



SIMPLE ACTIONS SAVE TIME AND RESOURCES

(Careful preparation of the patients for CT-scan)

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Bachelor's thesis
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ABSTRACT

Tampereen ammattikorkeakoulu
Tampere University of Applied Sciences
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PODKLETNOVA, IRINA:
Simple actions save time and resources
(Careful preparation of the patients for CT-scan)

Bachelor's thesis, 24 pages, appendices 3 pages
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The purpose of this Bachelor's thesis was to produce a guide on patient preparation for Computed tomography (CT) examination for the ward's nurses referring patients to CT scanning in Hatanpää Hospital. The aim of the thesis was to promote nurses' understanding about the nature of CT examinations and to provide information about patient safety and necessary procedures undertaken before CT examination.

The need for this project arose from the request by X-ray department to have a guide on patient preparation for CT- examination to be given to the wards and departments of Hatanpää Hospital. This study employed a functional approach, and it was based on literature and consultation interviews.

The outcome from this thesis is a guideline that clarifies the procedures and terms used in guiding the patients for CT scan, the guideline was meant to be used by the ward nurses.

Key words: CT-scanning, contrast material, nursing education, kidney malfunctioning, patient preparation

TIIVISTELMÄ

Tampereen ammattikorkeakoulu
Degree programme in Nursing
Suuntautumisvaihtoehdon nimi: sisätaudit ja kirurgia

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(Potilaan huolellinen valmistelu CT- tutkimukseen)

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Tämän opinnäytetyön tarkoituksena oli tuottaa opas hoitajille potilaan valmistelusta tietokonetomografia tutkimukseen (CT) Hatanpään sairaalassa.

Opinnäytetyön tavoitteena oli parantaa hoitajien käsitystä CT- tutkimuksesta ja antaa tietoa potilasturvallisuuteen liittyvistä menettelyistä ennen CT tutkimusta.

Tarve/toive tähän hankkeeseen tuli röntgenosastolta, jonka toivomuksena oli saada aikaiseksi opas hoitajille potilaan valmistelusta CT-tutkimukseen Hatanpään sairaalan osastoilla. Tässä tutkimuksessa käytetty toiminnallista lähestymistapaa, joka perustuu kirjallisuuteen ja asiantuntijoiden haastatteluihin.

Opinnäytetyön lopputuloksena on syntynyt ohjekirjanen, joka selkeyttää menettelyjä ja termejä, jotka ohjaavat hoitajia oikeisiin toimenpiteisiin potilaan valmistelussa CT-tutkimukseen.

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1 INTRODUCTION

Nursing work becomes nowadays more and more challenging because of rapid technological development. Computerized sophisticated techniques and devices have revolutionized surgery and diagnostic testing. Correspondingly, nurses' roles evolve, with each advance, bringing a safer and healthier future for both nurses and the patients in their care (Henderson 2006, 59).

To deliver safe, professional nursing care, nurses need to regularly update their knowledge in modern procedures of diagnostic and treatment (Barnard & Locsin 2007, 24). Computed tomography (CT-scan) is one of such modern diagnostic techniques. CT scans of internal organs, bones, soft tissue and blood vessels provide greater clarity and reveal more details than regular x-ray exams (Prokop & Galanski 2003, 6). Depending on the patient's condition and the reason for CT-scanning, different standard preparation procedures for patient are performed before the actual scanning (Prokop & Galanski 2003, 99-108). If the preparation procedures are performed incorrectly or inadequately, the CT-scan may not provide relevant information and the health of the patient could be compromised. Clear guidelines for this preparation will improve the level of nursing education in preparation patients for CT-scan. The current study was performed in X-ray department of Hatanpää Hospital in Tampere.

2 PURPOSE, TASKS AND OBJECTIVES

The purpose of this Bachelor's thesis was to create a short guide for ward nurses, which includes some general information about CT-scan and instructions for patient preparation, depending on the required scan-procedure.

The following tasks were completed during the study work:

- Identification of problems that occur during patient preparation for CT- scan.
- Finding out and discussion about theoretical basis for correct action.
- Provision of guidelines for proper patient preparation.

The objective of this thesis was to provide clear manual with instructions for patient preparation.

