



RESEARCH ARTICLE

PROCALCITONIN- A PREDICTIVE MARKER OF WOUND DISCHARGE AND COMPLICATIONS FOLLOWING ORTHOPAEDIC SURGERY

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ABSTRACT

Background: Early detection of wound discharge at operative site and its complications is very important to prevent morbidity associated with it. The aim of our research was to find out the important role of procalcitonin in predicting early wound complications at surgical site. We found out that at a cut off level of 30 pg/ml, serum procalcitonin can predict wound complication with sensitivity of 65.5% and specificity of 98.8%.

Materials and Methods: Patients of all age groups who had undergone orthopaedic surgery were prospectively included in this study. Any patient who developed post-operative wound discharge were followed up as per study protocol. Serum levels of procalcitonin was measured on POD4. First wound check was done on POD4. So at the end of the study, patients were classified into 2 groups: Group 1 - with wound discharge and complications, Group 2- wound discharge with no complications. The serum levels of PCT was compared among above two groups and results were drawn.

Results: Group 1 had higher mean PCT levels than Group 2 ($p < 0.05$). 30pg/ml is the cut off for predicting wound complication with sensitivity of 65.5% and specificity of 98.8%.

Conclusion: Serum Procalcitonin, at a cut – off of 30pg/ml is a specific bio marker for predicting wound discharge and complication with sensitivity of 65.5% and specificity of 98.8%.
Level of evidence-4.

INTRODUCTION

SSI (surgical site infection) is one of the most common type of hospital acquired infections (Pittet *et al.*, 1999). Its prompt identification is essential to avoid devastating complications (Georgens *et al.*, 2005; Morrey *et al.*, 1975; Mathews *et al.*, 2010). But we lack a reliable marker to detect surgical site infection and complications (Unkila-Kallio *et al.*, 1994; Levine *et al.*, 2003) Pyogenic culture and sensitivity is the gold standard to detect infection at surgical site but it is having low sensitivity and also it takes long time to get the report leading to delay in tackling infection by appropriate treatment (Morrey *et al.*, 1975; Mathews *et al.*, 2010) In this perspective, we should have a diagnostic marker which can predict wound complications in patients with wound discharge. There role of Procalcitonin (PCT) as a prognostic and diagnostic infective marker has been studied by various researchers (Crain and Muller, 2005; Gendrel and Bohoun, 2000; Ghorbani, 2009; Chan *et al.*, 2004).

But very few studies are there to depict the role of PCT in surgical site infections (Laffey *et al.*, 2002; Jebali *et al.*, 2007; Laifer *et al.*, 2005; Oberhofer *et al.*, 2006). In normal patients serum levels of PCT is undetectable, but it will get raised in patients with bacterial infections (Barresi and Pallotti, 2004; Assicot *et al.*, 1993). In comparison to other biomarkers PCT is having a lower half-life which makes it a suitable biomarker of infection (Shimetani *et al.*, 2001; Delevaux *et al.*, 2003). This study is aimed at finding out utility of PCT as a marker to predict early wound complications.

AIMS AND OBJECTIVES

To assess the efficacy of PCT as a biomarker of wound complications

MATERIALS AND METHODS

This study was conducted in the Orthopaedic department in a tertiary care centre in south India from March 2013-march 2014. A total of 520 patients who had undergone clean elective

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orthopaedic surgical procedure with no other evidence of infection were included in the study. This study was approved by research and Ethics Committee of institute and performed as per standards of Declaration of Helsinki, 1964. After getting informed consent patients were enrolled into the study were followed up as per our departmental protocol for antibiotic prophylaxis, pre-operative preparation and post-operative wound care. The epidemiological and clinical factors for all the patients were noted as per our proforma. Any patient who developed a serous discharge from the wound site was further evaluated for the presence of surgical wound complications. Wound swab was taken and sent for Gram stain along with pyogenic cultures; all the routine clinical and hematological work up were done to look for signs of infection including 4 hourly Temperature chart, pulse charting, WBC count and ESR and CRP levels. Patients of all age groups (n = 520) who had undergone orthopaedic surgery were prospectively included in this study. Serum levels of procalcitonin was collected on POD4 during first wound inspection in patients with wound discharge from the surgical site. Collected serum was stored a temperature of -70 degree celcius and PCT was determined by ELISA method (RAY BIOTECH) at the end of the study.

