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# Nutritional parameters predicting postoperative infections

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# NUTRITIONAL PARAMETERS PREDICTING POSTOPERATIVE INFECTIONS

Pages with reference to book, From 3 To 6

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## Abstract

Thirteen nutritional parameters viz body mass index (BMI), mid arm circumference (MAC), mid calf circumference (MCC), triceps skin fold thickness (TST), abdominal skin fold thickness (ASFT), abdominal girth at umbilicus (AG U), haemoglobin (Hb), total leucocytes count (WBC), absolute lymphocyte count (ALC), serum proteins (Prot.), serum albumin (AIb), serum total iron binding capacity (TIBC) and serum iron (Fe) were estimated in 52 (36 male and 16 female) consecutive patients admitted to a surgical service at the Abbasi Shaheed Hospital, Karachi. Nine males and one female developed surgical infections whilst the wounds of 27 males and 15 females healed by primary intent. There was a significant difference in the values of BMI, MCC, ASFT, Prot., and AIb between the patients with infected and clean wounds. Whilst MCC was significantly different, MAC was not as good a differentiator. Whilst Prot. and AIb were lower in the infected group, BMI, MCC, TST, ASFT were higher in the patients whose wounds healed by primary intent (JPMA 38:3, 1988).

## INTRODUCTION

Malnutrition and obesity both affect the outcome of surgical operations. Malnutrition impairs wound healing[1] and immunocompetence[2,3] and consequently encourages surgical infections. A variety of measurements can be used to quantitate nutritional status. These have been described earlier[4]. The present study was undertaken to determine which of the nutritional parameters best predict infections.

## PATIENTS AND METHODS

Fifty Two consecutive patients (36 male, 16 female) admitted for surgery to one surgical ward at the Abbasi Shaheed Hospital were nutritionally assessed. Postoperative followup was done to determine the incidence of wound infection, urinary infections and occurrence of peritonitis. The most frequent admitting diagnoses were cholelithiasis, appendicitis, Hernia, Hydrocoele, accidental wounds and miscellaneous. Ages ranged from 10—90 years of age (average age 35.3 years). The majority were in the lower middle class income group. The income was known in 35 patients, averaged Rs. 1516 per month and ranged from Rs. 400—5,000 per month. Nutritional assessment included parameters mentioned in Table I.

**TABLE–I**

**Nutritional Parameters Assessed.**

| "Anthropometric" measurements | "Biochemical" measurements | "Immunological" measurements |
|---|---|---|
| Height, weight and Body Mass Index | Total Proteins | Total WBC count |
| Mid arm circumference | Serum Albumin | Absolute lymphocyte Count |
| Maximal calf circumference | | |
| Triceps skin fold thickness | Hemoglobin levels | |
| Abdominal skin fold thickness | Total iron binding capacity | |
| Abdominal girth at umbilicus | Serum iron | |

The Body Mass Index was calculated from the height in meters (M) measured by a vertical extension rod and the weight in kg (by a beam balance) from the formula BMI = Wt in kg/(ht in m)2. The triceps skin fold thickness was measured by calipers, 2 cm below a fold of skin lifted off the middle of the triceps. Abdominal skin fold thickness was measured below the umbilicus. Abdominal girth at umbilicus was measured with the patient supine. The mid arm circumference was measured with the arm hanging loosely by the side whilst the patient was sitting. Maximal calf circumference was taken carefully at right angles to the thin. The Hb, leucocyte count (WBC), absolute lymphocyte count (ALE), serum proteins, albumin (TIBC) and serum iron were also determined. The wounds were inspected at the time of removal of sutures or earlier if the patient was pyrexial. Erythema around silk sutures was not considered infection whilst a stitch abscess or any discharge or coilection of pus was noted. Urinary tract infection and peritonitis were also considered as infections for the purpose of the study. Of 52 patients examined 42 had no infection (27 male, 15 female) and 10 ( 9 male, 1 female) developed post-operative infection.

