EVALUATION OF SKIN TEMPERATURE, REACTIVE C PROTEIN, AND HEMOSEDIMENTATION SPEED VARIATION IN UNCOMPLICATED PRIMARY KNEE TOTAL ARTHROPLASTY

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SUMMARY

Objective: To study the variation of skin temperature values (ΔT) on operative site, of reactive C protein (RCP) and of hemosedimentation speed (HSS) in patients submitted to primary knee total arthroplasty (KTA), in an attempt to establish a correlation among its curves over time. **Materials and Methods**: This prospective clinical study evaluated 29 patients followed up during 12 weeks, with measurements of skin temperature in both knees and RCP and HSS serum dosages. **Results:** After comparing the variables tested (ΔT, RCP and HSS), no statistical correlation was observed for both the Pearson's test (parametric test) and the Spearman's test (non-parametric test) among variables. Skin temperature variation follows a different pattern from that observed both for RCP and for HSS, with no correlation among curves. A standard curve was established for the three variables, and a statistically significant reduction was seen in RCP and HSS values from pre- to post-operative period. **Conclusion:** No correlation was observed between skin temperature and HSS and RCP levels in patients submitted to uncomplicated primary KTA.

Keywords: Replacement; Knee; Temperature; C-reactive protein.

INTRODUCTION

Knee total arthroplasty (KTA) is the definitive treatment to relieve pain caused by knee osteoarthrosis, restoring its alignment and function[1,2,3,4].

Infection after KTA is a serious complication putting the joint at risk and occasionally threatening patient's life[3,4,5]. The incidence of deep infection ranges from 1% to 5%[2,4]. Superficial infection occurs in 10-20% of the cases[2,4]. A higher rate is found in patients previously submitted to other surgeries, in rheumatoid arthritis carriers (particularly HIV-positive men) and in patients with skin ulcers[3,4].

Factors associated to infection are obesity, urinary tract infection, steroids use, kidney failure, diabetes mellitus, malnutrition and psoriasis[1,2,3,5]. Anemia, hypovolemia, and tobacco abuse are factors predisposing superficial infection[2].

The reactive C protein (RCP) is synthesized by hepatocytes, at acute inflammatory phase, as a response to infection. Its meaning in acute infection diagnosis and tissue destruction is well established[6-10]. Its levels change according to the disease activity, increasing from 6 hours of infection on, and reaching peak levels two days after onset. It returns to normal levels within one week after an appropriate therapy is initiated[1,6-10]. Modern, quantitative and fast methods are significantly increasing the potential of RCP serum levels use[1,6,7].

The hemosedimentation speed (HSS) is an important laboratory test for diagnosing postoperative infections. Its values rise after 48 hours from the onset of an infectious picture, with peak rise between three and five days, returning to its normal value approximately three weeks after an appropriate treatment is initiated[1,5,6,7,10]. Its value, similarly to RCP, is limited by the influence of other diseases or postoperative complications, being difficult to determine absolute limits to its adequate serum levels[5].

Skin temperature on surgical site is a non-specific sign in the evaluation of immediate postoperative infection, be-

Study conducted at Hospital das Clínicas (HC), Federal University of Minas Gerais (UFMG).

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cause the very healing mechanism leads to an increased vascularization by local inflammatory response, rising the temperature[3].

The objective of this study is to study the variation of skin temperature at surgical site, RCP values and HSS in patients submitted to primary KTA in the absence of pre- or postoperative clinical complications, in an attempt to determine its normal standards and to check the existence of a potential correlation among them.

MATERIALS AND METHODS

In a period comprehending July 2004 and May 2005, 29 patients submitted to unilateral primary KTA carrying essential osteoarthrosis and exempted of any pre- or postoperative complications were prospectively assessed.

All patients were operated by two authors (LHCJ and MAPA) at HC, UFMG.

Three patients presenting superficial infection, one with deep venous thrombosis, and another with urinary tract infection, who did not come back regularly for evaluation visits were excluded from sample. The remaining 20 were followed up during 12 weeks from immediate postoperative period on. Thirteen patients were females and seven males, with ages ranging from 58 to 75 years old (average: 65.85 years old).

Skin temperature for both knees was measured at immediate preoperative period, at 48 hours, and in one, two, four, eight and twelve weeks postoperatively using a contact thermometer *Digital Thermo®* model, *Alla France®* brand, placed on anteromedial surface of knees for a three-minute period. For analysis, differences in temperature between both sides (ΔT) were recorded. In the same procedure, blood samples were collected to measure serum levels of RCP and HSS, all of them performed by the same laboratory. The method employed for RCP measurement was the Nefelometry, using a *Beckman Array 360 System* equipment, which reference value was standardized as less than eight milligrams/ liter for the result to be considered as negative. HSS was measured by a modified *Westergreen* methodology, with material from *Seditainer® – Becton Dickinson®*, which reference values are standardized according to the table below (table 1):

	Male	Female
up to 60 years old	12mm	19mm
61 - 70 years old	14mm	20mm
above 71 years old	30mm	35mm

Source: Clinical Analysis Laboratory of HC/UFMG.

