DIABETIC FOOT LESIONS: ETIOLOGIC AND PROGNOSTIC FACTORS

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SUMMARY - The clinical characteristics of 132 diabetic patients referred for treatment of foot lesions were surveyed. One hundred and sixty three lesions (n = 163) concerned 88 men and 44 women during a five-year period (from January 1989 to December 1993). Hospitalisation rate equalled 9.16%, i.e. 11.17% for men and 6.82% for women (p < 0.001); the men/women ratio was 1.64. Eighty nine per cent (89%) of patients referred for treatment of foot lesions were surveyed. One hundred and sixty patients (n = 160) were included in the study. Mean age was 59.64 ± 11.74 years. The mean duration of diabetes was 10.95 ± 6.80 years. The patients had a high prevalence of diabetic complications, particularly peripheral neuropathy (84.85%) and obvious peripheral arteriopathy (78.78%). Infection was almost constant. There was no significant difference between men and women as far as the prevalence of complications was concerned. Smoking habits were noticed only in men. Inadequate footwear was considered as the major exogenous risk factor leading to a foot lesion. The definitive results 6 months after hospitalisation were as follows: the death rate was 9.09% (n = 2; 11 men and 1 woman, NS); 15.90% of patients (n = 12) underwent a major amputation (4 at the level of the thigh, 17 at the level of the leg), 14.39% of patients (n = 19) underwent a minor amputation; in 59.09% of patients (n = 78) there was no amputation. Two patients (1.51%) underwent two consecutive amputations, left hospital against medical advice (perdus de vue). Among the 160 patients, 20 patients (12.50%) went two consecutive amputations, left hospital against medical advice. The first foot lesion was presented type 2 diabetes and 11% of patients type 1 diabetes. Mean age at one hospitalisation for pied was of 9.16%, soit 11.17 % chez les hommes et 6,82 % chez les femmes (p = 0,001). Le sex-ratio H/F était de 1,64. Il s’agissait d’un diabète de type 2 dans 89 % des cas et d’un diabète de type 1 dans 11 % des cas. L’âge d’apparition moyen de survenue de la première lésion était de 59,64 ± 11,74 ans. La durée d’évolution du diabète sucré était de 10,95 ± 6,80 ans. Le diabète sucré était multicompliqué, avec une neuropathie périphérique dans 84,85 % des cas, une atteinte artérielle évidente dans 78,78 % des cas. L’infection était quasi-constante. Il n’y avait pas de différence entre les hommes et les femmes dans la prévalence des complications. Le tabagisme était présent chez les hommes uniquement. Les causes déclenchantes étaient dominées par le port de chaussures inadaptées (44 % des cas). Les résultats définitifs 6 mois après l’hospitalisation sont les suivants : taux de mortalité 9,09 % (n = 12; 11 hommes et 1 femme, NS); 21 patients (15,90 %) avaient subi une amputation majeure (4 au niveau de la cuisse, 17 au niveau de la jambe), 19 patients (14,39 %) avaient subi une amputation mineure. Deux patients (1,51 %) avaient subi chacun deux amputations successives et étaient sortis contre avis médical (perdus de vue). La fréquence des lésions du pied était plus importante chez l’homme. Il en fut de même de la gravité des lésions et du nombre d’amputations. Les facteurs susceptibles d’influer sur l’issue thérapeutique, en plus du sexe, sont : le délai de prise en charge thérapeutique, la qualité du traitement médical, l’attitude conservatrice ou interventionniste de l’équipe chirurgicale, le niveau inadéquat de l’amputation et finalement l’existence ou l’absence d’une prévention structurée. La prévention doit se fonder principalement sur l’éducation du malade, la formation du médecin généraliste et une meilleure coordination entre les chirurgiens et les diabétologues.

Key-words: diabetes, diabetic foot, infection, gangrene, amputation.

