Pain process of patients with cardiac surgery - semantic annotation of electronic patient record data

Abstract

Aims and objectives: The aim of the study was to describe and compare the pain process of the patients' with cardiac surgery through nurses' and physicians' documentations in the electronic patient records.
Background: Postoperative pain assessment and management should be documented regularly, to ensure optimal pain care process for patients. Despite availability of evidence-based guidelines pain assessment and documentation remains inadequate.
Design: A retrospective patients' record review.
Methods: The original data consisted of the electronic patient records of 26,922 patients with a diagnosed heart disease. A total of 1,818 care episodes of patients with cardiac surgery were selected from the data. We used random sampling to obtain 280 care episodes for annotation. These 280 care episodes contained 2,156 physician reports and 1,327 days of nursing notes. We developed an annotation manual and schema, then we manually conducted semantic annotation on care episodes, using the Brat annotation tool. We analysed the annotation units using thematic analysis. Consolidated criteria for reporting qualitative research guideline was followed in reporting where appropriate in this study design.
Results: We discovered expressions of six different aspects of pain process: 1) cause, 2) situation, 3) features, 4) consequences, 5) actions, and 6) outcomes. We determined that five of the aspects existed chronologically. However, the features of pain were simultaneously existing. They indicated the location, quality, intensity, and temporality of the pain and they were present in every phase of the patient's pain process. Cardiac and postoperative pain documentations differed from each other in used expressions and in the quantity and quality of descriptions.
Conclusion: We could construct a comprehensive pain process of the patients with cardiac surgery from several electronic patient records. The challenge remains how to support systematic documentation in each patient.
Relevance to clinical practice: The study provides knowledge and guidance of pain process aspects that can be used to achieve an effective pain assessment and more comprehensive documentation.

Keywords: pain assessment, documentation, surgery, cardio-thoracic nursing, qualitative study, postoperative pain, chest pain

1. INTRODUCTION

Cardiovascular diseases are a global health issue. Every year, 17.5 million people worldwide die from cardiovascular diseases and many of these patients need surgical care at some point in their lives. Coronary artery bypass graft (CABG) and heart valve replacement (HVR) surgeries are the most common surgeries due to cardiovascular diseases (Roger et al., 2012). In Finland 2,110 CABG surgeries were performed in 2010, in addition to 1,523 other open heart surgeries (Mustonen et al., 2012). In this research, "a patient with cardiac surgery" means a patient who has undergone either CABG or HVR surgery or both.

2. BACKGROUND

Postoperative pain should be assessed and documented regularly according to evidence-based recommendations, to be able to make decisions about pain management and to achieve optimal pain relief (Carlson, 2009; Heikkilä et al., 2016). Evidence-based pain assessment, management, and documentation can be evaluated by analysing documentation (Song et al., 2015). Evidence-based pain assessment and management methods improve pain management outcomes, shorten hospital stays, result in cost-effective care, and improve patient satisfaction (Samuels, 2010). Patient

satisfaction is also an important quality criteria from a heath care organization perspective (Bozimowski, 2012). Also, patients' own perspectives and own descriptions of their pain should be visible in the documentation, because the most reliable assessment of pain is a patient's subjective description (Sloman et al., 2005) and individual differences in pain experience need to be noticed (Chapman et al., 2012).

A majority of patients with cardiac surgery suffer from pain during their hospital stay, and over 50 % report moderate to severe pain (Stolic, 2010). To our knowledge, pain documentation of patients' with cardiac surgery has not previously been researched, although patients with cardiac surgery have been part of the study population in one previous study (Samules & Fetzer, 2009). Also, it has been reported that nursing documentation of postoperative pain is insufficient (Heikkilä et al., 2016). Adequate pain management requires regular and systematic pain assessment and documentation (Diby et al., 2008; Cogan et al., 2010; Hoogevorst-Schiple et al., 2016). Also it is essential to recognize the difference between cardiac pain and postoperative pain to be able to manage both of them adequately. Our purpose was to get a comprehensive understanding of the patient's pain process and to compare the descriptions of cardiac pain and postoperative pain. We analysed the pain process from the patients' perspectives, meaning that we reviewed the documentation of pain assessment and management throughout the patient hospital stay, not from the perspective of individual staff member, unit or certain aspect of pain. Both nurses' and physicians' documentations were analysed. Also, this study was the first step of a larger research project, where the manual annotation is used for machine learning in text analysis of larger data set.

