expected. In addition, jaundice, fever and sometimes blood in urine or even renal failure can be symptoms of DHTR. Due to risk of severe kidney damage, renal function needs to be monitored closely. (McClelland 2007, 62.)

Post-transfusion purpura is a condition of severe thrombocytopenia that occurs 5 to 12 days after the transfusion of red cells and platelets. (Transfusion medicine handbook 2016, 147.) The thrombocytopenia is caused by destruction of the transfused and patient's own platelets, that is due to person's own immune response to foreign red cell antigen. (Watson & Hearnshaw 2010, 47). It is a rare but possibly fatal adverse effect of blood transfusion. The symptoms are a low platelet count (thrombocytopenia) with haemorrhage. (McClelland 2007, 62.)

8 Discussion

8.1 Discussion of the product and the process

The aim of this thesis was to create a guide for students about blood transfusion for an adult patient and include the adverse effects of the

procedure. This thesis features a guide that provides the aimed information in a compact and accessible form. In this thesis, the focus was on urgent blood transfusion procedure for an adult. The purpose of this thesis was to provide information to enhance professional expertise and thus ensure the patient safety. The guide is meant for students in practice to enhance their knowledge and competence in blood transfusion.

The guide was made to be as simple and easy to read as possible, therefore, a lot of information was summarized. There was no need to repress the professional language in the guide since it was made for future professionals. Firstly, understanding of the blood groups, blood components and their functions in human body helps to comprehend the indications and principles of blood transfusion (Watson & Hearnshaw 2010, 41). Secondly, the procedure itself was essential to explain in detail in order for the health care professional to perform it safely (Oldham et al. 2009, 312). Thirdly, the adverse effects were thought to be pivotal to explain in the guide in order to learn what to monitor during the blood transfusion, and thus to improve the safety of the patient (Casey 2011, 20). The adverse effects explained in the guide were chosen based on their frequency of appearance in the articles. Lastly, the principles for a good guide were considered necessary to study in order to create a guide that is easy to read and the relevant information can be found effortlessly (Torkkola et al. 2002, 55).

The first research question was how to perform an urgent blood transfusion to an adult. All of the material had similar explanation for the procedure. The second question covered the risks and possible consequences of the procedure. Again, the findings of the articles were rather identical, only main focus altered between them. For example, Casey's (2011) article focused

mainly on the adverse effects of blood transfusion whereas Oldham, Sinclair and Hendry (2009) focused on the blood transfusion procedure.

There were some differences between the materials found in literature search. It is essential to compare and evaluate the information available to achieve the most reliable and relevant outcomes. There were some differences between the sources based on the country of their origin. To illustrate, the Finnish sources state that the time in which the blood component must be transferred after taking it from the refrigerator is six hours, whereas foreign sources note that it is four hours. (Hellstén 2006, 40; McClelland 2007, 18). Other divisive subject was the checking procedure, especially the need for two-person check. Where other sources stated that the checking procedure must include two people, other claimed that it would increase the possibility for errors as the other person may rely on the other to spot the mistakes (Bradbury & Cruickshank 2000; Oldham et al 2009, 317). Lastly, there were differences considering the baseline observations during a blood transfusion. The most of the sources included pulse, blood pressure and temperature to be measured before the transfusion, 15 minutes after the beginning and at the end of the transfusion (Oldham et al. 2009, 319; Parris & Grant-Casey 2007, 37-38.) Casey (2011, 25) and Watson and Hearnshaw (2010, 46) add respiratory rate to the baseline observations. Moreover, Bradbury and Cruickshank (2000) state that baseline observations are to be taken every 15 minutes for the first hour of transfusion.

Once all the material was analyzed it was rather easy to form the guide. It was not time consuming because all the results were found. Although there were some small differences between the materials, the majority of the material shared same results and the guide was based on them. In the guide mainly international material was used, which led to that the Finnish customs had to

be separately searched. The goal was to make the guide as short and compact as possible. However, as the thesis progressed, more and more relevant information came up that needed to be included in the guide. This led to the guide to be wider than was wanted at first. A table was created for the adverse effects to ease the legibility and to make the guide more appealing. The picture of the blood bag was added to clarify the written text of the guide. The guide was sent to the haematology department for evaluation. Unfortunately, the ward did not have the time to give their feedback about the guide. This lead to that in the guide, the protocols, unique to each health care district, are missing. All in all, the guide ended up presenting the relevant information in a clear manner. However, more cooperation from the haematology department was hoped for regarding the layout and specific details of the guide.