Table 1 – *Reference values for HSS.*

Time	r for ΔT / ΔRCP	r for ΔT / ΔHSS
Preoperatively	0.984	0.950
48 hours	0.067	-0.114
1 week	0.101	-0.311
2 weeks	0.244	0.067
4 weeks	0.123	0.393
8 weeks	-0.273	-0.128
12 weeks	-0.073	0.387

Source: HC/UFMG.

Table 2 – *Results of the Pearson's parametric test.*

The study design was approved by the Committee on Ethics in Research of the institution. A written post-informed consent term was signed by all participants.

For the statistical analysis of data, the Pearson's parametric correlation coefficient (r) was employed.

Statistical correlation comparisons were tested pair by pair, for two of three variables in a given time interval (for example: comparison between ΔT and RCP on the first postoperative week).

For all comparisons, the non-parametric analysis was used as well (Spearman's correlation coefficient).

RESULTS

The following results were achieved for Pearson's parametric test (Table 2):

After a comparison of variables tested (ΔT, RCP and HSS), it was noticed, both for Pearson's test and for Spearman's test, that no statistical correlation existed (r close to zero), showing that skin temperature variation follows a different pattern from that seen both for RCP and HSS.

Graphs 1, 2 and 3 show, respectively, the individual curves for ΔT, RCP and HSS with time (90 days).

In Graph 4, we made an overlap of ΔT, RCP and HSS curves with follow up time (90 days) enabling results visualization of the results of the previously mentioned statistical tests.

We can see that all variables tested show, at the first measurement interval (preoperative – 48 hours), an increase of values in the order of 3.7 to 4.2 times. RCP and HSS curves begin to drop after the first 48 hours postoperatively. RCP decreases faster, reaching levels below those of the preoperative period in approximately 28 days after surgery (4 weeks). HSS levels, in turn, only return to values below those of the preoperative period after 56 days (8 weeks).

ΔT presents a rise peak at the first measurement interval (preoperative – 48 hours), but keeps rising until the first 14 days postoperatively (2nd week), and only after that period it begins to decrease in a slower speed than other variables' reduction. Even after the evaluation period established in this study (12 weeks), ΔT was still decreasing, yet above values measured at preoperative time.

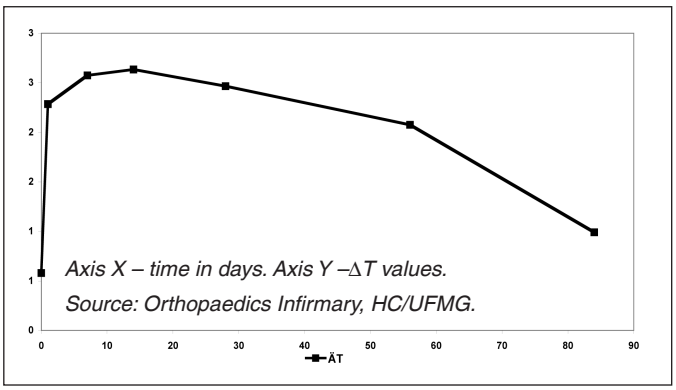
With the objective of evaluating the statistical correlation

among preoperative values at 90 days for each individual variable, the following results were achieved for Pearson's parametric test (Table 3):

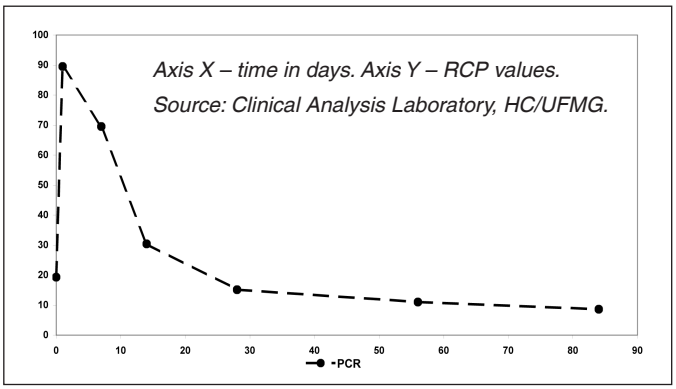
With those results, we see that both for RCP and for HSS, there is a statistically significant difference between pre- and postoperative values. Such fact could not be seen for ΔT, indeed presenting a negative correlation.

