PROCALCITONIN AND C-REACTIVE PROTEIN AS PROGNOSTIC BIOMARKER OF INFECTION IN TRAUMATIC FRACTURES
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ABSTRACT
The study was conducted in AL-Fallujha teaching hospital for the period from January to December 2018 on 100 patients with different fractures, (50 of them were without the presence of infections after the repair of the fracture and the other 50 were suffering from inflammation of the surgery after the repair). All information such as age, weight and sex of all patients in the study included the measurement of white blood cell level, reactive protein C level, procalcitonin level (i-chroma/immunofluorescence) and comparison of the two groups in relation to these variables as well as comparison in regard to time after the operation. In this work, total white blood cells count was significantly higher in fractured patients with infection than fractured patients without infection. In this study, CRP level was significantly higher in fractured patients with infection (10.81±1.2 mg/ml) than fractured patients without infection (8.33±0.93 mg/ml). In this study, procalcitonin (PCT) level was significantly higher in fractured patients with infection (163.3±5.9 pg/ml) than fractured patients without infection (131.7±4.8 pg/ml). The study revealed positive correlation of PCT with WBCs and CRP levels in infected fractured patients and no correlation of PCT with WBCs and CRP in non-infected patients. The study revealed positive correlation of PCT, WBCs and CRP levels with duration after surgical operation in infected trauma fractures patients below 3 days and weak correlation of duration above 4 days while the study showed no correlation of PCT, WBCs and CRP levels with duration after surgical operation of non-infected trauma fractures patients. Procalcitonin and CRP were significantly related with infected patients after surgical fracture operation and could be used as markers for determination of infection after surgery.

Keywords: PCT, CRP, Fracture, Surgical operation, Biomarker

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INTRODUCTION
The frequency of intertrochanteric fractures has been expanding altogether because of expanding future in the older populace; it has been anticipated that the all out number of hip breaks will arrive at 2.6 million by 2025 and 4.5 million by 2050 (1). In addition, mortality after proximal femur break is expanding with a 1-year
death pace of 14–36% (2,3). Careful treatment speaks to the ideal system for overseeing intertrochanteric breaks, which permits early assembly of the patient, decreasing the hazard for postoperative inconveniences (4). Universal proposals recommend that patients with hip breaks experience careful treatment 24–48 h after analysis (5). For older patients, who some of the time have cardiovascular, aspiratory, and mental comorbidities, a prompt surgery may at first convey too high a hazard for considerable dreariness and mortality. Accordingly, a perioperative observational period was created as a standard method for these patients. Checking in the postoperative period is likewise a piece of current rules (6,7). The time expected to play out a total therapeutic assessment and oversee comorbidities in old patients with trochanteric breaks can postpone medical procedure for in any event 12–24 h (8). Postoperative disease is one of the most genuine intricacies on account of its effect on mortality and dreariness in patients experiencing orthopedic methodology. Its right determination is essential for sufficient careful treatment. Also, it would permit the commencement of observational antimicrobial treatment quickly in patients with a disease and maintain a strategic distance from pointless antimicrobial use in patients without a contamination, in this manner sparing social insurance costs and averting the advancement of antimicrobial obstruction (9). In the early postoperative days, its identification is especially troublesome, and right now, it very well may be set up based on a few agreeing parameters, for example, clinical introduction, research center markers, imaging study, and microbiologic testing. C-reactive protein (CRP) and, even more as of late, procalcitonin (PCT) are two lab trial of significant helpfulness in clinical practice (1). CRP is the most accessible and generally utilized. CRP is a positive intense stage protein whose plasma fixation builds quickly up to 1000-overlap from around 1 mg/l, during fiery issue. CRP articulation and its acceptance in the hepatocytes are mostly managed transcriptionally by interleukin 6 through the actuation of a few interpretation factors. CRP is utilized to screen the postoperative course in careful injury following orthopedic inserts and to distinguish prosthetic contamination (2,4). Procalcitonin (PCT) is a protein made out of 116 amino acids and begins from an antecedent of pre-procalcitonin delivered in the thyroid organ, liver and neuroendocrine cells of the lungs and digestive system. Nevertheless, it is changed over to calcitonin just in the thyroid C-cells. Procalcitonin synthesized in different tissues is currently considered as a 'hormokine' yet its accurate job in wellbeing and malady has not yet been built up (8). Sound people have a low grouping of PCT in their blood. The degree of procalcitonin ascends because of proinflammatory upgrades, particularly those of bacterial beginning. In trials, hepatic tissue animated by TNF-alpha or IL-6 produce PCT in huge sums in the 24th hour after incitement (9). As indicated by past examinations, PCT is a generally excellent marker of bacterial diseases, in spite of the fact that its prognostic incentive in multitrauma patients has not been clarified at this point (10, 11).