RÉSUMÉ - Le pied diabétique: facteurs étiologiques et pronostiques. L’objectif de ce travail était d’étudier les caractéristiques cliniques et paracliniques des patients diabétiques ayant une lésion du pied, ainsi que les facteurs conditionnant l’issue thérapeutique et par conséquent le pronostic. Nous avons colligé 163 lésions des pieds chez 88 hommes et 44 femmes sur une période de 5 ans (de janvier 1989 à décembre 1993). Le pourcentage d’hospitalisation pour pied était de 9,16 %, soit 11,17 % chez les hommes et 6,82 % chez les femmes (p = 0,001). Le sex-ratio H/F était de 1,64. Il s’agissait d’un diabète de type 2 dans 89 % des cas et d’un diabète de type 1 dans 11 % des cas. L’âge d’apparition moyen de survenue de la première lésion était de 59,64 ± 11,74 ans. La durée d’évolution du diabète sucré était de 10,95 ± 6,80 ans. Le diabète sucré était multicompliqué, avec une neuropathie périphérique dans 84,85 % des cas, une atteinte artérielle évidente dans 78,78 % des cas. L’infection était quasi-constante. Il n’y avait pas de différence entre les hommes et les femmes dans la prévalence des complications. Le tabagisme était présent chez les hommes uniquement. Les causes déclenchantes étaient dominées par le port de chaussures inadaptées (44 % des cas). Les résultats définitifs 6 mois après l’hospitalisation sont les suivants : taux de mortalité 9,09 % (n = 12; 11 hommes et 1 femme, NS); 21 patients (15,90 %) avaient subi une amputation majeure (4 au niveau de la cuisse, 17 au niveau de la jambe), 19 patients (14,39 %) avaient subi une amputation mineure. Deux patients (1,51 %) avaient subi chacun deux amputations successives et étaient sortis contre avis médical (perdus de vue). La fréquence des lésions du pied était plus importante chez l’homme. Il en fut de même de la gravité des lésions et du nombre d’amputations. Les facteurs susceptibles d’influer sur l’issue thérapeutique, en plus du sexe, sont : le délai de prise en charge thérapeutique, la qualité du traitement médical, l’attitude conservatrice ou interventionniste de l’équipe chirurgicale, le niveau inadéquat de l’amputation et finalement l’existence ou l’absence d’une prévention structurée. La prévention doit se fonder principalement sur l’éducation du malade, la formation du médecin généraliste et une meilleure coordination entre les chirurgiens et les diabétologues.

Mots-clés : diabète sucré, pied diabétique, infection, gangrène, amputation.
Diabetic foot lesions are regarded as a serious complication since they may cause an increased frequency of morbidity and mortality [1, 2]. Moreover they are a great source of financial costs to the patient and the community [3]. Generally there is a link between amputation and mortality. Many factors seem to influence the rate of amputations and consequently the rate of mortality: the prevalence of diabetes, the average age of the concerned population, the conditions of management of diabetes [4], and finally the medico-surgical team’s therapeutic attitude [5]. This therapeutic attitude might influence not only the level of amputation but also its rate, in the way that it varies from one team to another.

Epidemiological studies try to detect, among diabetic patients, those who are biased towards foot lesion, and this is done mainly in order for them to take advantage from prevention programmes. It has been proven that on the one hand these programmes decrease the frequency of foot lesions and indirect costs (i.e. morbidity and mortality), the direct costs brought by foot lesions, whatever their clinical aspects, gangrenous or not [6, 7] on the other hand.

Basing our work on retrospective data, we tried to analyse the risk factors of diabetic foot, in order to identify, among an Algerian diabetic population, those patients who have an increased risk of being affected.

We then appreciated the benefits brought by a conservative treatment in a hospital, where there is no equipment for vascular surgery.

**PATIENTS AND METHODS**

- This retrospective study involved patients admitted to our department of Endocrinology for a diabetic foot from January 1989 to December 1993. They underwent an anamnesis, a clinical examination, and complementary tests searching for complications. Retinopathy was defined as any sign of retinopathy on examination; neuropathy as a loss of sensation in the feet [8]; nephropathy as urinary protein > 300 mg/dl; chronic renal failure as creatininemia > 15 mg/l. Arteriopathy was defined by the existence of intermittent claudication or the absence, or decrease, of peripheral pulses, essentially of the posterial tibial artery [9, 10].