**RESULTS**

The results are noted in Table II (for the entire group),

**TABLE –II**

**Anthropometric, Hematological and Biochemical Measurements.**

| | Mean | (Range) |
|---|---|---|
| BMI | 27.04 | (14.8–70.0) |
| MCC (cm) | 28.02 | (20 – 41) |
| MAC (cm) | 22.29 | (6.5 – 28) |
| TST (cm) | 1.25 | (0.5 – 2.8) |
| ASFT (cm) | 1.5 | (0.6 – 3.5) |
| ISFT (cm) | 1.164 | (0.5 – 2.6) |
| AGU (cm) | 72 | (53.5 – 97) |
| | Hematological measurements | |
| Hb | 16.6 | (5 – 17.4) |
| Total WBC | 8706 | (3250 – 18550) |
| ALC | 3308 | (1235 – 7049) |
| | Biochemical Measurements | |
| S. Prot | 8.7 | (5.3 – 10.5) |
| S. Alb | 3.83 | (2 – 6.6) |
| TIBC | 256 | (76 – 549) |
| Fe | 74.92 | (19.6 – 528) |

**TABLE – III**
**Anthropometric Measurements.**

| | Patients without infcction | Patients with infected wounds UTI |
|---|---|---|
| B.M.I. | 26.24 ± 7.833 | 25.62 ± 8.713** |
| *Maximal calf circumference (MCC) | 27.87 ± 3.95 | 28.65 ± 6.156** |
| *Mid arm circum-ference (MACC) | 22.64 ± 4.395 | 20.8 ± 4.0 |
| *Triceps Skinfold thickness (TST) | 1.34 ± 0.525 | 0.97 ± 0.306** |
| *Abdominal Skinfold thickness (ASFT) | 1.56 ± 0.629 | 1.25 ± 0.162** |
| *Abdominal Girth at umbilicus (AGU) | 73.58 ± 11.080 | 66.15 ± 7.433 |

*All measurements in cms.

** Statistically significant difference.

Table III (Anthropometric measurement),

## TABLE–IV
### Biochemical Measurements.

| | Patients without infection | Patients with infected wounds, UTI etc. |
|---|---|---|
| Serum Proteins (G/dl) | 7.573 ± 1.11 | 7.08 ± 0.794* |
| Serum Albumin (G/dl) | 3.828 ± 0.920 | 3.72 ± 0.614* |
| T.I.B.C. (micrograms/dl) | 271.07 ± 94.934 | 254.78 ± 137.535 |
| Serum Iron (micrograms/dl) | 58.512 ± 28.511 | 64.06 ± 33.389 |
| Hemoglobin (G/dl) | 11.26 ± 2.369 | 11.3 ± 1.481 |

* Statistically significant difference.

Table IV (Biochemical measurements) and

## TABLE –V
### Leucocyte Counts.

| | Patients without infection | Patients with infection |
|---|---|---|
| Total WBC count | 8500 ± 2860 | 9300 ± 2815 |
| Absolute lymphocyte count | 2964 ± 1212 | 3060 ± 1236 |

Table V (Total leucocytes count and ALC). Applying the student test, statistically significant differences were noted for BMI, MCC, 1ST and ASFT (Table III), S. Prot. and Albumin (Table IV) but not for ALC or TIBC.

