

## THE DIABETIC LEG – SURGICAL APPROACH OF 90 PATIENTS BASED ON A THERAPEUTIC PROGNOSTIC INDEX (TPI)

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**Abstract:** *Diabetes mellitus is a common disease with an increasing prevalence, representing a major public health issue. Diabetic foot is a frequent and severe complication of diabetes mellitus, appearing because of diabetic neuropathy and angiopathy, infection being often associated. The therapeutic management of the diabetic foot is difficult. The paper presents a clinical evaluation and the subsequent therapeutic decision and management of 90 cases of diabetic foot based on a therapeutic prognostic index (TPI). The TPI reliability in confirming the right surgical decision and in improving the surgical approach for better results is analyzed.*

**Key words:** *diabetic foot, therapeutic prognostic index, amputation.*

### 1. Introduction

Diabetes comprises a heterogeneous group of glycaemic metabolism abnormalities that lead to hyperglycaemia, through different pathophysiological mechanisms [4]. Diabetes mellitus has a high prevalence (2-6% of the population) expected to increase, since for every diagnosed case, there are at least other 2-3 undiagnosed cases [9, 12]. The central pathophysiological feature of diabetes mellitus is an absolute or relative insulin deficiency, which leads to a metabolic disaster, triggering a series of

cardiovascular, renal, neurological, and ocular complications [4, 9, 12].

The diabetic leg is characterized by the totality of the skeletal and soft tissue changes occurring in the lower limbs caused by diabetes mellitus, and it is a frequent and severe complication among diabetic patients [1, 6]. The concept of diabetic leg entails the occurrence of any profound ulcerations, infections or damages of the leg, determined by the presence of diabetic neuropathy and/or arteriopathy. The appearance of such lesions in a diabetic patient signifies that the medical treatment is not working

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anymore, a surgical approach being compulsory [1].

The worst lesion encountered in diabetic leg is diabetic gangrene, which is caused by three factors: the neuropathic factor (the most important and constant one), the vascular factor (characterised by the diabetic macroangiopathy and especially by the diabetic microangiopathy –present in all the cases), and the infectious factor (compulsory, but secondary to neuropathy and angiopathy) [2], [4], [7], [9], [13]. Although in patients with controlled diabetes mellitus the immune status is acceptable, there is a high susceptibility to infection, which is increased by the metabolic disbalance [2], [7].

The diabetic leg has a frequency of 8-15% among the diabetic population (North America and Europe), and it is responsible for over 80% of the non-traumatic amputations in the USA [1, 7]. The social and economic impact of the diabetic leg is huge, partly illustrated by great resources used for the patients' medical care. It is estimated that the costs of treating diabetic ulcerations exceed 1.5 billion dollars per year in the USA and have an increasing trend, even though the number of major amputations is decreasing [3]. In Portugal, the average cost of diabetic leg lesions' treatment is of 4,367.05 dollars per in-patient [5].

The multiple pathogenic aspects of the diabetic leg render the treatment difficult and complex [1]. The Therapeutic Prognostic Index (TPI) suggested by Pătraşcu and collaborators is a very important tool in the surgical management of the diabetic leg, because it takes into account data regarding the effect of diabetes mellitus upon the whole body and the severity of the lesion. Moreover, it is fairly easy to calculate and can suggest suitable therapeutic options [6], [7], [9].

## 2. Aim of the study

The aim of this study is to determine the reliability of TPI in a proper and complex evaluation of the diabetic leg and in guiding therapeutic management (the type of intervention).

## 3. Patients and Methods

We retrospectively analyzed 90 patients with different lesions of diabetic foot, hospitalized in the 2<sup>nd</sup> Surgery Department from the Clinical Emergency County Hospital of Brasov between January 2010 – July 2014, based on TPI calculation.

The parameters taken into account in TPI calculation are displayed in Table 1 [6, 7]:

A TPI score of less than 5.0 indicates the possibility of a conservative surgical intervention: simple draining incisions, phalanx or toe resections, ray resections (amputation of a toe and the corresponding metatarsal head), or the transmetatarsal amputation.

A TPI above 5.0 requires a major amputation, i.e. the amputation of the calf (when the TPI ranges between 5.0-6.6) or of the thigh (when the TPI is above 6.6).

## 4. Results

In the studied group, diabetic foot was more frequent in men (n = 64 patients; 71.11%) than in women (n = 26 patients; 28.89%), the men/women ratio being 2.46.

Leg lesions were less frequent in patients under 50 years of age, but the frequency increased suddenly, as in the 6<sup>th</sup> decade showed to be the highest. The patients aged under 50 were the most numerous in the study group (85.5%).

Almost half of the cases (41.11%) displayed diabetic leg lesions during the first 10 years of evolution of diabetes mellitus.