The need for such guide for the ward nurses emerged from the safety requirements for patients, so that "the patient receives the needed and correct care that will cause as little harm as possible", as stated in Finnish Patient Safety Strategy for 2009 – 2013 (2009, 20).

3 COMPUTED TOMOGRAPHY BRIEFLY

3.1 Computed Tomography of the Body

Computed tomography of the body (CT-scan) is one of the best and fastest tools for studying the internal organs. It is often the preferred method for diagnosing different cancers, since the image allows a physician to confirm, locate precisely, and estimate the extent of the tumours' involvement with other nearby tissue. CT-scan is commonly used for many purposes from minor accident to assessment of pulmonary embolism as well as for abdominal aortic aneurysms (Stöppler 2012, 2).

To improve the viewing of blood vessels and corresponding tissues, contrast material is used. There are certain rules and contradictions against the use of contrast material, because it can be toxic to kidneys and may cause contrast-induced acute kidney injury (AKI) or contrast-induced nephropathy (CIN) (Stöppler 2012, 3). To minimize the toxicity for the body, ward nurses need to prepare the patient properly for CT-scanning procedure.

3.2 Radiation Risks from CT

X-ray radiation exposure is considered to be one of the main risk factors during scanning procedure. As stated in the Guidelines from U.S. Food and Drug Administration (2009), the risk for adverse health effects from cancer is proportional to the amount of radiation dose absorbed. The quantity most relevant for assessing the risk of cancer detriment from a CT procedure is the "effective dose". Effective dose is evaluated in units of millisieverts (abbreviated mSv; $1 \text{ mSv} = 1 \text{ mGy}$ in the case of x rays). Using the concept of effective dose allows comparison of the risk estimates associated with partial or whole-body radiation exposures. This quantity also incorporates the different radiation sensitivities of the various organs in the body.

CT examination with an effective dose of 10 mSv may be associated with an increased possibility of fatal cancer of approximately 1 chance in 2000. The natural incidence of

fatal cancer in the U.S. population is about 1 chance in 5. Thus, the risk of radiation-induced cancer is much smaller than the natural risk of cancer.

The effective doses from diagnostic CT procedures are typically estimated to be in the range of 1 to 10 mSv. A particular radiation dose will depend on the size of the body part examined, the type of procedure, and the type of CT equipment and its operation. (U.S. Food and Drug Administration 2009). However, radiation dose for the patient from similar CT procedures varies from patient to patient.

For comparison, in Finland average effective dose in CT examinations of head was 1,3 mSv, for lungs and lumbar CT it was about 5 mSv, and for native abdomen CT it was about 12 mSv (STUK 2007).

3.3 How a CT system works

A motorized table moves the patient through a circular opening in the CT imaging system. While the patient is inside the opening of the CT imaging system, an x-ray source and detector within the housing rotate around the patient. A single rotation takes about 1 second. The x-ray source produces a narrow, fan-shaped beam of x-rays that passes through a section of the patient's body. (U.S. Food and Drug Administration 2012)

A detector opposite from the x-ray source records the x-rays passing through the patient's body as a "snapshot" image. Many different "snapshots" (at many angles through the patient) are collected during one complete rotation. (U.S. Food and Drug Administration 2012)

For each rotation of the x-ray source and detector, the image data are sent to a computer to reconstruct all of the individual "snapshots" into one or multiple cross-sectional images (slices) of the internal organs and tissues. (U.S. Food and Drug Administration 2012)

4 CURRENT KNOWLEDGE OF THE PREPARATION FOR CT-EXAMINATION

4.1 Current nurse knowledge about patient preparation for CT's

The first step in conducting this Thesis was to interview the staff of X-ray department about typical problems during patient preparation. Several problems were identified and most frequent were too low liquid intake, too well-lined bowel in virtual colonoscopy and improper transportation of patients with suspected pulmonary embolism (Louhivuori 2012; Peltonen 2012).