DISCUSSION

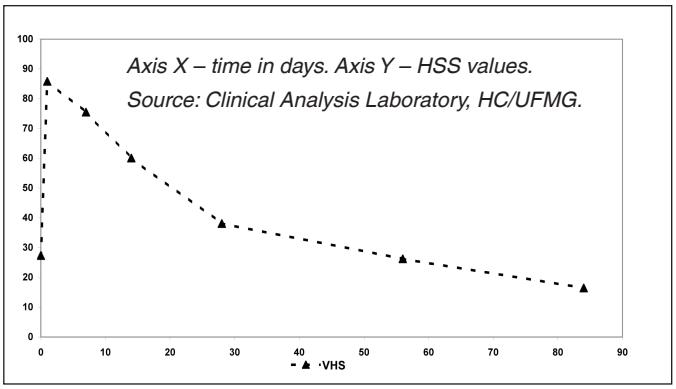
A postoperative clinical evaluation can provide an early diagnosis of a potential infection at surgical site. RCP and HSS are tests widely employed for that end, but they have the disadvantage of being non-specific [5-10], and may be changed in many diseases presenting inflammatory responses [1]. Other factors may also change HSS and RCP values, such as obesity[11], tobacco abuse[12], degenerative osteoarthrosis[13], changed acute phase response in elderly patients [14,15], burns[16], post-trauma stress[17], altitude[18], emotional disorders[19,20], menstrual cycle[20]. In this study, the variation patterns found on RCP and HSS curves are compatible with those reported by literature [1,2,6]. RC curve showed peak at immediate postoperative period (first post-surgery examination) followed by a progressive reduction of values, showing normalization



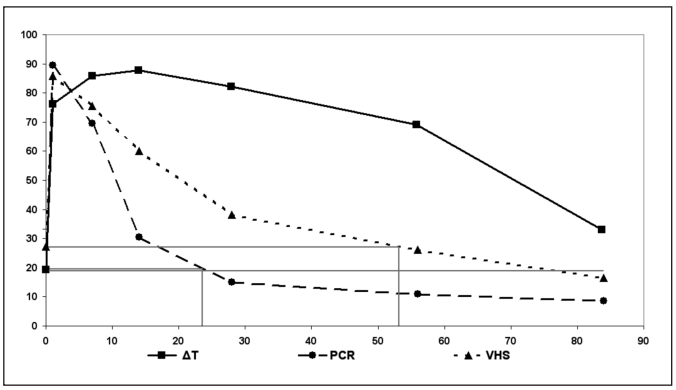
Graph 1 –ΔT variation with time.



***Graph 2 –** RCP variation with time.*



***Graph 3 –** HSS variation with time.*



Axis X – time in days. Axis Y –ΔT, RCP and HSS values.
Source: Clinical Analysis Laboratory and Orthopaedics Infirmary, HC/UFMG.

Graph 4 –ΔT, RCP and HSS variation with time.

within 30 days at most, with values below those of the preoperative period within 60 days.

In what concerns HSS, literature is more controversial, tending to return to normal levels within 3 to 6 months [5,20], which may remain high during up to one year after surgery [6]. In this study, a peak was noticed at the immediate postoperative period (first post-surgery examination), followed by a progressive decrease tending to normalize within at most 60 days, subtly faster as compared to literature [5,20], and values below those of the preoperative time within about 90 days.

Skin temperature rise at surgical site is a clinical symptom usually seen after an uncomplicated KTA. Until the present study, its normal variation curve had not been established in literature yet. In this evaluation, the ΔT curve presented a peak at immediate postoperative measurement, remaining high in two subsequent measurements, with decrease occurring from the 30th day on, and normalization was not observed until the 12th week, remaining above preoperative values during 90 days.

The possibility of correlating the increase of RCP and HSS values to skin temperature variation could establish a clinical standard, of simple application and economically feasible for postoperative monitoring, working as an inflammatory response

parameter. Unfortunately, this was not possible, because of the absence of statistical correlation, but here we determined the normal standard that can be used as a reference for cases in which postoperative infection is suspected, either superficial or deep. In agreement with the findings by Lara et al.[21] a significant reduction of preoperative RCP and HSS values against the values at 90 days was confirmed, highlighting the importance of arthroplasty in reducing inflammatory process (associated to preoperative osteoarthrosis).

	preop. ΔT	preop. RCP	preop. HSS
ΔT 12 weeks	-0.114		
RCP 12 weeks		0.984	
HSS 12 weeks			0.978

Source: HC/UFMG.

Table 3 – *Results of Pearson's parametric test.*

CONCLUSION

At primary uncomplicated KTA postoperative period, no correlation was found between HSS behavior, RCP, and the difference on skin temperature between both knees. RCP and HSS returned to values below preoperative levels after 30 and 80 days, respectively. Skin temperature had not decreased to previous levels even after 12 postoperative weeks.

Those parameters' rise should be regarded as normal after surgeries like the Knee Total Arthroplasty, even in the absence of complications.

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