*The parameters determining the TPI score*

Table 1

| Parameter   |                               | Points |
|---|-------------------------------|--------|
| Gender  | Female                        | 0.2 p  |
|   | Male                          | 0.4 p  |
| Age   | 20-29 years                   | 0.1 p  |
|   | 30-39 years                   | 0.2 p  |
|   | 40-49 years                   | 0.4 p  |
|   | 50-59 years                   | 0.6 p  |
|   | 60-69 years                   | 0.8 p  |
|   | >70 years                     | 1.0 p  |
| Number of years of diabetes evolution                 | 1-5 years                     | 0.2 p  |
|   | 6-10 years                    | 0.4 p  |
|   | 11-15 years                   | 0.6 p  |
|   | 16-20 years                   | 0.8 p  |
|   | > 20 years                    | 1.0 p  |
| The lesion type                                       | extensive wet gangrene        | 2.4 p  |
|   | wet gangrene with ulceration  | 2.4 p  |
|   | wet gangrene of the toes      | 1.1 p  |
|   | fistula prosteitis            | 1.1 p  |
|   | deep neuropathic ulceration   | 1.0 p  |
|   | gangrenous cellulitis         | 0.6 p  |
|   | necrotizing fasciitis         | 0.4 p  |
|   | profound leg phlegmon         | 0.4 p  |
|   | profound leg abscess          | 0.4 p  |
|   | dorsal foot phlegmon          | 0.4 p  |
|   | simple neuropathic ulceration | 0.2 p  |
|   | dry gangrene of the toes      | 0.2 p  |
| Bone damage   | present                       | 0.3 p  |
| Visceralization                                       | nephropathy                   | 0.3 p  |
|   | retinopathy                   | 0.3 p  |
|   | cardiopathy                   | 0.3 p  |
| Emergency<br>(surgery required in the first 24 hours) |                               | 1.1 p  |
| Associated diseases                                   | compensated                   | 0.2 p  |
|   | decompensated                 | 0.4 p  |
| Oscillometry  | 0-1                           | 1.5 p  |
|   | 1-2                           | 1.0 p  |
|   | 2-3                           | 0.5 p  |
|   | over 3                        | 0.0 p  |

Regarding the type of lesions, extensive wet gangrene ranged first (n=30 cases; 33.33%), followed by toe wet gangrene (n = 23 cases; 25.56%), and by osteitis and

fistulised osteoarthritis (n=14 cases; 15.56%). Bone damage was present in 28 (31.11%) patients (Figure 1).

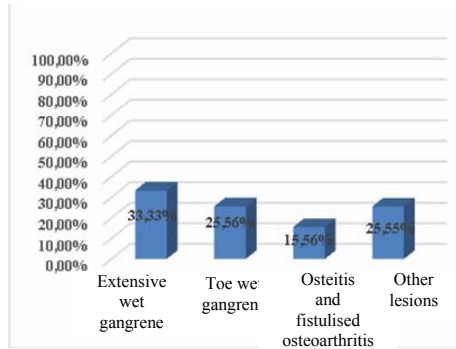


Fig. 1. *Type of lesions encountered in the patients from the study group*

Diabetic nephropathy (n = 27 cases; 30.00 %) and diabetic retinopathy (n = 20 cases; 22.22%) are the most frequent visceral complications observed in the studied group. They betrayed some advanced microangiopathy lesions. They were often associated in the same patient.

In 4 (4.44%) cases an emergency surgical intervention was performed, required because of toxic septic state in 3 cases (3.33%), and the by an extended lesion in another case (1.11%). In all the cases of toxic septic state the thigh amputation was performed.

Most of the patients in the studied group had associated comorbidities, mainly cardiovascular disease. We ought to mention the frail metabolic and cardiovascular compensation of these patients, in which decompensation could only be hastened by diabetic gangrene lesions or by septic lesions of the leg.

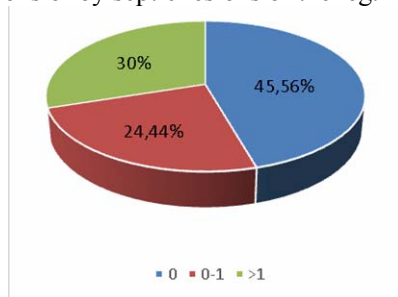


Fig. 2. *Oscillometry in the study group*

Most of the patients in our study group had low oscillometry values, i.e. 0 in 41 (45.56%) cases or ranging between 0 and 1 in other 22 (24.44%) cases, signifying diabetic macroangiopathic/atherosclerotic lesions (Figure 2).

Calculation of the TPI value showed that 40 (44.44%) patients from the study group had the TPI beneath 5, which suggested a conservative surgical approach. The other 50 (55.56%) patients had a TPI over 5, which indicated a major amputation (of the calf, respectively, the thigh in equal proportions: 27.78%) (Figure 3).