These observations are not exceptional. Research study from England (Majeed, Nayee-muddin, and Christie 2006) revealed that ward nurses do not have complete understanding about CT-scan procedures. Analyzing the nurse's answers to the questionnaire about CT scanning, researchers found out, that only 17% of respondents correctly stated that CT scanning involves X-rays. "Although 70% of nurses knew that a patient for abdominal CT would need oral contrast, only 6% were able to correctly answer that the agent in use was water soluble iodine" (Majeed et al. 2006, 826). The results of the study concerned the research team, because "nursing staff who look after patients requiring radiological investigations are expected to have some basic knowledge of the procedure, prerequisites and need for any special preparations" (Majeed et al. 2006, 825).

It can be concluded that there is an obvious demand for better education of CT and CT procedures in nursing education. It can be recognized as essential element that minimizes the amount of mistakes in preparation of patients for CT-scan, and allows providing safe and cost-effective diagnostic and treatment.

4.2 Patient preparation and contrast media application

4.2.1. General preparation

In general when a patient is scheduled for CT examination, the patient should come in advance if oral contrast will be administered.

For CT examination of the upper abdomen, patients should be scheduled some 30 minutes before the planned scan, and 60-90 minutes before the scan if the whole abdomen is to be examined with good bowel opacification (Prokop & Galanski 2003, 84).

4.2.2 Patients with impaired renal function

Iodinated contrast media (CM) can induce renal injury through a combination of changes in renal hemodynamics (initial vasodilatation followed by prolonged vasoconstriction) and direct tubular toxicity. Contrast-induced nephropathy (CIN) can occur with risk factors and is generally defined as an *increase in serum creatinine* > 25% or > 0,5 mg/dl (44 $\mu\text{mol/l}$) within 48-72 hours compared to baseline (Appendix 1).

Established risk factors are pre-existing renal insufficiency, diabetic nephropathy, large contrast volumes and dehydration. Relative risk factors include congestive heart failure, recurrent contrast procedures, and multiple myeloma patients with dehydration. (Walsh et al. 2007, 93.)

For patients with normal renal function there are no contradictions for contrast-enhanced CT. For patients at moderate or high risk special procedures are performed to prevent CIN (Prokop & Galanski (2003, 85-86) as follows:

1. Identification of patients at moderate or high risk by measuring serum creatinine in patients with (suspected) decrease in renal function, diabetes mellitus, or other risk factors scheduled for any intravenous administration.
2. Discontinue non-steroid anti-inflammatory drugs and Dipyridomole 48-72 before the procedure. Withhold diuretics or ACE inhibitors for 24 hours before the procedure.
3. Maintenance of additional hydration.
 - a) Hydration in moderate risk patients: 0,9 % saline 1.0 - 1.5 ml/kg/hr (based on volume status) beginning 4 hours before procedure, and continuing 8-12 hours after the procedure.

- b) Hydration in high risk patients: 0,9 % saline 1.0 - 1.5 ml/kg/hr (based on volume status) beginning 12 hours before procedure, and continuing 12-24 hours after the procedure.
4. Examination of patients at moderate or high risk:
- a) Usage of low osmolar contrast material.
 - b) Minimized volume of contrast material
5. Follow up of patients at moderate or high risk:
- a) Discontinued *Metformin* 48 hours following the procedure, and restart only if creatinine levels are normalized.
 - b) Closely monitoring of urine output and increased intravenous fluid rate to maintain input greater than output. The goal is to maintain positive fluid balance with high urine flow rate.

Recent publications suggested that a two-day regimen of hydration combined with acetylcysteine 600 mg twice daily - one day before and on the day of the examination - can protect the kidneys from CIN, even in patients with already decreased renal function (Calabrò et al. 2010, 35-40; Calabrò et al. 2011, 503-507 ; Awal et al. 2011, 264-269) .

These studies are summarized in the Table 1.

TABLE 1. The study demographics and the main findings of the preventive effect of antioxidant N-acetylcysteine on acute contrast induced nephrotoxicity in patients with impaired renal function

	Calabrò (2010)	Calabrò (2011)	Awal (2011)
Pretreatment	A)NaCl saline hydration and N-acetyl cysteine (NAC) / B) no hydration	A) hydration and oral NAC / B) no hydration	A) hydration and oral NAC / B) normal saline alone
Group size	342 patients 255 patients	172 patients 152 patients	50 patients 50 patients
Group characteristic	A) high risk / B) low risk patients	low-risk patients.	high risk patients
Main finding: Incidence of CIN	A) 4.4% B) 9.8%	A) 2.6% B) 11.2%	A) 0% B)12%

4.2.3 Gastrointestinal CTs, bowel preparation

The contents of the gastrointestinal tract can hamper or prevent evaluation of the stomach, duodenum, and colon on CT scans. However, unless there is special emphasis on these organs, no special preparation is needed but it can be recommended to discontinue solid foods some 3-4 hours prior to the examination (Prokop & Galanski 2003, 87).