The study aims were to:

1. Describe how pain process of patients with cardiac surgery appears in the nurses' and physicians' documentations in the electronic patient records.
2. Compare the descriptions of cardiac pain and postoperative pain in the nurses' and physicians documentation in the electronic patient records.

3. METHODS

3.1 Design, setting and sampling

This study was a part of a larger research project called Tailor (tailored information for patients and professionals) where digital documentation of care is developed using artificial intelligence. This study focused on developing documentation of pain. The study was part of Digital Nursing Turku - research program (Digital Nursing Turku, 2017). The study design was a retrospective patients' record review. The original data consisted of electronic patient records of 26,922 patients with a diagnosed heart disease admitted to one university hospital in Finland during the years 2005–2009. A total of 1,818 care episodes of CABG and HVR patients were selected from the data using the Finnish procedure codes, which are based on The Nordic Classification of Surgical Procedures (NCSP) (Terveysportti, 2015). We used random sampling to obtain a total of 280 care episodes for annotation. Random sampling was carried out in such a way that all of the care episodes were organised in random order by the computer. After that, it was possible to select the care episodes sequentially. These 280 care episodes contained 2,156 physician reports and 1,327 days of nursing notes. The physician reports consisted of the admission notes, surgical reports, intermediate evaluations, and discharge summaries. The nursing notes consisted of daily notes from one surgical inpatient ward. The data did not consist of nursing notes from the intensive care unit. However, physicians' reports consisted some mentions from the care in the intensive care unit. By reviewing both nurses and physicians documentations, we aimed more varied description of the patients' pain process that could be achieved by reviewing only nursing notes. Consolidated criteria for reporting qualitative research (COREQ) guideline, 32 -item checklist was followed in reporting where appropriate in this study design (Tong, Saisbury & Craig, 2007; see Supporting information Data S1).

3.2 Ethical considerations

The study was approved by the Ethics Committee of the Hospital District (17.2.2009 §67) and a permission to conduct the research was obtained from the Medical Director of the Hospital District (2/2009). Also a permission to use the primary data in this sub-study was obtained from the director of the research program.

3.3 Data collection

We used manual semantic annotation on the nurses' and physicians' clinical documentations to collect a data for thematic analysis. By "annotation", we mean a systematic labelling of words or expressions related to pain.

3.3.1 Annotation manual and schema development

At first an annotation manual (version 1.0) was developed to guide us in the annotation work. The manual contained detailed instructions about which expressions should be annotated and with which annotation topic label they should be marked. The manual was based on the evidence-based recommendations and the postoperative pain care process guidelines (The Finnish Society of Anaesthesiologists & Finnish Association for the Study of Pain, 2012; Nursing guideline, 2013). In the annotation we used the computer based annotation tool, called the Brat, to detect the pain documentation in the electronic patient records (Brat, 2014). We constructed an annotation schema into the Brat annotation tool. The schema was based on the annotation manual. It is presented in the table 1.

Table 1

3.3.2 Annotation work

Then the schema was used to annotate the care episodes. We manually conducted a semantic annotation on the nurses' and physicians' clinical documentations based on the mutually developed annotation manual. A whole word was used as the annotation unit. One word could be annotated with more than one label due to the nature of the Finnish language, as many words that are written separately in English are written as compound in Finnish. For example, chest pain (which in Finnish is the compound word "rintakipu") was annotated for both location (chest) and pain.