8.2 Validity and ethical considerations

For the study to be considered ethical, it must be conducted and reported in coherent manner. The validity and ethical aspects of the study are directly linked to one another. (Tuomi & Sarajärvi 2009, 127.) Considering the validity of the thesis, one must evaluate how accurately the information has been gathered. (Hirsjärvi, Remes & Sajavaara 2009, 226-227). The topic was extensively and diligently researched to enable relevant and up to date results, and those results were presented accurately throughout the process. (Kankkunen & Vehviläinen-Julkunen 2009.) For every fact there is a reference presented. The other researcher's results are respected; all data, procedures, results and methods were honestly reported. The results were presented in a neutral manner, thus, respecting various moral values, such as religious,

cultural and personal beliefs. (Kankkunen & Vehviläinen-Julkunen 2009; Hyvä tieteellinen käytäntö 2014.)

The research process was explained in detail in such manner that it can be repeated. Different databases were used to collect material for the thesis and only the studies that answered the research questions were chosen. When the initial literature searches were performed, there came up a great amount of material of which some were a few decades old. A decision was made to limit the searches to specific years in order to avoid outdated information. This lead to a reduction in number of the material. In addition, the same studies were used in multiple references. This might add to the validity of the thesis. On the other hand, this homologous sampling may have manipulated the results of this thesis to a certain conclusion. In the literature search only English material came up, due to the chosen databases. This lead to lack of Finnish methods in the literature review. It made forming of the guide for Finnish ward slightly difficult. Therefore, a search in Finnish was added to find some additional Finnish material to make the guide more accurate. The thesis was done as teamwork, this may have increased the validity of the study since every reference was discussed and debated on by two people. This helped to keep any personal opinions and biases were aside.

8.3 Conclusion and recommendations

This thesis consists of a written report and a guide. The guide was given to the haematology department in Central Hospital of Central Finland where it is available for studying. It can be given to students who are in need for more information on this topic. A vast amount of material was processed and the

most suitable ones were chosen. Literature review was conducted and the material was used for the final product.

The results of the thesis can be directly applied when a student comes to the ward for practice. The guide helps the staff to guide the student in the process of blood transfusion. This thesis could be further developed by including the sampling procedure or concentrating on specific group of people, for example children, or focusing on the emergency blood transfusion. Aggregating feedback of this guide from staff and the students could be a thesis project in future. The thesis could also be translated into Finnish to reach those Finnish students who do not speak English fluently.

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Attachments

Attachment 1. The articles and books used in literature search

Authors	Topic	Aim and purpose	Publication type	Main findings
Australian and New Zealand Society of Blood Transfusion. 2011	Guidelines for the administration of blood products 2nd edition	To give guidance on how to safely administrate blood components.	Book	Correct information at collecting blood samples and a know-how during adverse reactions save lives.
Aroviita, P., Auvinen M-K., & Mäki, T. 2007	Verivalmisteiden käytön opas 2007 [Guide for using blood products 2007]	To explain different blood products and how to properly store and use them.	Book	Storing of the transfused blood components after the transfusion, in case an adverse effect occurs, is important.
Bradbury, M. & Cruickshank, J.P. 2000.	Blood transfusion: Crucial steps in maintaining safe practice	To considers nurse's responsibilities and offers evidence-based guidelines for practice	Journal article – tables/charts	The nurses play pivotal role in the procedure and identification checks; close monitoring, aseptics and identity checks.
Casey, G. 2011.	Blood transfusion: The high-risk life-saving therapy	To enlighten the reader of possible adverse effects and how to detect them.	Journal article – tables/charts	Careful observations of patients during transfusion enable nurses to detect serious adverse effects; understanding of

