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CHANGES IN SERUM CREATINE KINASE IN PATIENT AFTER TOTAL HIP ARTHROPLASTY

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Abstract

Background: Some studies reported that measuring serum creatine kinase (CK) level is an objective method with which to determine the relative invasiveness of surgery. The purpose of this study was to evaluate the change in postoperative serum CK levels as a measure of whether the direct anterior approach (DAA) is less invasive than the posterior approach (PA) regarding postoperative rehabilitation. Objective: This article presents a literature review regarding changes in serum creatine kinase in patients after total hip arthroplasty. Method: Descriptive research with a qualitative approach, systematic literature review study. Researchgate, Google Scholar and ScienceDirect searches reviewed changes in serum creatine kinase in patients after total hip arthroplasty. A total of 5 studies conducted between 2019-2023 were included in this review. Results: A total of 42,890 titles were identified and found 5 studies that met the requirements/criteria which discussed changes in serum creatine kinase in patients after total hip arthroplasty. Conclusions: We analyzed biochemical markers of muscle damage in patients treated with total hip arthroplasty with minimally invasive and standard posterolateral approach to providing objective evidence of the local soft-tissue injury at the time of arthroplasty. The objective measurement of muscle damage marker provides an unbiased way of determining the immediate effects of surgical intervention in patients treated with total hip arthroplasty.

Keywords: *Creatine Kinase, Total Hip Arthroplasty*

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Introduction

Total hip arthroplasty is a standard procedure in the world and Vietnam. Beside the development of implants material and surgical instrument for better mobility and longevity of artificial hip joint, the minimally invasive total hip arthroplasty also been improved. Minimally invasive total hip arthroplasty requires the proper instrument, appropriate surgery approach with an experienced surgeon. Minimally invasive total hip arthroplasty is to cause less trauma to soft tissue and is not the same as smaller incision. The smaller incision is one of the criteria in minimally invasive total hip replacement but with smaller incision may cause poor exposure, challenging to manipulate instrument and implants, damage surrounding soft tissue such as muscle, nerve, artery and poor implant position. What one of the challenge surgeons have to face is to evaluate the efficiency and result of minimally invasive total hip replacement. If only based on pain and range of motion before and after surgery, the study is not accurate and objectively because pain is somewhat subjectively and affected by pain medicine and patient's pain tolerance. Hip range of motion also affected by hip pathology, hip contracture condition before surgery and challenging to address the relationship between soft tissue trauma after surgery with the range of motion. A smaller incision but cause more trauma to soft tissue is not less invasive than a bigger incision with less trauma. Using laboratory data in serum to measure muscle damage provide an objective method to evaluate the invasiveness between different surgical techniques and approaches (Tonotsuka, 2019). Creatine phosphokinase (CPK) also known as creatine kinase is an enzyme which catalyzes the conversion of creatine and utilizes adenosine triphosphate (ATP) to create phosphocreatine (PCr) and adenosine diphosphate (ADP). CPK plays a vital role in monitoring energy to different cells, especially muscle cell. CPK is an enzyme found primely in cardiac muscle, skeletal muscle, and brain tissue. CPK is classified using chromatography into three distinctive isoenzymes: CPK BB is expressed in the brain cell and smooth muscle in lungs; CPK MB is expressed in cardiac muscle; CPK MM is expressed in skeletal muscle. In normal condition, human serum contains mostly CPK MM. CPK MB is 5% of total CPK, and CPK BB is insignificant. CPK level test is a valuable test in diagnostic skeletal muscle pathology. So because of that,

this study is to evaluate CPK level in non-cemented total hip replacement (Berardinis, 2023). This research sets two main objectives. First, it aims to provide a comprehensive review of research on changes in serum creatine kinase in patients after total hip arthroplasty using the Researchgate, Google Scholar and ScienceDirect databases. Second, based on the analysis conducted on available publications, this research will identify research gaps and provide directions for future research.

Method

The research design used is a descriptive research method with a qualitative approach to literature study or literature review using the internet and manual search. Data was collected using databases and search engines Researchgate, Google Scholar and ScienceDirect. The search was carried out using the keywords "changes in serum creatine kinase in patients after total hip arthroplasty".