We ended up to complete the annotations in two rounds. The first round was carried out with 7 batches of 20 care episodes (n=140) by four annotators (A, B, C, and D), including two nursing pain experts and two information technology/linguistics experts. Six pairs were constructed (AB, AC, AD, BC, BD, and CD). Everyone annotated three batches of 20 (n=60) care episodes in pairs and one batch of care episodes was annotated by everyone, first individually and then together with the pairs. After the first round, we discussed annotations, until we achieved a consensus. Then we updated the annotation manual based on our discussions to version 1.1. After that, we corrected the first annotations to match up to the updated manual and carried out the second round of annotations with new batches of care episodes, again 7 x 20 (n=140) with similar pairs, to increase the validity of the annotation work. Finally, one annotator (KH) went through all the batches of care episodes (n = 280) one more time and made corrections based on the updated annotation manual, to increase congruence of the annotations.

3.4 Data analysis

We used thematic analysis to construct a comprehensive understanding of the patient's documented pain process from the annotation units. Thematic analysis was chosen based on its flexibility and theoretical freedom in data analysis (Braun & Clarke 2006).

3.4.1 Searching for themes

We started the analysis with a deductive approach that was based on the annotation manual and schema. We returned to the care episodes one more time, and collected all the annotated expressions under the annotation topic labels. Purpose of this phase was to gather all data relevant to each potential theme. For example, under the topic label intensity were gathered all the expressions used in the documentation to describe intensity. Also, we distinguished expressions between cardiac pain, postoperative pain and other pain. In addition we noticed in which part of the care episode the expression was found; in the admission notes, the surgical reports, the intermediate evaluations, the discharge summaries or the daily notes. That disclosed if the expression was documented by a nurse or a physician.

3.4.2 Reviewing themes

The annotation units under the annotation topics labels pain, implicit pain, and potential pain were organised according to the themes: cardiac pain, postoperative pain, and other pain. We organised the annotation units into a thematic map to construct an ensemble describing pain. In the thematic map, we combined pain, implicit pain, and potential pain to construct a theme “pain”. For this research, it was not relevant to differentiate these pain expressions, because they all represent either direct or indirect descriptions of pain or symptoms of pain. In this ensemble describing pain we could introduce all the annotated pain related expressions and the hierarchy and relations of these expressions.

3.4.3 Defining and naming the themes

Next we organised themes cardiac pain, postoperative pain and other pain side by side and combined annotation topics (n=15) in 11 main themes. Under the 11 main themes, we collected the annotated expressions. Then we organised the themes in chronological order, imitating a patients’ pain process. Next, we reorganised all the words under each main theme into subthemes, based on the meaning of the words, and we named those subthemes.

As our focus was on cardiac pain and postoperative pain, the expressions related to the type “other pain” were excluded from further analysis. The aim for this phase of analysis was to compare if either of the pain conditions were described more comprehensively than the other and if it was possible to recognize the patients’ pain process elements. Some of the main themes could be organised in chronological order, while others we perceived to appear simultaneously, such as features of pain. As a result of the analysis we described a chronologically progressing patients’ pain process and the simultaneously appearing features of pain.

4. RESULTS

4.1 The pain process of the patients’ with cardiac surgery

The themes were analysed and organised from the perspective of how the patients’ pain appeared in the different phases of the pain care process. We discovered expressions of six different aspects of the patient’s pain process: 1) cause, 2) situation, 3) features, 4) consequences, 5) actions, and 6) outcomes of treatment. The examples of expressions used in the documentation are presented in table 2. We determined that the features of pain existed simultaneously and were present in every phase of the patient’s pain process. The features indicated location, quality, intensity, and temporality of pain. These did not appear in chronological order like the other aspects of pain; instead, they existed when pain occurred and could be assessed in every phase of the patient’s pain process. They were not unchanging but existed whenever pain existed. Cardiac and postoperative pain documentations differed from each other in used expressions and in the quantity and quality of descriptions. Cardiac pain was documented more comprehensively than postoperative pain.

The first aspect of the patients' pain process was to clarify the type of pain and its cause. It was a common practice in the documentation to differentiate if the patients with cardiac surgery were suffering from either cardiac or postoperative pain or both. Even though there was a reason for pain it did not necessarily exist until some situation provoked it to occur. The second aspect of the patients' pain process identified the situations provoking pain. Whenever pain existed, its simultaneously existing features were usually assessed. This was the third aspect. Assessment of the features included noticing also the factors aggravating or alleviating the pain. The fourth aspect of the patients' pain process was the consequences of pain, and the fifth aspect was what kind of nursing or medical care had been offered to the patients. The final and sixth aspect of the patients' pain process was assessment of treatment outcomes.