In special investigations of the *stomach and pancreas*, solid foods should be discontinued the evening before the examination. The patient may continue to take oral medications. This makes it possible to achieve optimum distension of the stomach and duodenum (Prokop & Galanski 2003, 87).

For special CT examinations of the small bowel (*CT enteroclysis*), solid foods are discontinued 24 hours before the examination. Although multiple methods will provide good results, a regimen of a low-residue diet, high fluid intake (3000ml/day) and laxative medications (as Moviprep®) for one day is simple and works well (Prokop & Galanski 2003, 87 - 88).

Special CT examinations of the colon (*CT colonography*) require the same kind of bowel preparation that would precede a barium enema. “Dry” preparations, typically given for barium enemas, are superior to “wet” preparations, typically given for colonoscopy, because there is less fluid left within the colon, and air can be used as a negative contrast agent. The regimen suggests low-residue diet, high fluid intake, and laxative medications that can be used for two days. (Prokop & Galanski 2003, 88).

4.3 Patents with pulmonary embolism

CT is a non-invasive and cost-effective tool for diagnosing pulmonary embolism (PE). Dr. M.J.L. van Strijen’s research group reported, that CT scan was effective in 98% cases of suspected PE, i.d. only in 10 patients out of 510 participants the presence/absence of PE was not proven (van Strijen et al., 2003, 127). Recent estimation of CT effectiveness stated overall sensitivity for detecting PE as 69%, and specificity as

86%. Besides, CT-scan helps with diagnosis of pathologies other than pulmonary embolism (Headley and Melander 2011, 132).

Position of the PE patient is crucial for the patient's survival. There are three case reports about sudden deaths in PE patients when the person was in sitting position. In the first case report the sudden death occurred after two and a half hour of sitting in the car (Hitosugi et al. 2005, 179). In the second report of PE caused sudden death occurred after 4h 40 min travelling by car (Mimasaka et al. 2008, 101), and in the third case report even 30 minutes of sitting in the car followed by death from PE (Ette et al. 2007, 80).

When a patient has a suspicion for PE, he/she should be kept in horizontal position and be transported from the ward to CT-scan in his own bed. That will reduce the possibility of blood clot(s) to move and cause sudden death from PE (Peltonen 2012).

5 THESIS METODOLOGY

5.1 Functional thesis

A functional thesis consists of closely combined reporting, theory and product. The report describes the process of writing the thesis, justification of chosen approach and building the guide-brochure. The theory part is based on the existing literature on the subject and is the ground for the final product which in this thesis is in the form of a guide-booklet. (Vilkka & Airaksinen 2003, 9-10.)

A functional thesis is not based on research questions or research problems. Knowledge arises from experience and action. The purpose is to present a functional implementation combined with its reporting and evaluation. It is target-oriented and aims in instructing, guiding, organizing or rationalizing practical activities by providing a product which might be in a form of a leaflet, handbook. Cd, portfolio, web-pages or an exhibition or event arranged. (Vilkka & Airaksinen 2003, 9-10.)

The final product of this thesis is a guide-brochure. Target group for this guide are ward-nurses. The work was initiated by working life demands and was executed in an exploratory approach. The process model consisted of mapping problems, planning, implementation and assessment. Working plan of the thesis was done with the awareness of the future objectives, and the purpose. (Hakala 2004, 66-67.)

Guide for nurses is the outcome of the study that carried out in accordance with the process model. The work material was collected from previous research articles and publications and also from interviews with experts (Louhivuori 2012, Peltonen 2012).