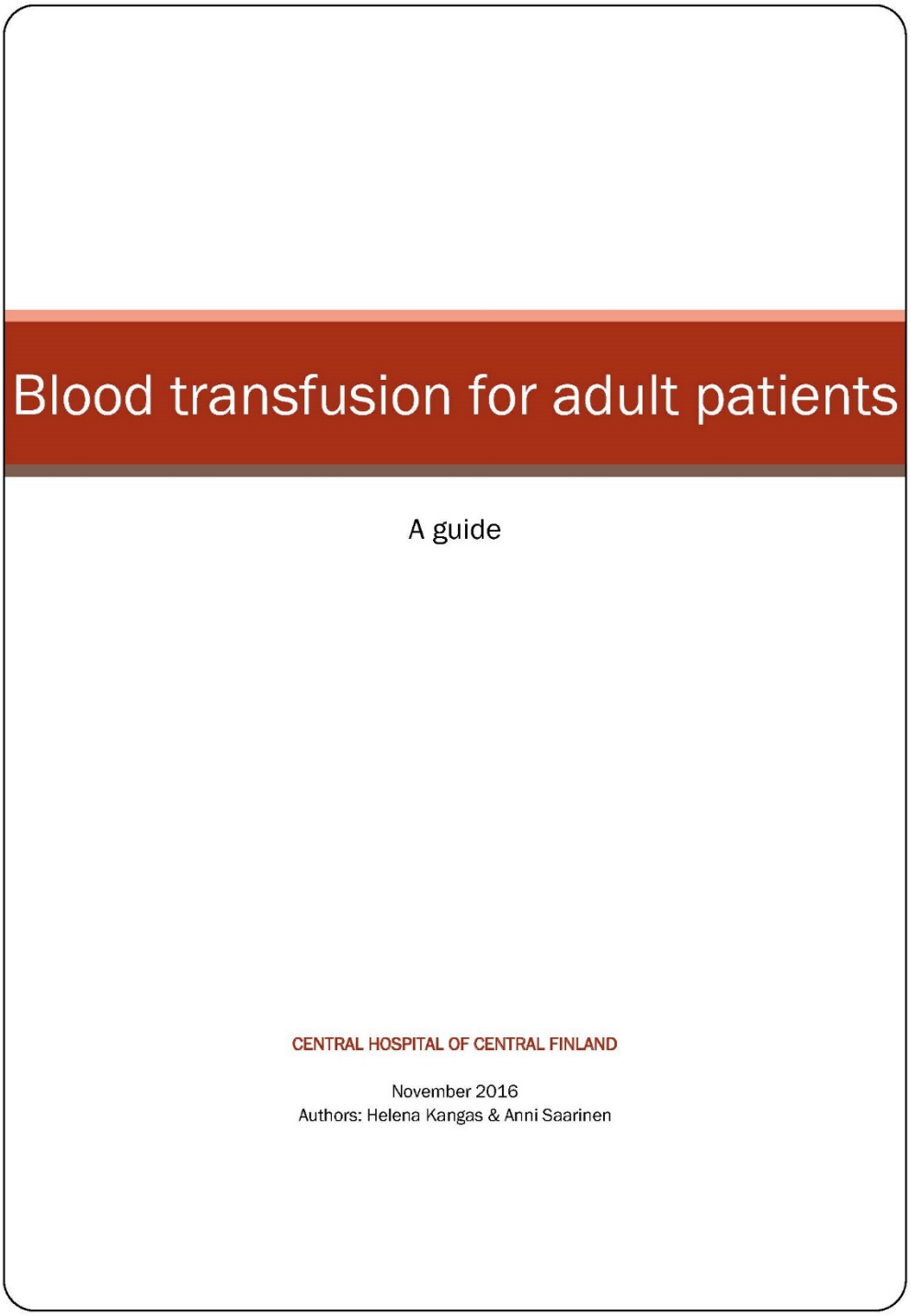
				adverse effects enable effective care.
Effa-Heap, G. 2009.	Blood transfusion: Implications of treating Jehova's Witness patient	To examine legal and consent issues around blood transfusion in Jehova's Witness patients and their implications for medical and surgical management	Journal article	Honest communication in a supporting manner and information help the patient to make an informed decision; everybody has a right to make their own decision regarding their body.
Gray, A., Howell, C. & Pirie, E. 2005.	Improving blood transfusion: a patient-centered approach	To present safer ways for blood transfusion based on other researches.	Journal article – tables/charts	Identification checks and careful record keeping are essential in adult blood transfusion.
Gray, A., Hearnshaw, K., Izatt., C., Kirwan, M., Murray, S. & Shreeve, K. 2007.	Safe transfusion of blood and blood components	To outline the role of the nurse in evidence-based transfusion practice.	Journal article – tables/charts	Patient's understanding of the procedure is to be ensured before transfusion and correct equipment gathered as well as prepared for adverse reactions.
Hellstén, S. 2006.	Verensiirto-opas 2006 [Blood transfusion guide 2006]	To explain the basics about blood grouping, crossmatching, transfusion procedure and adverse effects.	Book	Nowadays fresh frozen plasma is replaced with Octaplas. Flow rate of the transfusion is