Table 2

4.1.1 The causes of pain

The only documented cause of cardiac pain was *the diagnosis*. We found different kinds of diagnoses documented as causes of cardiac pain, such as coronary artery disease or heart failure. We also found that the surgery was the primary cause of postoperative pain.

The causes of cardiac pain were documented comprehensively and were mainly documented by the physicians. We found them almost in every patients' care episodes, whereas the cause of postoperative pain was not documented as often and was more often documented by the nurses. We often deduced the postoperative pain from the peripheral items documented in the patient records, such as a pain location "the patient has pain on the chest" and the type of medication given. The problem was that it was not clear, according to that kind of documentation, if a patient was having postoperative pain instead of cardiac pain. In some cases, it was said more clearly: "the patient is having wound pain".

4.1.2 The situations where pain occurred

We found that cardiac pain occurred in somewhat different situations than did postoperative pain. However, we divided all of the situations into the same subthemes: *the patients' own actions, situations related to the environment, situations related to time,* and *situations related to actions of the caring personnel*. By *patients' own actions,* we mean the situations where a patient was doing something that contributed to the cardiac pain occurring, for example physical activity such as walking, shovelling or cycling. We found that some sort of movement was the kind of *patients' own action* that contributed to both types of pains occurring. Sometimes, cardiac pain occurred even when a patient was just resting or sitting, which were also considered as *patients' own actions*. Postoperative pain occurred when a patient was moving but in a different kind of *patients 'own actions*, such as coughing, deep breathing, or getting out of the bed.

By *related to the environment* we mean the situations where pain occurred in certain places. We found that both types of pain occurred in places like an intensive care unit or an inpatient ward. Places that were typical for cardiac pain but not for postoperative pain were places outside the hospital, such as at home, at work, or in the ambulance.

Pain occurrence was also described *in relation to time*. We found various times when cardiac pain occurred, such as before the hospital admission, in the morning, or postoperatively. For postoperative pain the only situation *related to time* was "when coming to the ward". Both types of pain occurred in situations *related to actions of caring personnel*, such as during the examination or during other types of caring situations.

In the same manner as pain cause, also situations where pain occurred, cardiac pain situations were documented more comprehensively than postoperative pain situations. Cardiac pain situations were described in a richer and more detailed manner. The cardiac pain situations were mostly

documented in the physicians' admission notes and the postoperative pain situations were mostly documented in the nurses' daily notes.

4.1.3 The features of pain

The features of pain that we identified from the documentation were divided into four simultaneously existing features: 1) temporality, 2) intensity, 3) location, and 4) quality. Pain features contained also factors that either increased or decreased pain.

Temporality revealed the time when the pain occurred, how long the pain continued, and if the pain occurred more than once. We divided the expressions of temporality into subthemes: *time*, *a moment of time*, *periodicity* and *duration*. Cardiac pain was more generally documented with variety of expressions describing temporality, like *duration* "since last summer" or *periodicity* "daily", while postoperative pain was mostly described as in *a moment of time "*this morning"*,* in some cases also as *duration*, such as "all the time" or as *periodicity*, such as "nightly".

Pain intensity was documented by both; the numerical rating scale (NRS) and verbal pain estimations. The majority of pain intensity incidents documented were verbal estimations. Numerical assessment was only used in postoperative pain. We divided pain intensity expressions into categories: *no pain* "painless", *mild* "some" or "NRS 1-3,5", *moderate* "NRS 4-6,5", *intense* "severe" or "unbearable" or "NRS 7-10", *decreased* "eased off" or "slightly better" and *increased* "got worse" or "more difficult".