5.2 Producing quality teaching material

The content and the style of the guide very much depend on the target group or auditory to whom the guide is addressed. The cover graphic determines the reader's attitude and should present the purpose, be friendly and get attention. Lists, tables and figures support the text visually in a logical way without distractions. The overall work should

match the age and competence of the reader. Language and words should be chosen according to the literacy skills and educational level of the intended audience. When concept words are used, they are explained with examples. Learning material that matches in logic, language and experience facilitates engagement, learning and reading. It should have a positive and culturally competent approach to the reader. (Bartholomew et al. 2006, 409-419.)

The material should be distinguished from other similar products and thus have an individual appearance. Criteria for a quality material are a unique yield, usability in the target group, attractiveness, amount of information it provides, clarity and coherence. The credibility and reliability of resources used should be assured. The applicability of the text can also be tested by consulting a member of the target group or a specialist on the specific area studied. (Vilkka & Airaksinen 2003, 51-55, 129.)

Properly designed guide could improve the patient compliance and save time on CT wards. It could be an effective tool in nurse education, providing basic knowledge of CT-scan procedure and the reasons for patient preparation to CT-scanning.

5.3 Thesis schedule

The development of the Thesis progressed according to the schedule presented in Table 4.

TABLE 4. Thesis schedule

Thesis plan	January 2012
Research permit	February 2012
Literature review	March – April 2012
Expert interviews	March – May 2012
Analysis and writing	May – September 2012
Ready work	October the 5 th 2012
Report for working life	November 2012

6 IMPLEMENTATION

6.1. Collection of information

The earlier acquired knowledge and personal interest of the author in CT scanning procedures influenced the selection topic of this thesis. The need for such research was recognized in X-ray department of Hatanpää Hospital.

The process of building this thesis started in November 2011, after the first meeting with personnel in X-ray department of Hatanpää regional hospital. Two semi-structured interviews were organized with the experts from the staff of X-ray department. According to the widely accepted practice, interviews were scheduled in advance and organized around a set of predetermined questions. (Whiting 2007, 36.) The questions were:

What are the necessary preparations for different CT-scan procedures to the ward patients?

What are the risks and disadvantages if a patient arrives unprepared to the CT scanning?

What needs to be done to improve the nursing knowledge about CT-scan procedure?

Other questions emerged from the interviews.

Information was gathered along the way considered relevant to the subject. Recently published references with up-to-date results were found mainly from medical library and through online databases such as the EBSCOhost. The areas of the study were: CT-scanning, contrast material, nursing education, kidney malfunctioning, patient preparation, pulmonary embolism, quality teaching material.

Along with the theory, the product was structured and the guideline was chosen to be in the form of a booklet. This kind of written material was regarded as most relevant (suitable) for the learning and practical purposes of ward nurses. A booklet is a lasting, easy-to-use and clear material with low costs. Features of a quality educative material were studied, and existing guidelines for patient preparation to different CT scan procedures were explored to collect possible ideas for these guidelines (Turnbull 2003).

Transmission of information and efficient methods of teaching were studied in order to be able to share the knowledge clearly and beneficially forward through a compact booklet (Raisbeck 2008).

6.2. Analysis of CT-scan information leaflets given to patients in Hatanpää X-ray department

Outpatients who were booked for a computed tomography (CT) scan were provided with the information leaflets and an appointment letter. Information leaflet helps to provide them with necessary information, relieve their anxiety and ensure that they are safe to have the test. It has been shown that proper preparation prevents possible delays and cancellations. By contrast, hospital inpatients rely solely on the ward nursing staff for the information about scan procedure and correct patient preparation (Majeed et al 2006, 825).

Information leaflets for all CT examinations, available in X-ray department, were analysed. Several standard procedures were observed. 1) Blood test for serum creatinine values that should be performed within 2 weeks prior to CT-examination and identification of kidney malfunctions; 2) instruction to avoid food during 2 hours before the examination, however drinking was recommended, and 3) identification of allergy to contrast media or current cytostatic medication.

There are several variations of contrast media CT examinations and in all cases *Metformin*-containing medications should be discontinued on the morning of the CT-scan procedure *Metformin*-containing medication must be discontinued for 3 days after the scan.

Special preparations of the patient before CT-scan can be divided to six types. They are summarised in Table 2.