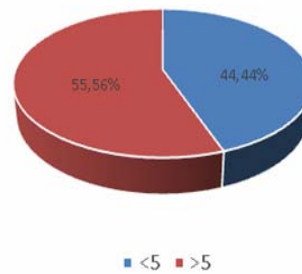


Fig. 3. *The therapeutic prognostic index (TPI) in the study group*

These data allowed us to outline the profile of the patient with diabetic leg representative for the studied lot as follows: male aged over 50 (more frequently aged between 60 and 69), with an evolution of diabetes mellitus of up to 10 years, with lower limb diabetic gangrene, with or without bone damage; also associating diabetic nephropathy and retinopathy, as well as multiple cardiovascular complications. The atherosclerotic lesions of the lower limb arteries were advanced, demanding a major surgical approach – major amputation (of the calf or thigh).

Surgical procedures performed in the patients with diabetic leg lesions from the studied group consisted of 27 major amputations (23 thigh amputations and 4 calf amputations), representing 30.00% of the cases. The other 63 (70.00%) patients were treated only by conservative

interventions (Figure 4). A post-operative local favorable evolution was noted in 85 (94.44%) cases.

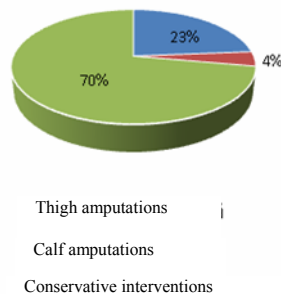


Fig. 4. *Types of performed surgical interventions*

The consistency of the TPI with the surgical intervention was noted in 67 (74.44%) cases, supported by the favorable evolution in the 63 cases in which the operative indication did comply with, and by the local unfavorable evolution in 4 cases, in which the operative indication did not comply with. The inconsistency of the TPI with the type of surgical approach was noted in 23 (25.56%) cases, 22 of which had a favorable evolution, when the surgical indication did not comply with, and 1 case of unfavorable evolution when the surgical indication suggested by the calculation of the TPI did comply with. Of the 22 cases that had a favorable evolution despite the non-compliance with the TPI, conservative surgical interventions vs. major amputations (suggested by the TPI value) were performed in 20 cases. In 15 (75.00%) of these cases the PTI difference (between the TPI suggested type of surgical approach and the performed intervention) was smaller. Attention must be drawn on the TPI value in these circumstances, as it ranged between 5 and 6.

## 5. Discussion

The TPI proposed by Pătrașcu and collaborators is a useful working tool in clinical practice, as it may guide the surgeon

towards the type of surgical intervention to be performed in a certain patient with a diabetic leg lesion. Thus it helps in reducing the number of useless amputations (because of lesions' overrating), and also the number of serial surgeries because of failure by underestimation the seriousness of the lesion. Consequently, the duration and costs of hospitalization could decrease [6], [7], [9]. The practical utility of TPI increases especially in the case of young surgeons, who are most frequently involved in the treatment of the diabetic leg [9]. The reliability of the method has been verified through several studies and it was rated between 89% and 93% [6], [7], [9].

In our study group, the reliability of the TPI was 74.44%, the inconsistency between the TPI and the surgical intervention being determined, in most cases, by the patient's refusal to accept a major amputation. Bearing in mind the fact that in most of these cases from our study group the local evolution was favorable, our data suggest that a correction is required whenever the TPI ranges between 5 and 6, by choosing first a conservative surgical intervention vs. a major amputation, especially in selected cases: toe wet gangrene, osteitis, fistulised osteoarthritis, necrotising cankers, foot perforating ulcers. This has been noted and reported by other authors as well [9].

In our lot of diabetic legs 27 major amputations were performed, representing 30.00% of the cases. We appreciate this value as unacceptably high, a warning signal for an unappropriated approach of the diabetic leg, and also for the patients' level of education. No effort should be spared in improving this percentage.

The tracking down of the diabetic leg risk factors, mainly the diabetic neuropathy, leads to the improvement of the TPI values (patients addressing to medical personnel sooner, with less severe lesions), and to the increase in the share of conservative interventions [1], [7], [10], [11].

The diabetic patient education regarding the metabolic equilibrium preservation and

the leg and foot hygiene plays a major role in the prognosis of diabetic leg [1], [7], [8]. Once a patient with diabetic leg lesions addresses to a specialist, it is important to use a prompt assessment system thereof and to establish a reliable therapeutic plan. TPI proves to be a useful tool for the surgeon in guiding the type of intervention in certain cases of diabetic leg.

## 6. Conclusions

TPI remains a really useful working tool in establishing the most suitable surgical therapeutic approach of each certain patient with diabetic leg. Alongside a wider use in clinical practice, some further studies in order to improve the results are needed.

The training of the medical staff (to allow them to get familiar with this pathology) and the education of the diabetic patient are two extremely useful (but insufficiently exploited) measures that might contribute to an early detection of the diabetic leg lesions, improving the prognosis and the quality of life in diabetic patients.

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