We deduced that aggravating and alleviating pain factors were also part of the features of pain. Aggravating factors, or factors that increased already existing pain, were, in both, cardiac pain and postoperative pain, found to be associated with *the patient's own actions*, such as "sitting makes the pain worse" or "deep breathing". Alleviating factors, or factors that decreased pain, were also found to be associated with *the patient's own actions*, such expressions like "lying on back helps". For cardiac pain alleviating factors were such as "resting" or "stopping" and for postoperative pain as "changing position" or "stying in bed".

In the documentation, we found that cardiac pain was located on the chest "sternum", chin "on the left side of the chin", neck "radiates to the neck" or upper back "in between scapula". Postoperative pain was located on the chest or in the legs or in the area where the drain was located.

We found various expressions describing the pain quality with cardiac pain. It was the most comprehensively described pain aspect. In cardiac pain, we found expressions in all subthemes, into which we divided the quality expressions: *suddenness / stability* "instable" or "prolonged", *impact* "oppressive", *descriptive* "hot sensation" or "squeezing", and *symptom-based* "palpitations". We found postoperative pain only in two subthemes: *impact* "disruptive" and *descriptive* "stinging". Again, cardiac pain was mostly documented by the physicians, in the admission notes and the features of postoperative pain were mostly documented in the nurses' daily notes.

4.1.4 The consequences of pain

We identified different kind of consequences of pain in the documentation and divided them into subthemes: *the patients' own actions, actions of personnel, inhibits/restricts, physical impact*, and *need of analgesics.* Cardiac pain was considered to have consequences in all the categories*.* Instead, we could not find any consequence of postoperative pain that could be considered to appear as *actions of personnel*. *Actions of personnel* were situations when pain was induced but the actions did not aim for pain relief, such as "breakfast being withheld". For cardiac pain, "wants to have the operation" appears as the consequence *the patients' own action*. For postoperative pain, we considered "holds breath occasionally" or "does not want to move" to be *the patients' own actions.*

We also identified consequences that *inhibit or restrict* a patient to act and consequences that appear as *physical impact*. For cardiac pain, consequences inhibiting or restricting were, for example, “must keep stopping” and for postoperative pain, “disturbs sleeping”. *Physical impacts* as consequences of pain were entries such as “heartbeat feels intense and disruptive” for cardiac pain and “difficult to breathe” for postoperative pain. We identified *need of medication* for cardiac pain in entries that note, “needs plenty of nitroglycerin” and for postoperative pain in entries that note, “needs plenty of analgesics”. The cardiac pain consequences, similar to the situations, were mostly documented in the physicians’ admission notes and the postoperative pain consequences were mostly documented in the nurses’ daily notes.

4.1.5 The actions due to pain

The actions due to pain differed from the consequences in that they aimed for pain relief, attempting to either ease the patient’s pain or resolve the cause. This was the most comprehensively documented aspect of the patient’s pain process. In the documentation, we identified several actions and we divided them into five subthemes: *to seek treatment, examination, treatment, medication-related,* and *consulting*. Based on the annotation topic labels in annotation schema, we considered medication, cognitive care, physical care, and emotional care to be actions due to pain.

We found *to seek treatment* to be an action only in cardiac pain, and we considered such actions to be either the patient “comes to the hospital” or the health care provider “sends to hospital” to be *to seek treatment*. *Examination* was considered to be an action that aimed to resolve the cause of pain, such as “angiography”. As a *treatment,* we mean actions other than medication that aimed to ease the patient’s pain, for example “coronary artery bypass”-operation for cardiac pain. We considered *medication-related* actions to be expressions that described a patient taking medicine or caregiver giving medicine, or a patient refusing to take medication. *Consulting* was expressions such as “called to the doctor” or “neurologist consultation”. We divided medication, as an action due to pain, into subthemes based on medication type: *cardiac medicine, paracetamol, opioids, anti-inflammatory drugs* and *external medication*.