The inclusion criteria for this research are that the articles used as literature are research articles, both original articles and studies/reviews. Articles or literature discussing changes in serum creatine kinase in patients after total hip arthroplasty were published from 2019-2023. Researchers found articles that matched these keywords with details from Researchgate (n = 29,300), Google Scholar (n = 12,400) and ScienceDirect (n = 1,190) so that N = 42,890. The search results that were obtained were then checked for duplication using Mendeley and the same articles were found, so there were articles that were excluded or duplicated (n = 7,890). Researchers carried out screening based on the title (n = 810), then obtained abstracts (n = 105) then a complete copy was taken and assessed for suitability (n = 10) then screened based on inclusion and exclusion criteria on the entire text (full text) so that A total of (n = 10) were obtained which could be used in a systematic literature review. The results of article selection can be depicted in the Flow Diagram below.

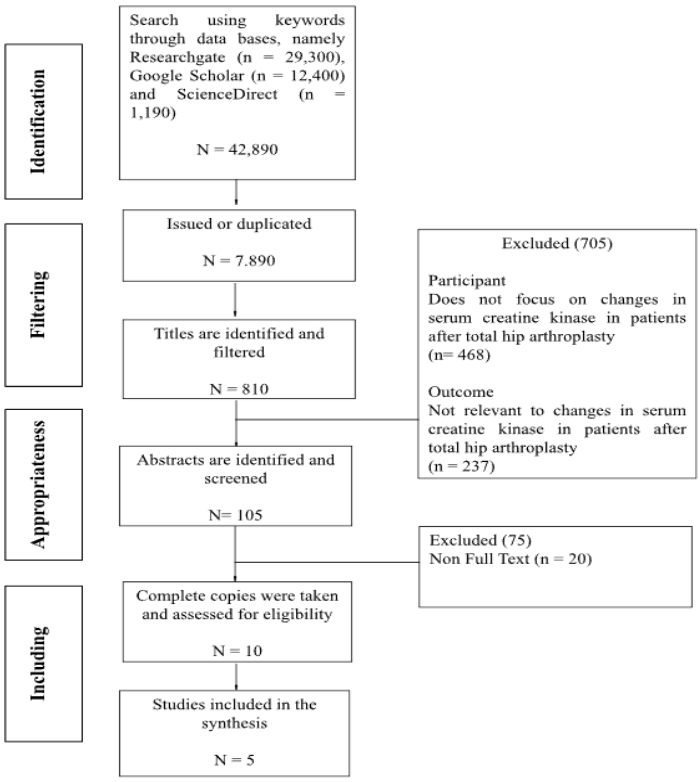

Figure 1. PRISMA Flow Chart

Results

The study results showed that 5 articles met the criteria based on the systematic literature review topic. The results of study characteristics from 3 databases (Research gate, Google Scholar and Science Direct) are depicted in table 1 below:

Discussion

Based on the results of the systematic literature review analysis, the data obtained are as follows:

1. Creatine Kinase

Creatine kinase (CK) is an enzyme that's found in your skeletal muscle, heart muscle and brain. When any of these tissues are damaged, they leak creatine kinase into your bloodstream. Elevated CK levels may indicate muscle injury or disease (Poloczek, 2020).

Creatine kinase consists of two subunits, namely B (brain) and M (muscle), each subunit has a molecule weighing 43,000 Daltons. So the combination of these two subunits will only produce three creatine kinase isoenzymes, namely CK-BB (CK-1), CK-MB (CK-2), and CK-MM (CK-3). CK-BB can be mainly found in the kidney and brain while CK-MM is mostly found in skeletal muscle. CK-MM is found in high concentrations in skeletal and cardiac muscle. CK-MB has high concentrations in heart muscle, but CK-MB is also found in small amounts in the lungs, small intestine, uterus, prostate and healthy skeletal muscle. CK-MM is most abundant in skeletal muscle and CKMB is most abundant in cardiac muscle. The highest concentration of CK-BB is found in the brain, in small amounts found in the lungs, stomach, prostate, digestive tract and bladder. CK-MM and CK-BB are completely irrelevant for detecting myocardial necrosis (Meng, 2021).

The physiological role of creatine kinase is to maintain large amounts of phosphorylated creatine energy, which is used to restore the amount of ATP that has been used during muscle contraction. In muscle tissue that requires high energy intake (ATP), for example

striated muscle, this enzyme plays a role in catalyzing the production of ATP (energy). Normal CK levels range between 20-200U/L and an increase in CK is an indication of muscle damage which is characterized by the possibility of muscle injury or is caused by certain medications such as statin drugs. Meanwhile, an increase in total creatine kinase is not specific to the heart and can be found in patients with skeletal muscle injuries. Clinically, a creatine kinase test is performed to look for indications of heart attack, rhabdomyolysis, muscular dystrophy and kidney failure (Ramadanov, 2023).