The aim of this study was designated to view the role of CRP and PCT in prognosis and healing of fracture trauma.

MATERIAL AND METHODS

The study was conducted in AL-Fallujha teaching hospital for the period from January to December 2018 on 100 patients with different fractures, (50 of them were without the presence of infections after the repair of the fracture and the other 50 were suffering from inflammation of the surgery after the repair). All information such as age, weight and sex of all patients in the study included the measurement of white blood
cell level, reactive protein C level, procalcitonin level (i-chroma/immunofluorescence) and comparison of the two groups in relation to these variables as well as comparison in regard to time after the operation.

**Statistical analysis**

Computerized statistically analysis was performed using Mintabver18.0 statistic program. Comparison was carried out using Chi-square ($X^2$) for determination of the $P$. value ($P<0.05$: significant).

**RESULTS**

Age range for patients with infection as (50-81) years, whilst for patients Without infection as (48 -79) years, as well as male/female were 20/30 in patients With infection compare to patients Without infection 22/28 (table 1).

<table>
<thead>
<tr>
<th>Studied groups</th>
<th>No.</th>
<th>Age (years)</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Range (mean)</td>
<td>(male/female)</td>
</tr>
<tr>
<td>With infection</td>
<td>50</td>
<td>50-81 (72.1)</td>
<td>20/30</td>
</tr>
<tr>
<td>Without infection</td>
<td>50</td>
<td>48-79 (71.3)</td>
<td>22/28</td>
</tr>
</tbody>
</table>

In this work, total white blood cells count was significantly higher in fractured patients with infection than fractured patients without infection and as displayed in Table 2.

<table>
<thead>
<tr>
<th>WBCs count ($\times 10^9$/L)</th>
<th>With infection</th>
<th>Without infection</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>50</td>
<td>50</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean ±SD.</td>
<td>13.8±0.91</td>
<td>7.6±0.68</td>
<td></td>
</tr>
</tbody>
</table>

In this study, CRP level was significantly higher in fractured patients with infection (10.81±1.2 mg/ml) than fractured patients without infection (8.33±0.93 mg/ml) and as displayed in Table 3.

<table>
<thead>
<tr>
<th>CRP level (mg/ml)</th>
<th>With infection</th>
<th>Without infection</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>50</td>
<td>50</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean ±SD.</td>
<td>10.81±1.2</td>
<td>8.33±0.93</td>
<td></td>
</tr>
</tbody>
</table>

In this study, procalcitonin (PCT) level was significantly higher in fractured patients with infection (163.3±5.9 pg/ml) than fractured patients without infection (131.7±4.8pg/ml) and as displayed in Table 4.
Table 4: Difference between fractured patients with and without infection regarding PCT level

<table>
<thead>
<tr>
<th>PCT level (pg/ml)</th>
<th>With infection</th>
<th>Without infection</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>50</td>
<td>50</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean ±SD.</td>
<td>163.3±5.9</td>
<td>131.7±4.8</td>
<td></td>
</tr>
</tbody>
</table>

The study revealed positive correlation of PCT with WBCs and CRP levels in infected fractured patients and no correlation of PCT with WBCs and CRP in non-infected patients, Table 5.

Table 5: Correlation of PCT with WBCs and CRP levels

<table>
<thead>
<tr>
<th>Parameter</th>
<th>PCT level</th>
<th>Infected patients</th>
<th>Non-infected</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBCs count</td>
<td>0.61</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>CRP level</td>
<td>0.73</td>
<td>0.19</td>
<td></td>
</tr>
</tbody>
</table>

The study revealed positive correlation of PCT, WBCs and CRP levels with duration after surgical operation in infected trauma fractures patients below 3 days and weak correlation of duration above 4 days while the study showed no correlation of PCT, WBCs and CRP levels with duration after surgical operation of non-infected trauma fractures patients, Table 6.

Table 6: Correlation of PCT, WBCs and CRP levels with duration after surgical operation of trauma fractures