All patients with wound discharge are completely examined to rule out other source of infection like genito urinary and respiratory system by clinical examination and lab investigations. All the patients were followed up till surgical wound healing. Two groups were formed at the end of the study (wound discharge with complications and wound discharge with no complication). At the end of the study the serum samples from all patients of two groups were tested for the levels of Procalcitonin and the Mean levels of procalcitonin were compared between the two groups and sensitivity, specificity of PCT were assessed using the appropriate statistical analysis (Unpaired t test was used for the comparison of biochemical parameters). The sensitivity, specificity and predictive values were analyzed using SPSS software version 19. All statistical analysis were carried out at 5% level of significance and a p value < 0.05 was considered significant and results were drawn.

RESULTS

Out of 520 patients, minimum age of patient was 4 years and maximum age was 79 years .max patient comprises of 20-30 age group~30%. Male comprises of 54% and males 46%.40 patients out of 65 showed no deep infection, there was no need for debridement and ultimately healed with daily C and D alone.

Mean value of serum procalcitonin in patients with wound discharge wound complications vs wound discharge without complication in (pg/ml)

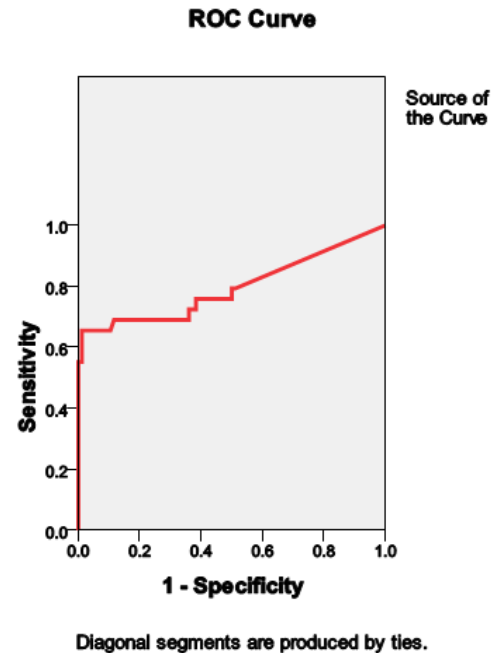
	With complication (n=25)	Without complication (n=40)
Day 3	176.43	5.40

Serum levels of procalcitonin in patient with wound discharge with complication (n=25 vs patient with no wound complication(n=40)

DAY -0	CATEGORY	N	Mean	sd	T	p
POD3	Wound discharge with complications	25	176.43	303.99	5.288	.000
	Wound Discharge with no wound complications	40	5.40	8.78		

But 25 out of 65 patients showed deep infection and complications, it required multiple wound debridement and prolonged antibiotic therapy.so serum levels of PCT was

compared between patients with wound discharge with complication and wound discharge with no complications.30 pg/ml is the cut off for POD4 for predicting wound complication with sensitivity of 65.5% and specificity of 98.8%. It is clear from the analysis that serum levels of procalcitonin on post op day 4 can be used as a specific laboratory marker for predicting wound complications.



Infection	Frequency	Percent
Wound discharge with complications	25	38.4
Wound discharge with no complications	40	61.6
Total	65	100.0

DISCUSSION

Wound discharge from the surgical site is a common finding on first wound infection after orthopedic surgery and if it get complicated, leads to increased rate of re-operations, increased morbidity and increased economic burden to the patient (De Lissovoy *et al.*, 2009). There are no reliable markers to diagnose infection due to low specificity of biomarkers (Unkila-Kallio *et al.*, 1994; Levine *et al.*, 2003). So markers with higher sensitivity and specificity are under research.