We also divided cognitive care into two subthemes: *medication-related* and *rehabilitation-related*. We defined cognitive care as care in which information about pain was given to the patient. *Medication-related* actions could only be recognized in postoperative pain. *Medication-related* care was considered to be care that aimed to give the patient information about the importance of good pain relief in the recovery process, and contained expressions such as “reminded to take medication regularly” or “discoursed about analgesics and importance of pain management”. *Rehabilitation-related* actions could also be recognised only in postoperative pain and was considered to be care that aimed to give the patient information about rehabilitation’s importance in the recovery process and actions promoting rehabilitation, and contained expressions such as “told about significance and goals of rehearsal” or “guided to change positions regularly”.

We considered physical care to be all nonpharmacological treatments. We also divided physical care into subthemes: *operation-related, rehabilitation related, skin related,* and *well-being-related*. By *operation-related* care, we mean actions that aimed to relieve operation-related pain or discomfort, such as “cold therapy”. *Rehabilitation-related* care was care that aimed to promote recovery as “breathing exercises”. *Skin-related* care aimed to prevent or treat skin problems, such as “changed position many times”. By *well-being-related* care we mean care that aimed at other kinds of physical well-being, such as “changed dry sheets” or “eye gel put on eyes”. We considered emotional care to be care intended to take the patient’s mind off the pain. We could not find any expressions of cognitive care, physical care, or emotional care related to cardiac pain. Only postoperative pain was treated with these nonpharmacological methods, according to the documentation. Again, actions due to cardiac pain was mostly documented by the physicians and the actions due to postoperative pain were mostly documented by the nurses.

4.1.6 The outcomes of treatment

We found both positive and negative pain treatment outcomes in the documentation. By positive outcomes we mean expressions that disclosed the pain treatment's success. We divided positive outcomes into subthemes: *medication-related, physical, facilitation of functioning,* and *mental*. *Medication-related* expressions could be found in cardiac pain, such as "settled" and postoperative pain "relieves really well". *Physical* outcomes could be found in cardiac pain, such as "blood pressure and heart rate calm down". By *facilitation of functioning,* we mean treatment successes that enabled or made some actions easier. *Facilitation of functioning* expressions were found in postoperative pain, such as "deep breathing gets easier". By *mental* outcome we mean the treatment successes that influence the patient's psychological well-being, such as"calms down by talking".

We discovered that all of the negative treatment outcomes were related to medication and also mostly related to postoperative pain. We divided these expressions into categories: *no response* "medication does not help", *nausea* "vomiting after analgesics", *confusion* "delusions after analgesics", and *fatigue* "becomes really tired after analgesics". The only negative outcome to treatment of cardiac pain was found to be *no response* to Nitroglyserin. Treatment outcomes were mostly documented in the daily nursing notes.

5. DISCUSSION

5.1 Interpreting the results

This study aimed to describe and compare the pain process of the patients' with cardiac surgery through nurses' and physicians' documentations in the electronic patient records. The patient's pain process aspects that we could recognize from the annotated patient records were: 1) cause, 2) situation, 3) features, 4) consequences, 5) actions, and 6) outcomes. The patient's pain process includes both the nursing care and physicians' process, which is more comprehensive and describes the pain process more varied than the nursing care process alone. Cardiac and postoperative pain documentations differed from each other in used expressions and in the quantity and quality of descriptions.

Even though the documentation followed the nursing guidelines (2013) and the recommendations of acute postoperative pain and pain management documentation (The Finnish Society of Anaesthesiologists & Finnish Association for the Study of Pain, 2012), the pain process was not documented comprehensively and systematically in every patient's records during every working shift throughout the patient's whole hospital stay, as it should be. For example, pain assessment was not documented systematically following the nursing guidelines (2013), which requires documentation of pain, at a minimum: pain intensity, location, quality, temporality, analgesic prescription, analgesic administration, dosage, time, reassessment and outcomes of the treatment every 2–4 hours after surgery. Inadequate documentation makes pain management seem inadequate as well, even when that is not necessarily the case. Also, inadequate documentation impairs communication between professionals and jeopardizes continuity of patient care and patient safety.