<table>
<thead>
<tr>
<th>Parameter</th>
<th>infected fractured patients</th>
<th>0-3 days</th>
<th>4 and more</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCT level</td>
<td></td>
<td>0.77</td>
<td>0.46</td>
</tr>
<tr>
<td>WBCs count</td>
<td></td>
<td>0.51</td>
<td>0.33</td>
</tr>
<tr>
<td>CRP level</td>
<td></td>
<td>0.72</td>
<td>0.45</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Procalcitonin is a protein orchestrated in various tissues beginning from a forerunner of pre-procalcitonin, and in this structure, it is emitted into body liquids. Sound individuals have low convergences of PCT in their blood. Various injury patients show an expansion of PCT serum focus, contingent upon the seriousness of the damage (12). PCT is by all accounts a decent marker for checking the status of provocative response in patients experiencing numerous injuries (13). Zhu et al (14) showed in that postoperative PCT, CRP and TNF-α were altogether higher in the tainted gathering than the uninfected gathering. The uninfected gathering was higher than the control gathering, and there were huge contrasts between the three gatherings (P < 0.05). In late examination, Zhao et al (15) demonstrated that, as contrasted and the non-disease gathering, PCT and CRP levels were essentially expanded at each time point after medical procedure in the contamination gathering.
The affectability of PCT joined with CRP in the identification of early disease after medical procedure was higher than that of either utilized alone. Hunziker et al. (16) assessed 103 sequential patients with new beginning of fever inside 10 days after orthopedic medical procedure. WBCs, CRP, and PCT were evaluated on days 0, 1, and 3. Contamination was analyzed in 45 of 103 patients and included the respiratory tract (18 patients), urinary tract (18 patients), joints (four patients), careful site (two patients), circulation system (two patients), and delicate tissues (one patient). Not at all like CRP levels and WBC checks, PCT were esteemed to be essentially higher in patients with disease contrasted and patients without contamination on days 1 and 3. Collector working qualities bend showed that PCT had the most elevated symptomatic precision. Yasmin et al. (17) presumed that PCT might demonstrate to be a helpful parameter to recognize early postoperative foundational infective complexities after break medical procedure. They assessed 21 patients who experienced medical procedure for peritrochanteric hip breaks. As opposed to CRP levels, which were better than average level in all patients, PCT levels were higher than the ordinary level just in patients who created complexities. The affectability and explicitness of PCT to decide foundational complexities were 100 and 100% on the primary day, and 100 and half on the subsequent day, individually. Castelli et al. (18) researched the symptomatic estimation of PCT and CRP in septic entanglements after real injury. They reasoned that height of PCT implies conceivable septic confusions during SIRS after real injury. What's more, high PCT focus at affirmation after injury in ICU patients demonstrates an expanded hazard for septic complexities. Ahmadinejad et al. (9) considered 120 patients with positive SIRS conceded in the crisis branch of a college medical clinic. Hochreiter et al. (19) found that observing of PCT is a useful apparatus for directing antimicrobial treatment in careful escalated care patients. Simon et al. (20) played out a meta-examination to assess the exactness of PCT and CRP levels for the finding of bacterial disease. PCT level was progressively delicate and increasingly explicit contrasted and CRP level for separating bacterial from noninfective reasons for aggravation. Flute player et al. (21) inferred that CRP and ESR had poor affectability for the analysis of prosthetic embed disease. They dissected preoperative CRP and ESR in 636 members who experienced knee (n=297), hip (n=221), or shoulder (n=64) arthroplasty, or spine embed (n=54) expulsion. CRP and erythrocyte sedimentation rate esteems were higher in knee arthroplasty and spine embed patients than in hip arthroplasty patients with contamination, and demonstrated the most reduced affectability for determination of shoulder arthroplasty disease. Notwithstanding, numerous examinations discovered outcomes that repudiate our investigation as they demonstrated that PCT is certifiably not a superior marker of contamination contrasted and CRP. Ugarteet al. (22) considered 111 tainted and 79 noninfected patients in a forthcoming, observational examination in the Medicosurgical Department of Intensive Care. There was noteworthy connection between's the PCT and CRP focuses in the tainted gatherings. This might be because of the disparity in the meaning of day 0 in this investigation, as day 0 in the noninfected patients was the day of confirmation, though in the tainted ones it was the day when the patients wound up contaminated and the anti-infection was started. The WBCs was raised in the two gatherings with no critical contrast between the two, demonstrating that the WBCs may mirror the pressure reaction to the provocative condition yet it isn't explicit for contamination. Chan et al. (22) demonstrated that PCT is certifiably not a superior marker of bacterial disease contrasted and CRP for grown-up crisis division patients, yet it is a helpful marker of seriousness of contamination. Contrasted and CRP, PCT had a practically identical affectability, a lower particularity, and a lower region under the beneficiary working trademark bend. This might be ascribed to the
utilization of single PCT level just on admission to the crisis division, and subsequently the connection with the result was imperfect. Kang et al (24) played out a forthcoming report on 348 back to back cases including patients who experienced spinal medical procedure under general anesthesia. As an indicator for early twisted disease, the affectability, particularity, PPV, and NPV for irregular CRP reactions were determined as 100, 96.8, 31.3, and 100%, individually. Along these lines, CRP screening is a straightforward and dependable test for the discovery of early irresistible intricacies after spinal medical procedure.

CONCLUSION

Procalcitonin and CRP were significantly related with infected patients after surgical fracture operation and could be used as markers for determination of infection after surgery

ETHICAL CLEARANCE

The Research Ethical Committee at scientific research by ethical approval of both environmental and health and higher education and scientific research ministries in Iraq

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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REFERENCES


