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A Study on Change in ESR among Patients Undergoing Reamed Intramedullary Nailing At a Tertiary Care Hospital

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Abstract

An erythrocyte sedimentation rate (ESR) is a type of blood test that measures how quickly erythrocytes (red blood cells) settle at the bottom of a test tube that contains a blood sample. Normally, red blood cells settle relatively slowly. A faster-than-normal rate may indicate inflammation in the body. Forty patients (32 males; 8 females; mean age, 43.1 (range, 20–97) years) who sustained isolated closed diaphyseal fracture of the femur or the tibia remained in the study group. All femoral fractures and tibial fractures were treated with an interlocking nail, with reamed technique. ESR in the study group was high during the preoperative period (average values of 42.8; $P = 0.001$), whereas there was a sharp rise to 66.8 (average value) postoperatively ($P, 0.001$), reaching the peak on the 3rd postoperative day (average value, 82.7; $P, 0.001$ in comparison to the preoperative mean value). ESR mean value returned near to POD 1 on the tenth postoperative day (65.5).

Keywords: ESR, reamed intramedullary nailing, diaphyseal fracture

Introduction

The erythrocyte sedimentation rate (ESR) is a hematologic test that measures the length of fall in millimeters of a column of erythrocytes in a given interval.

An erythrocyte sedimentation rate (ESR) is a type of blood test that measures how quickly erythrocytes (red blood cells) settle at the bottom of a test tube that contains a blood sample. Normally, red blood cells settle relatively slowly. A faster-than-normal rate may indicate inflammation in the body ^[1].

Inflammation is part of your immune response system. It can be a reaction to an infection or injury. Inflammation may also be a sign of a chronic disease, an immune disorder, or other medical condition. If ESR is high, it may be related to an inflammatory condition ^[2].

C-reactive protein (CRP) is a globulin composed in the liver with normal value of 0.6 mg%.

Elevated ESR and CRP are normally found in pregnancy, diabetes, end-stage renal failure, chronic heart failure, anemia, and obesity.

ESR also is relatively elevated in females and older people.

Generally, ESR and CRP changes constitute a nonspecific indication of the presence of systemic or inflammatory disease or tissue damage, the progression of a recognized disease, and can be used as criterion of response to the treatment ^[3].

Lactic acidosis represents a state of hypoperfusion and is a predictor of multiple organ failure. Studies in the trauma literature demonstrate that elevated lactate at the time of hospital admission and persistent lactic acidosis is associated with poor outcomes ^[4].

We hypothesize that elevated admission lactate levels and elevated preoperative lactate are associated with increased postoperative pulmonary morbidity in multisystem trauma patients undergoing definitive IMN.

This study was initiated by an observation: many patients undergoing closed reamed intramedullary nailing for femoral or tibial fractures had an elevated temperature (up to 39°C) from 1 to 7 days postoperatively.

Despite the elevated temperature, patients were feeling well, had a good appetite, and were

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participating normally in their physiotherapy and rehabilitation program [5]

As a result of these clinical observations, a prospective study was initiated to authenticate the observation of elevation of body temperature after reamed intramedullary nailing, and to confirm the suspicion that this happened because of the surgery within the medullary canal [6]

A parallel study about the alteration of ESR and CRP was considered necessary to investigate more objectively the magnitude of body reaction after reamed intramedullary nailing, because rise of these biologic markers is indicative of an ongoing inflammatory process.

Methodology

Study subjects: ESR, CRP, and plasma lactate and Temperature monitoring, pre operatively and post operatively (1, 3 and 10th Post-operative day) in 40 consecutive patients with closed diaphyseal fracture femur/tibia - study group

The same biological parameters were monitored in 40 patients who sustained isolated closed IT fractures of femur treated with Dynamic hip screw or proximal femoral nailing-control group

Inclusion criteria

- Isolated closed fractures of the femur or tibial diaphyseal fractures regardless of gender, and degree of fracture morphology
- Isolated closed IT fractures treated with dynamic hip screw or PFN regardless of gender and degree of fracture morphology

Exclusion criteria

- Polytrauma excluded
- Pathological fractures
- Co-morbid conditions
- Children with intramedullary fixation are excluded.

Results

Forty patients (32 males; 8 females; mean age, 43.1 (range, 20–97) years) who sustained isolated closed diaphyseal fracture of the femur or the tibia remained in the study group. All femoral fractures and tibial fractures were treated with an interlocking nail, with reamed technique.

After exclusions, 40 patients (30 males; 10 females; mean age, 60.09 (range, 28–85) years) remained in the control group. Their fractures were treated with a Dynamic Hip Screw or proximal femoral nail.

Table 1: AGE

Groups	N	Min Age	Max Age	Mean	SD	P
		In Years	In Years			Value
Unreamed	40	28	85	60.9	13.1	0.0003
Reamed	40	20	97	43.1	21.7	

There is a statistically significant difference between Unreamed and Reamed for the parameter Age in years.

Table 2: Gender

Groups	Male	Female	Total	P Value
Unreamed	29	11	40	0.578
Reamed	33	7	40	

Table 3: ESR in Unreamed Group

	N	Min	Max	Mean	SD	P Value
PRE OP	40	10	141	55.1	33.5	0.025
POD 1	40	15	150	67.5	35.6	
POD 3	40	8	180	84.7	48.0	
POD 10	40	12	170	72.9	42.9	

Table 4: ESR in reamed group

	N	Min	Max	Mean	SD	P Value
PRE OP	40	4	160	42.8	37.7	0.001
POD 1	40	12	140	66.8	34.3	
POD 3	40	17	165	82.7	45.1	
POD 10	40	8	170	65.5	41.7	

There is a statistically significant difference between pre-op and post-op values for the parameter ESR in REAMED group ESR in the study group was high during the preoperative period (average values of 42.8; P = 0.001), whereas there was a sharp rise to 66.8 (average value) postoperatively (P, 0.001), reaching the peak on the 3rd postoperative day (average value, 82.7; P, 0.001 in comparison to the preoperative mean value). ESR mean value returned near to POD 1 on the tenth postoperative day (65.5).