The actions due to pain were the most comprehensively documented aspect of the patients' pain process, reflecting the idea that documentation was more task-oriented than patient-oriented. The patient's pain process documentation did not represent either the patients' needs or the patients' descriptions of the situations or the pain. The descriptions were mostly focused on the nurses' actions and the documentation reflected the nurses' task-oriented way of thinking: they did the task and then documented it. The documentation did not reflect analytical thinking about either their work or the patient's pain process. However, the documentation does not reflect reality. Nurses do variety of comforting actions that are not documented. Even being present and listening to the patients may offer comfort. Studies have shown different kind of actions to offer comfort and pain relief to patients, which are not necessarily documented, such as touch and massage (Collinge et al., 2013).

Especially physical touch has been found to comfort patients without words (Routasalo, 1999). In studies touch has been described as an expression of care, way of communication and even when it is a part of a clinical task, it can be interpreted as an expression of empathy, compassion, and presence (Kelly et al., 2018). So variety of unrecognized and not documented actions are performed by nurses that are comforting the patients.

Cardiac pain was documented more comprehensively than postoperative pain; cardiac pain quality in particular was described with a wider variety of words. Patients have described the postoperative pain quality after cardiac surgery as aching, stabbing, sharp (Eti Aslan et al., 2010), burning, throbbing, causing breathlessness (Gélinas, 2007; Eti Aslan et al., 2010), pressure, shooting, and muscle or bone pain (Gélinas, 2007) in previous research. In this research, similar expressions were used to describe cardiac pain. Postoperative pain was described as disturbing or stinging. This shows how subjective experiencing and expressing pain is, which makes pain assessment and distinguishing different pain types a challenging task. Especially in cardiac patients' care it is essential to recognize the difference between cardiac pain and postoperative pain to be able to manage both of them adequately.

Postoperative pain location after cardiac surgery has been reported in: thorax, abdomen, chest, lower limbs, back, everywhere, and throat (Gélians, 2007). The findings in this research identified similar pain locations. Puntillo and colleagues (2014) found that actions such as tube or drain removal, wound care, and endotracheal suctioning increased postoperative pain. In this research, different actions were identified as increasing factors, such as deep breathing, coughing, moving or turning in bed, getting out of bed, and moving. Similar findings has been reported also earlier (Yorke et al., 2002; Milgoram et al., 2004; Yorke et al., 2004).

Cardiac pain process was mostly documented by the physicians and postoperative pain process was documented by the nurses. This is natural, since physicians are responsible for the patients' medical care, such as clarifying the cause of cardiac symptoms and prescribing examinations and treatment. Also cardiac pain occurred mostly before the hospital admission and it was documented on the physicians' admission notes. Nurses are more responsible for patients' condition and care on daily bases and they are more aware of patients' postoperative pain. Nurses did not document cardiac pain, which could be interpreted either as patients did not have cardiac pain after cardiac surgery or nurses did not recognize the difference between cardiac pain and postoperative pain, since both of them could be expressed as "chest pain". As mentioned earlier, pain assessment and distinguishing different pain types is a challenging task.

All of the aspects of cardiac surgery patients' pain process and the features of their pain should always be noticed in pain care. Adequate pain management increases patient satisfaction. A patient having less pain does not necessarily mean better patient satisfaction, but how nurses react to the patient's pain has a major impact on patient satisfaction (Hanna et al., 2012). Also, active collaboration and communication between caregivers and patients about the patient's pain improves pain management and patient satisfaction (Innis et al., 2004; Quinlann & Clowell, 2009; Wadensten, 2011); this can be achieved with regular pain assessment (Diby et al., 2008; Cogan et al., 2010; Hoogevorst-Schiple et al., 2016).

The annotation manual and schema created for this study were useful reviewing this research topic and can be used for future patient record reviews. Even though the manual and schema were used for the patients with cardiac surgery pain annotation and to annotate the electronic patient records in one hospital, they could be usable to annotate any acute pain documentations. In previous research, the documentation review has been conducted using variety of different auditing tools, such as the Samuels Pain Management Documentation Rating Scale (Samuels & Kritter, 2011) or the Pain Documentation Audit tool (Eid & Bucknall, 2008) Assessment of postoperative pain documentation has mostly focused on evaluation of pain features and relief methods documentation. Only a few previous studies have reviewed both nurses' and physicians' documentations as we did

(Chanvej et al., 2004; Samules, 2012), and they did not examine patient's entire pain process as comprehensively as we did.