				adjusted after the biological test.
McClelland, D.B.L. 2007.	Handbook of transfusion medicine 4th edition	To summarise existing knowledge about effective blood transfusion.	Book	Correct indication, storing and infusion of blood products and understanding the blood grouping reduce the risk for adverse reactions.
New Zealand Blood Sevice. 2016	Transfusion medicine handbook 3rd edition, 2016	To assist health care professionals in blood transfusion and to explain indications and adverse effects of the procedure.	Book	Understanding of different adverse effects is essential in the care of blood transfusion patient.
Oldham, J., Sinclair, L. & Hendry, C. 2009.	Right patient, right blood, right care: Safe transfusion practice	To examine the key principles and practicalities to be considered in day-to-day practice.	Journal article – pictorial, tables/charts	Patient's identity must be carefully confirmed and special attention paid to the unconscious. Monitoring the vital signs is essential during blood transfusion.
Parris, E. 2010	Deciding when to use universal blood	To provide an overview of blood groups, guidance on the appropriate use of 0 RhD negative blood and suggestions on how it can be used in	Journal article – pictorial, tables/charts	Blood groups depend on the type of antigens present on the red blood cells. O negative blood is called universal blood. RhD factors need to be

		emergency care practice.		considered as well.
Parris, E. & Grant-Casey, J. 2007	Promoting safer blood transfusion practice in hospital	To discuss the implications of the audit findings for the administration of blood at the bedside and to examine initiatives to support hospital staff in their efforts to improve blood transfusions safety.	Journal article	The patient's identity must be properly confirmed and special attention paid to the ones who cannot verbally confirm their identity.
Watson, D. & Hearnshaw, K. 2010	Understanding blood groups and transfusion in nursing practice	To provide the reader with an overview of the blood components that may be used within health care setting and to discuss the best practice in testing, storage and administration	Journal article – CEU, exam questions, tables/charts	Understanding the functions of blood components, the indication for transfusion can be understood. Not all adverse effects can be avoided but early detection and management is crucial.
Wilkinson, C. & Wilkinson, J. 2001	Administration of blood transfusions to adults in general hospital settings: A	To evaluate publications associated with the process of blood transfusion in hospital setting.	Literature review	To avoid risks the staff must carefully prepare for the transfusion and keep a valid record of the process.

	review of the literature			
Wright, A. 2010	Maintaining safety during blood transfusion	For the audit, transfusion nurse specialist followed blood transfusion procedure and documented administration checks and patient monitoring undertaken by nurses.	(Questionnaire) Journal article- pictorial	In cases where the verbal check cannot be performed (paediatric, unconscious) it is crucial that the patient is wearing identity wristband. Two members of staff are to carry out the checking process.
Yhlen, K. & Ashton, K. 2006	Bloodless care: When blood transfusion is not an option	To give alternatives to blood transfusion	Journal article - forms	The staff has responsibility to give enough information of the procedure and its risks and benefits, for the patient to make an informed decision.

Attachment 2. Guide for a blood transfusion for an adult patient



Blood transfusion for adult patients

A guide

Blood grouping

When considering blood transfusion, it is crucial to verify the patient's blood group. The most significant categorization systems are ABO and RhD. Every person has a blood group which can be A, B, O or AB. People presenting certain blood group have antigens for the other. Except O group has no antigens, which leads to that it can be given to any other blood group. In case the blood has antigens for both A and B, the blood group is AB, also known as universal recipient. In addition, there are RhD positive and negative division. If RhD antigen is present the phenotype is RhD positive, in the absence of the antigen the group presents itself as RhD negative. RhD negative can be transfused to RhD negative or positive. In an emergency situation, RhD positive blood can be given to RhD negative blood group. In that case, anti-D shot mus be given.

Blood products and their indications

Red blood cells maintain the balance between the two gases by bringing the carbon dioxide from the cells and returning with the oxygen. Indication for red blood cell transfusion is anaemia. The product must be stored at temperature between +2° and +6° Celsius, and it lasts for 35 days. Red blood cells are given at the rate of 2 hours per package (about 250ml), and must be used within 6 hours after taking it out the refrigerator.