2. Total Hip Arthroplasty

Total hip arthroplasty (THA) has been indicated as the surgical intervention with greatest improvement in pain and physical function. However some patients continue to experience hip pain after elective surgery. We investigate prognostic factors that negatively affect treatment effectiveness and the patient outcome. The "hip region" constitutes the groin, buttock, upper lateral thigh, greater trochanteric area, and the iliac crest. Pain originating from various sources and not directly linked to prosthesis may be perceived here and includes the lumbosacral spine, referred pain from abdominal organs and soft tissue sources such as trochanteric bursitis, tendinitis, hip abductor dysfunction, and inguinal hernia. An accurate assessment of the pain cause is extremely difficult to construct and a complete differential diagnosis is fundamental. We assess all the possible causes of hip pain after THA and we divide them depending on the presence or absence of radiographic signs (Tonotsuka, 2019).

Total hip arthroplasty (THA) is one of the most clinically successful and cost-effective interventions in health care, with excellent longterm results in terms of reducing pain and improving function and quality of life in patients with debilitating hip disease. Self reported patient satisfaction has been reported to be closer to 90%. Many authors reported on successfully relieved pain after THA also in cases where patients' preoperative functional status was poor. Physical function improvement is long lasting over 25 years and is not affected by mild pain. However, despite remarkable developments in surgical technique and implant design, some patients continue to experience distressing pain after elective surgery. Results from a Danish nationwide study found that 12.1% of patients 12-18 months after hip arthroplasty were significantly impaired in their daily activities by chronic pain. The occurrence of pain following a technically satisfactory arthroplasty is of concern for both the orthopaedic surgeon and the patient. It's one of the most difficult challenges for the surgeon to evaluate and to treat. The difficulties in managing painful THA is due to the heterogeneous nature of the disease. Pain related to the surgery itself can be associated with the implant, bone alterations and soft tissue or nerve injuries. The situation complicates when history, clinical examination, and plain radiography fail to locate the exact origin of hip pain. In few cases patients were revised without having found the cause of pain. In the total 299,368 primary THAs reported in the Swedish Hip Register that were performed from 1979 to 2008, the 0,03% was revised for pain as a single cause representing the 0,4% of all the reasons for revision in the 24,199 first revision THAs. In order that the source of the pain be accurately located, a systematic approach is required. Surgeons and physicians must contend with numerous factors that can affect the patient outcomes. We have analyzed the predisposing factors that could lead to a painful hip arthroplasty and we have investigated the possible causes of this pain (Ramadanov, 2023).

Table01: Summary and References

No	Author	Title	Method	Result	Database
1.	Luca De Berardinis, Marco Senarighi, Luca Farinelli, Fjorela Qordja, Alberto Gallo, Marco Spezia and Antonio Pompilio Gigante (2023)	In primary total hip arthroplasty, the direct anterior approach leads to higher levels of creatine kinase and lower levels of C-reactive protein compared to the posterolateral approach: a propensity score matching analysis of short-term follow-up data	Systematic Literature Review (SLR)	PSM analysis yielded 44 pairs of DAA and PLA patients. CK was significantly higher ($p < 0.001$) in the DAA than in the PLA group on postoperative day (POD) 2, 5 and 10. The POD2, POD5 and POD10 CK/preoperative CK ratio was 12.9, 5.0 and 0.8 in DAA and 8.8, 3.3 and 0.6 in PLA ($p = 0.017$, $p = 0.012$ and $p = 0.025$, respectively). The POD2, POD5 and POD10 CRP/preoperative CRP ratio was 95.1, 65.6 and 22.8 in PLA and 34.7, 23.3 and 8.9 in DAA ($p < 0.001$, $p = 0.002$ and $p < 0.001$, respectively). Conclusion PSM analysis of early postoperative CK and CRP values demonstrated that the DAA should be considered as a less stressful approach, not as a muscle-sparing or a minimally invasive THA approach.	ScienceDirect https://jos r-online.biomedcentral.com/articles/10.1186/s13018-023-04084-x