TABLE 2. Essentials of CT examinations that require patient preparations before CT procedure

CT examination	Patient preparation	Reason	Examination details
Virtual Colonoscopy	<p><u>On the day before examination</u> –only liquid food is allowed. Seeds and berries’ peels filtered out.</p> <p><u>In the evening before examination</u> – 4 liters of Moviprep solution to drink.</p> <p>In the morning of examination – only liquids (tea, coffee or juice) are allowed</p>	<p>For the successful examination, it is important that the gut is empty from stool.</p> <p>2 weeks before CT scan fiber / seed reach food intake is limited.</p> <p>In the evening before CT scan the bowel emptied by Colonsteril solution.</p>	<p>At the examination colon filled with air through the anus before scanning , which may cause pain and swelling. In general, problems are tolerable.</p> <p>Contrast agent is also injected intravenously at the examination.</p>
Entero-CT	<p>In the morning of examination – only water is allowed to drink. X-ray department provides <i>Colonsteril</i> drinking solution. The intention is to drink decilitre every five minutes for one hour.</p> <p>Contrast agent is usually also injected intravenously at the examination</p>	<p>For the successful examination, it is important that the intestine is empty.</p> <p>This way intestine can be differentiated from other structures</p>	<p><i>ColonSteril</i> can cause diarrhoea on the day of examination.</p>
CT urogram	<p>About half an hour before the examination the patient is</p>	<p>This gives a better differential diagnosis of the abdo-</p>	<p>Contrast agent can be injected intravenously at</p>

	given bowel contrast agent to drink, which should be drunk slowly and steadily.	men.	the examination. Examination takes about half an hour.
Angio-CT	The study uses intravenously injected contrast agent. A contrast agent administered to the antecubital fossa intravenously prior to the study	Throughout the investigation the patient lies motionless in CT table.	Examination takes about half an hour.
Aorta-CT	The study uses intravenously injected contrast agent. A contrast agent administered to the antecubital fossa intravenously prior to the study	Throughout the investigation the patient lies motionless in CT table	Examination takes about half an hour.
Heart-CT	Before the study blood pressure and pulse is measured. If necessary, a high pulse rate is reduced with medication.	Throughout the investigation the patient lies motionless in CT table	Examination takes about 15 minutes

6.2.1. Virtual colonoscopy

According to the expert's observation, preparation for virtual colonoscopy had created most of the problems among all CT-examinations (Louhivuori 2012; Peltonen 2012)

CT- colonoscopy can be successful only if the colon is free from faeces. That can be achieved by proper clearing GI tract with laxative Moviprep, The prescribed regimen of drinking Moviprep solution needs to be followed (Appendix 2). If Moviprep clearing is not performed, or performed in a wrong way, faecal masses in colon significantly reduce the quality of CT-image, or completely disturb the procedure (Peltonen 2012).

6.3 Hydration regimen

Proper hydration is a key issue for kidney protection against CIN. Definite requirements for hydration depending on the body region in CT-scan are summarized in Table 3.

TABLE 3. Hydration regimen before CT examinations.

Region	Procedure	Duration
adrenal gland oesophagus kidney kidney stones ventricles	300 – 600 ml of water	20 min – 1 h
upper abdomen pancreas (not pancreatitis) kidney secretion kidney tumour ventricles	600 ml of water + “haimaryyppy pöydällä”	1 h
whole body whole abdomen lower abdomen	1 l of water	2 – 3 h
pancreatitis	15 ml gasrografin + 600 ml water	1 h
abscess diverticulitis	22 ml gastrografin + 1 l water	2 h
enteroclysis	1 pack Colon steril + 1,3 l water	1h = 1 dl after each 5 min

After CT-examination it is recommended for the patient to drink 2 – 3 glasses of water.

(Translated with permission from a Finnish version of X-ray department documentation)

If the patient is not properly prepared at the ward (advised to drink enough) before sent to CT scan, it may delay the scan and mix the daily itinerary of X-ray department. This was the case especially with patients coming from emergency department (Louhivuori 2012; Peltonen 2012).

6.4. Pulmonary embolism

When a patient is scheduled for CT-scan with suspicion on pulmonary embolism, it is the duty of a ward nurse to ensure the safe delivery of the patients to the scanning facilities. To avoid the embolus to move and to block pulmonary artery, the patient must be transported lying in his ward-bed (Louhivuori 2012). However, during discussions with experts in X-ray department, it was emphasized that in most of the cases patients, who are suspected to have pulmonary embolism, are delivered to CT-scan sitting in a wheelchair (Peltonen 2012).