Platelets' main function is the role in blood coagulation. They are most commonly transfused due to thrombocytopenia and haemorrhage. Platelets are stored at 22°C (±2), they must not be refrigerated at any point. Platelets require an agitator to prevent premature expiration. With agitator, platelets last for 5 days and without it for 24 hours. Platelets are given at the rate of 30 to 60 minutes per package (about 250ml).

Some functions of plasma include roles in clotting of blood and immunization. Plasma is processed into fresh frozen plasma (FFP), and it is used in major haemorrhage and coagulation deficiencies. It can be stored for up to two years in a temperature of -30°C. Once thawed, the product must be used within 24 hours. Nowadays, pharmaceutical product Octaplas® is used instead of FFP. Octaplas has better infection safety, less side effects and it is more homogeneous.

The Procedure

It is imperative to ensure the patient's identity throughout the process of blood transfusion. It must be done verbally and comparing to the patient documentation. In case the patient is unable to verify their identity, it must be confirmed with another member of staff and via the identification band. Identity band must be firmly attached and include at least name, surname, social security number. In addition, record keeping must be conducted. This includes indication for transfusion, date of transfusion, start and end times of each transfused component and adverse reactions. Transfusion

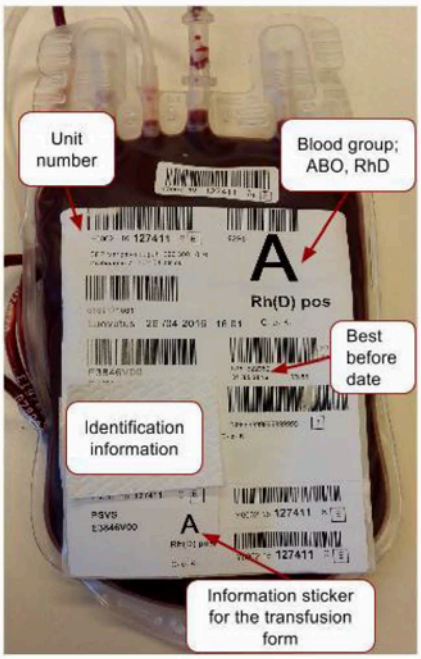
is always performed according to doctor's orders. It can be performed by a registered healthcare professional who has been given the required introduction and training.

1. Inform the patient about the proposed treatment and its possible adverse effects. Also, allow patient to ask questions. After explaining the treatment, the patient is able to make an informed decision.

2. Order the laboratory to perform blood sampling. From the sample, ABO and RhD are determined and a crossmatch is performed between donated blood and the patient's blood sample.

3. See if they have special requirements, for example diuretics. Order the blood product according to the doctor's referral by filling out appropriate forms.

4. Two registered nurses must check that the blood product matches the following information on the dispatch note, prescriptions and patient information: the identity, the blood group information and validity of the tests, the serial number of the product, and best before –date. Check the colour and the appearance of the product and that the package is clean and not damaged. Also, the label is firmly intact; if it is damaged or loose the blood product cannot be used. Remember to attach information sticker from the blood bag to the patient's documentation.



5. Gain intravenous access. Choose the cannula size according to the transfusion rate. Prepare the transfusion set in aseptic manner in clean environment. Remember to use tubing with a correct filter (150-200µm pore size). Do not add any medication to blood product. Blood does not need to be warmed, unless it is clinically indicated, for example rapid infusions and neonatal exchange transfusions.

6. With another member of staff, ask the patient to state their first name, surname, and social security number, and compare the information to the wristband, the blood product and the patient documentation. Ensure the patient's commitment to the care. Measure and record the following vital signs: blood pressure, pulse, temperature and respiratory rate. This must be done before each unit of blood.

7. Start the biological test; blood is transfused slowly at a rate of 10-15 drops per minute for the first 10-15 minutes. Record the start of each unit. If any side effects occur, terminate the procedure immediately. Measure and record the vital signs 15 minutes after beginning the transfusion. Increase the drop rate to the level doctor has ordered. Monitor the changes in the patient's condition throughout the procedure.

8. Measure and record the vital signs at the end of the transfusion. Record the finish of each unit. Make sure there is a permanent record of the procedure. It is recommended that the patient remains closely monitored for another one to two hours after the transfusion.

9. Store segments of red cell component's compatibility tubing with unique unit number in refrigerator for three days, whereas platelets and plasma products for a few hours. In case the blood transfusion must be stopped, store the transfused product and the transfusion set in a plastic bag in the refrigerator for 24 hours.