2.	Nikolai Ramadanov, Polina Marinova-Kichikova, Robert Hable , Dobromir Dimitrov and Roland Becker (2023)	Comparison of Postoperative Serum Biomarkers after Total Hip Arthroplasty through Minimally Invasive versus Conventional Approaches: A Systematic Review and Meta-Analysis of Randomized Controlled Trials	Systematic Literature Review (SLR)	Our meta-analysis indicates that there was no significant overall difference between MI THA and CA THA in terms of postoperative serum biomarkers (CK, CRP, and Hb). We found a slight advantage of MI THA in CRP values. MI THA had a 16 mg/L lower CRP value 3 days postoperatively than CA THA. MI THA had a 3 mg/L lower CRP value 4 days postoperatively than CA THA. However, these findings do not provide sufficient evidence to recommend changing the surgical approach from CA THA to MI THA, since the differences between the examined approaches did not seem to reach MCID.	Science Direct https://www.mdpi.com/2673-1592/5/3/49
3.	Weikun Meng, Liang Gao, Zhong Huang, Haoyang Wang, Duan Wang, Zeyu Luo, Yang Bai, Guanglin Wang, Zongke Zhou (2021)	Supercapsular percutaneously-assisted total hip (SuperPath) versus mini-incision posterolateral total hip arthroplasty for hip osteoarthritis: a prospective randomized controlled trial	Systematic Literature Review (SLR)	Compared with the PLA group, the SuperPath group yielded a significantly shorter incision length (7.83 vs. 12.45 cm, P<0.001), longer operative time (102.72 vs. 66.22 min, P<0.001), more blood loss (1,007.38 vs. 844.55 mL, P=0.005), and more soft tissue damage (creatine kinase: 1,056.05 vs. 821.50 U/L, P=0.006) on postoperative day 3. The SuperPath group also showed deficient acetabular cup positioning (abduction angle: 36.94° vs. 42.66°, P=0.004) and a greater decrease in ROM (flexion: 107.66° vs. 114.44°, P=0.004; 109.83° vs. 116.11°, P=0.002; 111.66° vs. 118.88°, P<0.001) on postoperative days 1, 3, and 14, as well as severe early-term pain symptoms (pain VAS on postoperative day 3: 7.05 vs. 6.55, P=0.041). However, the LOS, C-reactive protein levels, erythrocyte sedimentation rate (within 2 weeks postoperatively), and HHS were comparable between the groups during the 12 months postoperatively. SuperPath may be a promising, minimally invasive technique for the treatment of OA in the future. Further investigation is necessary to evidence the possible superiority of SuperPath over other conventional mini-incision THA approaches.	Researchgate https://atm.amegroups.org/article/view/62178
4.	Bronisława Skrzep-Poloczek, Jakub Poloczek, Elżbieta Chełmecka, Wojciech Kazura, Agnieszka Dulska, Maciej Idzik, Jerzy Jochem, and Dominika Stygar (2020)	General, 21-Day Postoperative Rehabilitation Program Has Beneficial Effect on Oxidative Stress Markers in Patients after Total Hip or Knee Replacement	Systematic Literature Review (SLR)	We can conclude that the 21-day postoperative general rehabilitation program has a significant impact on balancing oxidative processes and significant reduction of oxidative stress markers in patients with hip or knee replacement. Individually tailored, systematic physical effort is a crucial element of the post operative protocol, which helps patient's to recover effectively after the surgery by improving the redox balance.	Google Scholar https://www.hindawi.com/journals/omcl/2020/4598437/

5.	Hisahiro Tonotsuka, Hajime Sugiyama, Daisuke Tanaka, Tatsuto Ito, Ayano Amagami, Keishi Marumo (2019)	Postoperative creatine kinase elevation following hip arthroscopy and associated risk factors	Systematic Literature Review (SLR)	Mean CK was 104.7 ± 68.7 IU/L preoperatively and 839.2 ± 2214.0, 523.9 ± 1449.4, 186.0 ± 690.7, and 122.0 ± 307.1 IU/L on postoperative days 1 and 3 and at postoperative weeks 1 and 2, respectively. CK was significantly higher on postoperative days 1 and 3 than before surgery. In total, 11 patients (9.0%), including 8 males (16.0%) and 3 females (4.2%), had CK > 10 ULN. Younger age and longer duration of traction are independent risk factors for CK > 10 ULN. After hip arthroscopy, CK levels should be monitored, especially in young patients and cases of prolonged duration of traction during surgery.	Google Scholar https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6938993/#:~:text=In%20hip%20arthroscopy%2C%20due%20to,risk%20factor%20for%20CK%20elevation.

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Conclusions

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Suggestion

With this research, it is hoped that it can increase the knowledge and insight of researchers in applying knowledge later and can apply research methods learning obtained in academics and can become reference material for continuing to carry out further research, namely continuing research that is more varied and complex in order to obtain better research results. better.

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Informed Consent and Ethical statement

Not Declared

Conflicts of interest

The author declares no conflicts of interest.

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