Experiencing pain is personal and subjective (Roedriger et al., 2006; Eti Aslan et al., 2010). The patient's own evaluation is the most reliable pain assessment and should be considered more in pain care. It is important to ask patients to describe their pain in their own words. (Sloman et al., 2005.) This research, contains some verbal descriptions of pain quality and intensity, but it is unclear if the descriptions were the patients' own words or the nurses' interpretations of the patients' pain. However, cardiac pain descriptions which were documented mostly in the physicians' admission notes, were presumably the patients' own descriptions of their cardiac pain and symptoms, because the cardiac pain had mostly occurred before hospital admission. Because of this, it is more difficult to make interpretations of the pain that existed earlier. Instead, postoperative pain naturally existed during the hospital stay and we cannot know if the descriptions were just the nurses' interpretations or the patients' own descriptions. Accordingly, one outcome of this research is the conclusion that cardiac patients' pain process is at least partly missing the patients' own pain perspective. More research is needed about how patients describe their cardiac pain and postoperative pain. After that, the cardiac patient's pain process could be expanded to also include the patient's perspective. Another important consideration for the future research is to include intensive care patients' descriptions of their pain and also electronic patient record review for documentation in intensive care units where the most severe pain occurs postoperatively.

5.2 Strengths and limitations

This study has some limitations. Firstly, the results are based only on the information obtained retrospectively from the electronic patient records, so the conclusions drawn rely on how the professionals describe patient's pain when they document it electronically. Based on the data, it cannot be known how the patients experience pain or how they describe it themselves. Secondly, the data did not consist of nursing notes from the intensive care unit, so we presumably missed the most severe pain and its documentation. Thirdly, the patient record data were collected in only one of the five university hospitals in Finland and relatively long time ago. However, the cardiac surgery patients' data (n = 1,818) represent about one fifth of cardiac patients operated on in Finland during the data collection period and, the data consist of a massive amount of clinical care episodes during a five-year period, so they provide a wide range of pain descriptions from a large amount of different professionals.

Methodologically, the strength of this study is the annotation work; it was done with great accuracy by four independent annotators in six different pairs. It was performed by a multidisciplinary team, consisting of information technology, linguistics, and nursing experts which increases trustworthiness of the study. In addition, the annotation manual and schema were based on the evidence-based recommendations of postoperative pain care and documentation.

6. CONCLUSIONS

We could construct a comprehensive pain process of the patients with cardiac surgery from several electronic patient records. The challenge remains how to support systematic documentation in each patient. In this study, the patients' pain perspectives remains incomplete. That should be studied in the future by interviewing patients with cardiac surgery about their cardiac and postoperative pain. Also in the future, it would be interesting to compare physicians and nurses documentation of pain process more systematically and comprehensively, and also include the intensive care units' documents into that review.

7. RELEVANCE TO CLINICAL PRACTICE

This study shows that documentation of pain is still inadequate. Some systematic and continuous education about documentation is needed. Also importance of distinguishing cardiac pain and

postoperative pain should be noticed in pain assessment, management and, documentation. Expressions like “chest pain” could cause a confusion from the point of view of communication between the clinicians and continuity of care. Documentation needs to be precise and comprehensive, so that possibility of misunderstanding is minimized.

Nurses are in a key position regarding pain assessment and management. Understanding the causes of pain, pain process and differences in pain features improves patients’ pain care. The study provides knowledge and guidance of pain process aspects that can be used to achieve an effective pain assessment and more comprehensive documentation.

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What does this paper contribute to the wider global clinical community?

- The annotation manual and schema created for this study were useful reviewing this research topic and they could be used also in the future.
- The patient's pain process described in this research widens the perspective of the pain care process, by noticing both physicians' and nurses' documentations.

- The study provides knowledge and guidance of pain process aspects that can be used to achieve an effective pain assessment and more comprehensive documentation.