- According to their importance, foot lesions were classified in 5 grades (from 1 to 5) at patient’s admission. Wagner classification [11] was used (grade 1: superficial ulcer; grade 2: deep ulcer; grade 3: deep abscess and/or osteomyelitis; grade 4: forefoot gangrene; grade 5: massive gangrene of the foot). Three groups were constituted for the study: group I (grades 1 + 2), group II (grade 3), group III (grades 4 + 5). Medical treatment (essentially antibiotics) and surgical procedures depended on the importance of the lesion.

To compare the above groups, we used the following statistical methods: chi-squared test, chi-squared test after Yates’ correction for the qualitative variables; Student’s t test and variance analysis for the quantitative variables.

**RESULTS**

**Epidemiological aspects** – The percentage of admission in our department reached 9.16% (163 lesions out of 1779 admissions for diabetes); 11.17% of the lesions concerned men (107 lesions out of 958 admissions), and 6.82% concerned women (56 lesions out of 821 admissions) This difference was significant (p < 0.001), with a sex-ratio equal to 1.64 (Table I). In 89.39% (n = 118) of cases type 2 diabetes and in 10.61% (n = 14) type 1 diabetes were observed. Obesity (BMI>30) was noticed in 8.33% (n = 11). The diagnosis age of diabetes was 49.44 ± 12.77 years. Ten of type 2 diabetics were unknown before the appearance of the lesion. The percentage of first lesions was 80.98% (n = 132). The occurrence age at the first lesion was 59.64 ± 11.74 years. The mean duration of diabetes was 10.95 ± 6.80 years (n = 122) (Table II). The mean duration of diabetes was 10.98 ± 5.86 years in group I (n = 42), 9.25 ± 4.56 years in group II (n = 20), 11.5 ± 7.94 years in group III (n = 60), respectively. The difference was not significant between the 3 groups. The average period between diagnosis of an already known diabetes and the first lesion was 10.95 ± 6.80 years (Table II).

More than ninety per cent (95.50%) of lesions occurred over age 40. In case of an already known diabetes, oral antidiabetic drugs were prescribed in 83.33% of cases (n = 90), insulin were prescribed in 15.74% of cases (n = 17), one case was on diet only. Patients with type 1 diabetes (n = 14) were already taking insulin. Among the patients with already known diabetes (n = 122), 13 were not followed up. Among the remaining patients (n = 109), 44.08% (n = 48) were followed in a university hospital, and 55.92% (n = 61) were followed in a public or private centre (not significant difference). Hospitalisations occurred in cold season (first and fourth terms) and in hot season (second and third terms) with the same frequency, i.e. 80 and 83 cases respectively.

Seventy patients, i.e. 58.82%, were unemployed (they were either retired or they had no job). Ninety three, i.e. 70.45%, were illiterate, the remaining others had rarely passed the level of primary school. All were sedentary. We noticed smoking habits only in men at a rate of 85% (n = 75), whereas no woman smoked. The diabetes was complicated with arterial hypertension in 42.42% of cases (n = 56), retinopathy in 45.45% of cases (n = 60; blindness was seen in 1 case only), nephropathy in 30.30% of cases (n = 40), chronic renal failure in 12.12% of cases (n = 16). Neuropathy...
was present in 84.85% of cases (n = 112) and arteriopathy in 78.78% of cases (n = 104).

**Foot lesions and responsible factors** – One hundred and two patients (77.27%) were from Oran, and 30 (22.72%) patients from a town near Oran or another county. Information about the delay of visit between the initial lesion and the admission to hospital was available in 96 cases. This delay varied between 2 and 120 days with an average of 31 ± 40.11 days. The distribution of the lesions according to the Wagner classification was as follows: group I: 36.81% (n = 60, 35M+25F), group II: 17.18% (n = 28, 17M+11F), group III: 46.01% (n = 75, 55M+20F). Infection was almost constant except two cases of dry gangrene. Neuro-ischaemic lesions were present in 58.28% of cases (n = 95 among which the 2 cases of dry gangrene), neuropathic lesions in 29.44% of cases (n = 48), pure ischaemic lesions in 5.52% of cases (n = 9). In 6.74% of cases (n = 11), lesions occurred although there was no neuropathy nor arteriopathy, these cases were classified as cutaneous abscess. The risk factors which were responsible for the lesions are shown in Table III. In some patients, uncured plantar chronic ulcers were responsible for more serious lesions and were then considered as risk factors.