7 DISCUSSION

7.1 Conclusions

The thesis has studied the current knowledge about CT examinations, the standard recommendations for CT procedures and the current practice of the wards and nurses in preparing the ward patients for CT-scans.

The purpose of this Bachelor's thesis was to identify the possible problems and to produce for ward nurses a short guide, which includes some general information about CT-scan and instructions for patient preparation. As an outcome of this thesis a booklet-guide "Preparation of the patients for CT-scan: simple action saves time" was created both in Finnish and English language.

7.2 Reliability

The reliability and credibility of the thesis comes from the nature of the project. The ground for this functional thesis comprised already existing studies. Credibility is based upon whether researchers follow good scientific practice. (Tuomi 2007, 143). References used in this study were widely reviewed, compared and chosen critically on ground of professional source, time of release and use as a reference in other studies.

7.3 Ethical considerations

This Thesis is functional and based on existing publications. The permission to collect and use the information from X-ray department was granted from Hatanpää hospital. As patients were not interviewed for this study, no ethical problem related to disclosure of personal information appeared. In summary the thesis has no ethical concerns and it relies on the author's honesty and accuracy.

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APPENDICES

Appendix 1. Creatinine

Creatinine is a non-protein waste product of creatine phosphate metabolism by skeletal muscle tissue. Creatinine is freely filtered and therefore the serum creatinine level depends on the Glomerular Filtration Rate (GFR). Renal dysfunction diminishes the ability to filter creatinine and the serum creatinine rises. If the serum creatinine level doubles, the GFR is considered to have been halved. A threefold increase is considered to reflect a 75% loss of kidney function.

Reference values for serum creatinine:

Adult males: 0.8 - 1.4 mg/dl: values are slightly higher in males due to larger muscle mass

Adult females: 0.6 - 1.1 mg/dl: creatinine clearance is increased in pregnancy, resulting in lower serum levels

Children: 0.2 - 1.0 mg/dl: slight increases with age because values are proportional to body mass

A panic value for creatinine is 10 mg/dl in nondialysis patients.

(Prokop & Galanski 2003, 84)

Appendix 2. Virtual colonoscopy CT study (instructions for patient)**Preparation for the study:**

For the successful study it is important that the bowel is free from feces. For that reason bowel is emptied before the study. Patient himself fetches emptying agent Moviprep from Pharmacy.

A week before the study

Stop eating berries and fruits containing seeds.

During two days preceding the study day

Do not eat berries, fruits and vegetables.

During the day preceding the study day

Eat only bouillon-like food, such as vegetable- and meat bouillon, berry fool (seeds and peels are sieved away).

Evening preceding the study day

Start Moviprep treatment according to the instructions:

Course of treatment comprise two liters of Moviprep solution. One package contains 2 plastic bags of dose-packs. In each plastic bag there are dose-pack A and dose-pack B.

Open plastic bag.

Empty one dose-pack A and one dose-pack B to empty jug.

Add to the powder 1 liter tepid water.

Mix solution until powder is dissolved to clear solution (about 5 min). Put the drink to cool place, then it is more pleasant to enjoy.

This way prepared solution need to be consumed during 1 – 2 hours of preparation. When first liter is consumed, prepare and drink second liter of Moviprep-solution. After the beginning of treatment it is not allowed to eat solid food until CT study is performed.

Time schedule for preparation:

Procedure	Time	Done
Lighten food diet 1-2 days before the start of emptying		
Start consuming first dose of Moviprep solution (1l)	17- 18	
Keep at least 2h break before consuming the next dose of Moviprep solution		**
Start consuming second dose of Moviprep solution (1l)	20- 21	
Time to go to bed	23	
Large intestine ST scan	09-	

** In addition to each liter of Moviprep solution you should drink another liter of clear solution (like: water, clear soup, fruit juice without fruit pulp, coffee/tea without milk).

Extra liquids are taken on the day preceding the study day.

(Translated from Finnish by I.Podkletnova)