ESR in the control group was preoperatively 55.1 (P = 0.025), 67.5 on the 1st postoperative day (P = 0.025), 84.7 on the 3rd

postoperative day, and 72.9 on the 10th postoperative day.

Discussion

Mueller & Rahn [7] proposed removal of the medullary contents before reaming by suction in an effort to decrease the intramedullary pressure and avoid systemic complications; a proposal that needs to be validated in vivo because their study was performed on cadaveric bones.

However, other studies have shown that although intramedullary pressure increases significantly during reamed intramedullary nailing, only a minimal difference is noted in the pulmonary hemodynamic response even in the presence of thoracic trauma.

Additionally, Giannoudis *et al.* [8] proposed that systemic inflammatory reaction leading to the appearance of acute respiratory distress syndrome or multiple organ failure may occur because of the patient's individual characteristics and hyperstimulation of the immune system by surgery, a procedure that is described as the "second hit." The amount of contribution of each one of the described factors in the pathogenesis of the systemic inflammatory reaction that follows reamed intramedullary nailing is not clear.

Furthermore, the possibility of a relationship between the magnitude of increase of biologic markers and the appearance of systemic disease, especially after polytrauma or chest injury, remains to be clarified. Although there have been several studies about the clinical significance of the alterations of ESR and CRP observed after elective orthopaedic surgery (hip and knee replacement, spinal operations, few reports have been published concerning the behavior of these biologic markers after trauma surgery.

Schulak *et al.* [9] refer to previous studies to conclude that ESR often increases to high levels after major surgical operations or extensive trauma and usually returns to normal

within 6 months. Thus in this study, there is a raise in ESR, CRP, PL and TEMP pre operatively probably due to trauma. Interestingly, they mention that in major orthopaedic procedures, preoperative and immediate postoperative ESR values do not differ. This is in contrast to our finding that ESR (& CRP) rises acutely immediately postoperatively, bearing in mind that intramedullary nailing of long bone fracture is not generally considered major operation.

In another relevant study, Kallio *et al.* [10] found that CRP increases more after open reduction and internal fixation than after intramedullary nailing of closed tibial fractures. However, they had only 5 patients treated with open reduction and internal fixation and only 10 treated with intramedullary nailing (without mentioning whether reamed or unreamed technique was used).

Ellitsgaard *et al.* [11] found that ESR was generally variably raised during the first week after surgery for hip fractures, whereas CRP showed a distinct pattern with a rapid increase on the second day. They did not analyze their results in depth, such as the degree of alteration in connection to the type of fracture or the surgical technique.

In the present study ESR and CRP were still elevated on the last sample taken on the 10th postoperative day. It has been reported that it may take several weeks until these reactants reach normal levels after elective or other trauma surgery. Knowledge that body temperature may reach high levels for several days after reamed intramedullary nailing and its specific characteristics (such as evening spikes, medicinally controllable, and patient's good mood and appetite) could decrease the necessity for investigating its cause, providing that there are not any other clinical signs present to indicate the beginning of an infectious process (eg, urinary tract infection). In our unit, we use 1 preoperative and 3 postoperative days of a 3rd-generation cephalosporin when treating patients in both groups. Antibiotic coverage is then discontinued, regardless of temperature elevation, unless otherwise indicated from a detected or highly suspected infectious process. In contrast, antibiotic coverage is continued in cases of persisting high temperature postoperatively after other trauma operations that do not violate the intramedullary canal.

Additionally, ESR & CRP, plasma lactate is not considered reliable indicators for the evaluation of a suspected infectious process in the early postoperative period. Patients are warned before operation that it is likely they will develop high temperature postoperatively, which could last up to 1 week. This policy has taken anxiety and stress away from patients, relatives & allows undisturbed continuation of rehabilitation program [12]

All the patients are treated under regional anesthesia and not under general anaesthesia. Keeping in mind that drugs used in general anaesthesia could result in change in inflammatory mediators.

Existence of such a group could clarify the role of surgery in the appearance of the observed inflammatory process.

The limitation of this study is administering anti-inflammatory drugs and anti-pyretic drugs post operatively. Further limitation has been the termination of the study on the 10th postoperative day, because it was not possible to collect blood samples from many patients after they were discharged from the hospital. Because the ESR and CRP were still elevated on the 10th postoperative day, we were not able to define the time needed for these markers to return to normal after reamed intramedullary nailing.

Patients in the study group and control group were given

simple medication (eg, paracetamol tablet) whenever their temperature was higher. Therefore, paracetamol could influence the results of the study by lessening the magnitude of temperature rise and making the comparison of the two groups less striking. Consequently, we do not believe that the use of paracetamol jeopardized the overall results as described.

Finally, it should not pass unnoticed that the patients in control group were older than patients in study group. This may explain why ESR & CRP values were elevated on admission in control group, because it is known that biologic markers rise normally with age [37, 39]. Nevertheless, the important issue in this study is not the starting value, but magnitude of alteration in values of biologic markers in both groups postoperatively.

Conclusion

Both reamed and unreamed groups cause an acute elevation of body temperature as well as significant alteration of both ESR and CRP (but not Plasma lactate). But there is no significant difference between these two groups (study and control).

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