**Therapeutic outcome** – Patients in groups II and III underwent surgical procedures (cutting out, incision of abscess) without any amputation. Fifty seven amputations were indicated in group III (76%), 52 were practised (69.33%), 5 patients refused the operation. The surgical procedures in group III are shown in Table IV. Most patients, whether or not amputated, remained in hospital until the healing of the wound. Some were treated as outpatients in our department until the healing of the wound, too (8 patients from group I, 17 from group II and 25 from group III).

The patients who refused amputation died. The death was caused by a gaseous gangrene and a septicaemia in one case. Seven patients died after surgery; for the latter patients, the death had various causes: septicaemia associated to a perineal gangrene (1 case), blood transfusion accident (1 case), sudden death (2 cases), coronary accident (3 cases).

**Table I. Patients and lesions.**

<table>
<thead>
<tr>
<th></th>
<th>Patients</th>
<th>Lesions</th>
<th>Hospitalizations</th>
<th>% of lesions</th>
<th>P</th>
<th>sex ratio M/F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>88</td>
<td>107</td>
<td>958</td>
<td>11.17</td>
<td></td>
<td>1.64</td>
</tr>
<tr>
<td>Women</td>
<td>44</td>
<td>56</td>
<td>821</td>
<td>6.82</td>
<td>&lt; 0.001</td>
<td>1.64</td>
</tr>
<tr>
<td>Total</td>
<td>132</td>
<td>163</td>
<td>1779</td>
<td>9.16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table II. Comparison of clinical data in men and women.**

<table>
<thead>
<tr>
<th></th>
<th>Total N = 132</th>
<th>Men n = 88</th>
<th>Women n = 44</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age at Diagnosis of diabetes</td>
<td>49.44 ± 12.77</td>
<td>50.76 ± 12.47</td>
<td>46.68 ± 13.08</td>
<td>NS**</td>
</tr>
<tr>
<td>2. Age when first lesion occurred</td>
<td>59.64 ± 11.74</td>
<td>60.98 ± 12.00</td>
<td>56.98 ± 10.84</td>
<td>NS**</td>
</tr>
<tr>
<td>3. Duration of diabetes (years)*</td>
<td>10.95 ± 06.80</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* for already known diabetes (n = 122). ** NS: not significant

**Table III. Risk factors causing the lesions.**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Lesions (n = 163)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate footwear</td>
<td>72</td>
<td>44.17</td>
</tr>
<tr>
<td>Not cured PCU*</td>
<td>24</td>
<td>14.72</td>
</tr>
<tr>
<td>Isolated mycosis</td>
<td>19</td>
<td>11.66</td>
</tr>
<tr>
<td>Minor trauma</td>
<td>12</td>
<td>7.36</td>
</tr>
<tr>
<td>Cutaneous infection</td>
<td>11</td>
<td>6.74</td>
</tr>
<tr>
<td>Burns</td>
<td>08</td>
<td>4.91</td>
</tr>
<tr>
<td>Self-manipulation</td>
<td>07</td>
<td>4.29</td>
</tr>
<tr>
<td>Unknown</td>
<td>10</td>
<td>6.13</td>
</tr>
</tbody>
</table>

PCU*: Plantar chronic ulcer.
The definitive results 6 months after hospitalization were as follows: the death rate was 9.09% (n = 12; 11 men and 1 woman, NS); 21 patients (15.90%) underwent major amputation (4 at the level of the thigh, 17 at the level of the leg), 19 patients (14.39%) underwent minor amputation; in 78 patients (59.09%) there was no amputation. Two patients (1.51%) underwent each one two consecutive amputations, left hospital against medical advice during their second hospitalization, and then we lost contact with them.