## DISCUSSION

Assessment of various nutritional parameters can indicate to the surgeon the patients who stand a higher risk of infection, morbidity from anastomotic and wound breakdown and mortality. Nutritional assessment should, therefore, form a part of assessment of all patients scheduled for major surgery, specially so for bowel anastomoses and reconstructive surgery. From the plethora of nutritional assessment parameters it is advisable to select the few that should be assessed to predict mortality and morbidity. This will minimise the number of investigations, costs and time utiisation. From an earlier study, we expect 41% males and 38% females to be undernourished (by BMI standards). We, therefore, feel that BMI should be measured (though others feel that moTbidity and mortality are not correlated to BMI), specially as weight always has to be measured for drug dosage calculations, and the only additional parameter to be measured is the height. This can be measured by the extended vertical beam attached to weighing scales. The other parameters showing significant difference between infected and clean patients are listed in Table II — IV. Surprisingly arm measurements which estimate muscle bulk were not predictors whilst calf muscles measurements were. Poor arm muscle development may reflect the lack of recreational exercise due to lack of time in a population known for working simultaneously at two occupations. Calf muscles automatically develop in a population which needs to walk long distances in the absence of organised public transport. In addition to the many nutritional parameters assessed (Table II) serum transferrin and allergy to skin test allergens have been reported as useful predictors of successful outcome of operations. Facilities for estimation of serum transferrin were not available and are not likely to be available in most hospitals in Pakistan. However, serum transferrin levels correlate well with the total iron binding capacity (TIBC). We, therefore, estimated TIBC and serum iron levels; neither were significantly different in the two groups of patients. Skin test allergens were also not available. We have not estimated skin test allergy as the only easily available antigen was tuberculin and most of our population have been exposed to it. A combined allergy to candida, streptokinase-streptodonase (SKSD) or Trichophyton antigen could indicate a grave prognosis. Serum proteins and albumin are good predictors. Whilst a low BMI indicates a poor nutrition and susceptibility to infection. Of 5 patients with low BMI, only one patient sustained infection (peritonitis) for which there were other precipitating causes. Patients with BMI as low as 14.8 and 16.45 did not get infected. The total leucocytes (TLC) and absolute lymphocyte count (ALC) were no different in the two groups. One patient had an ALC of 350/cumm. He showed no infection. His albumin level was 4.0 g/dl and BMI 20.44. Amongst the patients with infection 3 had an ALC of below 2000. Five patients had as BMI above normal (Table VI).

TABLE–VI

BMI, TST and Absolute Lymphocyte Count of Patients with Infections.

| Serial No | Sex | BMI | Alb G/dl | Absolute lymphocyte count | Type of Infection **** |
|---|---|---|---|---|---|
| 5, | M | 21.97 | 3.2 | 5640 | Wound infection |
| 7 | M | 19.33* | 3.8 | 2560 | Peritonitis |
| 23 | M | 22.49 | 4.5 | 2838 | U.T.I. |
| 26 | M | 28.80** | 3.3 | 1960*** | Staph pyogenes |
| 30 | M | 28.30** | 4.0 | 2400 | Gin –vi cocci |
| 35 | M | 25.29** | 3.3 | 1728*** | Staph Pyogenes E. Coli UTI |
| 37 | M | 26.6** | ND | 4800 | Staph pyogenes E. Coli |
| 40 | F | 40.0** | 4.9 | 1800*** | Not specified |
| 50 | M | 24.8 | 3.6 | 2538 | E. Coli |
| 52 | M | 22.4 | 2.9 | 3456 | Staph. Pyogenes |

* Low BMI ** High BMI *** Absolute Lymphocyte count below 2000.

**** Wound infection unless specified.

Normal values-BMI 20–25 (males), 19–24 (females).

ND - Value undetermined.

Of the 6 patients with a serum albumin below 3 g/dl only one patient developed an infection and, of all the patients with infection, only one patient had an albumin level below 3.0 g and 3 patients an albumin level under 3.5 g (Table VI). Thus parameters in isolation are not predictors of infection (many patients with low DM1 or low serum albumin have remained uninfected). Much depends upon an interaction of the various factors, including variables such as extent of wound contamination. We hypothesize that this socio-economically deprived group of patients has been exposed to multiple environmental immunological challenges from early life. This exposure to unhygienic water supply and their development, as children, in the foetid environment of over- flowing gutters has primed their immune system to respond effectively and efficiently to bacterial antigenic challenge.

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