How to prevent adverse effects

Human error creates the single greatest risk for adverse effects in blood transfusion; these most commonly develop from incorrect patient identification. They can be avoided by paying attention to the patient identification, asepsis and record keeping at every step of the process. Maintaining the skills and knowledge of health care staff by systematic training, as well as proving them in practice, are ways to reduce the chance for receiving wrong blood. In addition, two members of the staff must check the blood product, patient identity and compare these to the patient documentation.

Adverse effects

In case any adverse effects of blood transfusion (see the table below) occur, stop the transfusion immediately. Maintain the intravenous access by transfusing saline 0,9%. Ask for assistance and notify the doctor. After quitting the transfusion, apply symptomatic care and continue to monitor the patient closely. Often, acute reactions take place during the first 15 minutes. All side effects must be recorded and informed to the doctor. In the table below stopping the transfusion, closely monitoring the patient and notifying the doctor, are referred as standard precautions. In severe reactions, fill out the appropriate forms and forward them to the blood bank.

Adverse effects can be divided into mild and severe. Mild effects are low fever and allergic reactions that do not involve decreasing blood pressure. Severe effects are classified as reactions that lead to death, major morbidity, disability or hospitalization. All the severe adverse effects and hazardous situations must be informed to the Blood security office (Veriturvatoimisto).

Adverse effect	Mild/Severe Onset time	Cause	Symptoms	Treatment
Transfusion-transmitted infection (TTI) and Sepsis	Severe, within minutes of the start of transfusion	Bacterial contamination of blood components	High fever, rigors, tachycardia, hypotension, shock with multi-organ failure	Standard precautions, prepare for resuscitation. Broad- spectrum antibiotics.
Acute haemolytic transfusion reaction (AHTR)	Severe, within minutes of the start of transfusion, or up to 24 hours	Transfusion of incompatible blood product	Fever, oliguria, hypotension, jaundice, nausea, flushing, breathlessness, abdominal/chest pain	Standard precautions
Anaphylaxis	Severe, at the beginning of transfusion	Severe allergic reaction between donated blood's plasma protein and recipient's antibodies	Mild allergic symptoms, rapid pulse, nausea, bronchospasm, cardiovascular collapse	Standard precautions, prepare for resuscitation
Allergic reaction	Mild, during or within 24 hours of transfusion	Allergic reaction between donated plasma protein and recipient's antibodies	Urticaria, itching, oedema, stridor, cyanosis	Symptomatic care; antihistamines
Transfusion-associated circulatory overload (TACO)	Severe, after the first 15 mins but within 6 hours	Blood is transfused too fast for the patient to tolerate	Tachycardia, acute respiratory distress, hypertension, pulmonary oedema, dyspnoea, jugular venous pressure	Prevention of overload. Standard precautions, prepare for resuscitation
Febrile non-haemolytic transfusion reaction (FNHTR)	Mild, 30-60mins after the beginning of transfusion	Interaction between recipient's antibodies and donor plasma's white cell antigens	Fever, chills	Symptomatic care; antipyretics
Transfusion-related lung injury (TRALI)	Severe, within 6 hours of transfusion	Human leucocyte antigen antibodies reacting with patient's neutrophils	Dyspnoea, fever, hypotension, tachycardia	Standard precautions, prepare for resuscitation
Delayed haemolytic transfusion reaction (DHTR)	Mild, after 24 hours	Secondary immune response that affects the Rh system's antibodies	Fall in haemoglobin level or the level does not rise as expected, jaundice, fever, blood in urine	No specific treatment, further transfusions if needed, monitor renal function
Post-transfusion purpura	Severe, within 5-12 days	Destruction of the transfused and patient's own platelets	Low platelet count with haemorrhage	High dose of intravenous immunoglobulin

Read more

Aroviita, P., Auvinen, M-K. & Mäki, T. 2007. Verivalmisteiden käytön opas 2007 [Practice guide on blood products 2007]. Punainen risti [Red Cross]. Frenckell Kirjapaino

Hellstén, S. 2006. Verensiirto-opas 2006 [Blood transfusion guide 2006]. Suomen Kuntaliitto. Kerava: Savion Kirjapaino.

Pages on Suomen Punainen Risti: Veripalvelu [Finnish Red Cross: Blood service] websites. https://www.veripalvelu.fi/