**DISCUSSION**

The clinical data of this study show that the diabetic lesions occurred in diabetic patients aged over 40 and whose disease appeared more than 10 years before. Diabetes was very often complicated especially with arteriopathy (79% of cases) and neuropathy (85% of cases). Infection was present in almost all cases except two. Ischaemia and neuropathy are the predisposing factors in the formation of diabetic foot ulcers, but an initiating factor, such as physical or mechanical stress, is required for an ulcer to develop [12, 13]. In the majority of cases, infection occurs after the formation of an ulcer. In our work, infection developed in few patients who had neither arteriopathy nor neuropathy, probably because of poor metabolic control [14] and poor personal hygiene. Inadequate footwear, which was present in 44% of cases, represented the principal risk factor. Other factors can be noticed such as a low socio-economical status.

More lesions, a high percentage of serious lesions and consequently a high rate of mortality were noticed in men. This could be explained, partly, by smoking habits, which represent the only significant etiological factor when we compare men with women. The delay for an adequate management can be divided in 3 parts: delay to see a doctor (a General Practitioner), delay to be hospitalized, and delay to be operated. All these delays were considerably increased. One can shorten them by educating the patients, by medical training and a better co-ordination between medical and surgical departments. Before admission in hospital, whatever the seriousness of the lesion, patients had received empirical regimens of antibiotics; this was inadequate in terms of the nature of the drug, its doses, and duration of the treatment. We are now aware of the importance of an adequate and prolonged antibiotic therapy for these lesions which are due either to aerobic and anaerobic germs, even in group II [15-18]. The lack of existence of vascular reconstruction in our hospital was also responsible for the morbidity rate, i.e. the rate of amputations and the length of healing (19). Surgical attitude was not always adequate, this led to an exaggeration of amputations (some were abusive) in spite of our recommendations. In addition to that, the level of amputations was not always adequate. On the other hand, we were able to avoid amputation in many cases belonging to group II or to group III (grade 4). This fact, i.e., avoiding amputations was in agreement with many authors’ experience [5, 20, 21]. The number of lesions referred from university hospital and from public and private medical structures were similar. Thus, neither the number of annual consultations, which often exceeds 4 per year, nor the follow up in a specialized department were sufficient to prevent serious lesions. Probably, the physician’s attitude when examining or not the patients’ feet not only allows to detect minor lesions but also determines the attitude the patient will have in preventing foot lesions [22]. To summarize, the factors that influence the outcome seem to be: male gender, delay of management, quality of medical treatment, surgical attitude, inadequate level of amputation and finally lack of structured prevention.

The remedy to the problems mentioned above needs the following approaches: medical training, consensus between physicians and surgeons, guide for primary care practitioners. Above all it is necessary to set up a structured prevention by training primary care practitioners, and by performing educational programs.
for patients presenting high risks. All what precedes truly constitutes the most efficient factors susceptible to lessen financial costs, morbidity and mortality rates. This would have an impact in the delay for hospitalization, adequate management and gravity of the lesions. Because of the socio-economical status and the patients’ illiteracy, and given our social context, it is preferable to hospitalize these patients in order to give the first remedy and show them how to improve their lesions.

CONCLUSION

Foot lesion results in important direct and indirect costs. It represents a public health concern whose solution is first and foremost prevention. This prevention can be estimated in two levels: talking to all the diabetic people in order to warn the occurrence of foot complications and then insist on personal hygiene and need for metabolic control; recognizing patients who likely risk to present a foot lesion. The last solution is preferable: it concerns those who have already had a diabetic foot, those presenting a peripheral neuropathy or/and an arteriopathy of the limbs, patients with low socio-economical status whose diabetes duration exceeds 10 years, old people whatever the duration of the disease. The advanced age could itself constitute an independent factor [1, 20].

There is an urgent need to adapt educational programs to the educational level of the patients: in our sample, 70% were illiterate. Education must put emphasis on the wearing of adequate shoes and the personal hygiene. In addition to that, the general practitioners who may see the patients with initial lesions, must be informed. A corollary to this prevention is the development of a department of vascular surgery. Some teams have shown the benefits of specialized multidisciplinary clinics which allow to decrease the number of amputations to 50% [7, 23]. This is one of the objectives of St Vincent declaration. Nevertheless, in our country, there are other priorities like the development and equipment of reconstructive vascular department.

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