In our study out of 520 patients who had undergone clean elective orthopedic surgical procedure 65 patients developed wound discharge on first wound infection on POD4.25 out of

65 patients developed wound discharge with deeper plane of surgical site involvement and had undergone a second surgery in the form of wound exploration and debridement, whereas the Remaining 40 patients improved with daily dressings and I/V antibiotics. Mild sero-sanguinous discharge from the operative site is seen quite commonly at the time of 1st wound check. However many of these wound discharges settle down over a period of few days without any intervention, and only required careful observation. Sometimes however this discharge can be an indicator for underlying infective foci and if left untreated the results can be catastrophic. Early intervention with wound exploration and debridement can prevent this catastrophe in most cases. However there is no objective marker which can help the surgeon in taking this crucial decision of whether to intervene or observe. Studies done in patients undergoing cardiac surgeries and major cancer surgeries have shown serum procalcitonin to be an effective biochemical marker which can predict the development of early SSI's in these patients (Mokart *et al.*, 2005; Pierre-Emmanuel Falcoza *et al.*, 2005).

Most studies show that the procalcitonin levels increase in the immediate post-operative period but owing to its short half-life of 18 – 24 hours the levels start decreasing rapidly (Davidson *et al.*, 2013; Oberhofer *et al.*, 2006). A persistently high level and rising levels seen on the 3rd or 5th post-op day have shown a positive correlation with the development of early onset surgical site infection (Mokart *et al.*, 2005; Pierre-Emmanuel Falcoza *et al.*, 2005). These results prompted us to do this study in orthopedic patients to look for similar results and to identify if serum procalcitonin can be an effective marker in prediction wound complications. It has been revealed that the serum levels of PCT rise following surgery (Davidson *et al.*, 2013; Oberhofer *et al.*, 2006; Yeon Gu chung *et al.*, 2011; Maier *et al.*, 2009). On comparing the levels of serum PCT in all the patients who had developed wound complications during the early post-op period, we found that PCT in serum on POD4 is significantly higher and required a wound debridement as compared to the patients who developed wound discharge without complications.

The cut of value PCT is calculated to be 0.5ng/ml for predicting infection by various studies (Sabine faesch *et al.*, 2009; Butbul *et al.*, 2005; Martinot *et al.*, 2005; Fottner *et al.*, 2008). However, study by Hogle *et al.* (Hügler *et al.*, 2008) has taken 0.25ng/ml and study by Gunalp Uzun *et al.* (Gunalp Uzun *et al.*, 2007) has taken 80pg/ml as the cut-off. So there is no consensus in calculating the cut-off as it is infective laboratory marker under research. In our study the value of serum procalcitonin in predicting wound complication was found to be 0.03 ng/ml as compared to most of other studies with a cut off of >0.5 ng/ml for predicting infection. This result is in accordance with the study showing lower values of procalcitonin in localized infection as compared to patients with generalized infection (Christ-Crain *et al.*, 2006). It is studied that persistent elevation of PCT levels make the presence of a complicating bacterial infection likely and it is recommended to check serial serum levels of PCT to detect infection (Christ-Crain *et al.*, 2006; Christ-Crain *et al.*, 2004).

In our study, at a cut off value of 0.03ng (30pg)/ml, PCT is having a sensitivity of 65.5% and specificity of 98.8%. It should be emphasized that the cut off value for predicting SSI in our study is below the detection of most of commercially

available PCT assays. In this context only sensitive PCT assays should be used for estimation of infective marker in serum for early detection surgical site wound complications. So we postulate that higher serum procalcitonin levels (in our study we calculated this level as 0.03ng/ml) in the post-operative period on POD4 indicates severe wound complications, poor outcome and thus can guide the operating surgeon in deciding which patient may warrant an early wound lavage and debridement

Compliance with ethical standards

Ethical standards

This study was done after getting informed consent from all participants and also was done as per ethical standards of the 1964 Declaration of Heinski as revised in 2000. It was approved by the responsible ethics committee of our institute.

Conflict of interest

The authors declare that they have no conflict of interest.

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