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Nadia Boudjenah *

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Case Report

Diabetic Foot in Algeria Illustration IV – Clinical Case Report

Nadia Boudjenah

General Surgeon, Diabetic Foot Surgeon, Diabetic Foot center, Algiers, Algeria.

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Abstract

It seemed interesting to us to share this observation because it reflects our management of the diabetic patient with a wound and suffering from a severe disabling Neuropathy.

Our clinical case today is a 55-year-old male. A patient with type 2 diabetes, on insulin therapy and oral anti-diabetics and being treated for high blood pressure. He came to our consultation on August 05, 2020, with an infection of the right foot, of which the starting point is the second and third toes. These ones being ischemic

Key words: diabetic foot; general surgeon; neuropathy

Introduction

It seemed interesting to us to share this observation because it reflects our management of the diabetic patient with a wound and suffering from a severe disabling Neuropathy.

Our clinical case today is a 55-year-old male. A patient with type 2 diabetes, on insulin therapy and oral anti-diabetics and being treated for high blood pressure. He came to our consultation on August 05, 2020, with an infection of the right foot, of which the starting point is the second and third toes. These ones being ischemic. *Picture below*.

First visit: AUGUST 05, 2020

We also found, apart from foot damage, tingling and unbearable disabling pain of a neurological type on the four limbs with a predominance in the lower limbs.

This patient seemed asleep to us because of heavy medication. He was not feverish and his blood sugar on arrival was 3 g/l. We also found a moderate diastasis of the rectus abdominis.

To assess the patient's condition, we asked for several tests to be done as quickly as possible:

- blood test of which the results below show the following: an infection, an anémia, vit D3 insufficiency, hyperthyroidism, Hb1Ac at 10.1% and minor disturbances in liver function.

LABORATOIRE D'ANALYSES MEDICALES

Dr. B. HAMMADI

Médecin biologiste

Ancien Praticien Consultant des hôpitaux de Paris

Biochimie, Hématologie, Parasitologie, Microbiologie, Immunologie, Hormonologie

Adresse : 04, Avenue Colonel Lotfi B.E.O, Alger - Téléphone : 021 97.86.30

Mobile : 05 40 97 32 88

Nom : [redacted]
Prénom : [redacted]
Age : 55 ans

Médecin traitant :

Alger le, 06/08/2020
N°: 5051

BIOCHIMIE

ARCHITECT ABBOTT

	Résultats	Unités	Valeurs de référence	Antériorités
CALCIUM SANGUIN (CA)	84	mg/L	80 - 105	
C- REACTIVE PROTEINE (CRP)	***90***	mg/l	< 6	
Résultat vérifié.				
CHOLESTEROL TOTAL	2.20	g/l	1.50 - 2.50	
HDL- CHOLESTEROL	0.61	g/l	sup à 0.35	
CREATININE SANGUINE (CREATINEMIE)	13	mg/l	5 - 14	
GLUCOSE SANGUIN (GLYCEMIE)	***1.77***	g/l	0.60 - 1.10	
PHOSPHORE SANGUIN	40	mg/l	25 - 50	
TRIGLYCERIDES	1.20	g/l	0.40 - 1.60	
UREE SANGUINE (UREMIE)	0.46	g/l	0.15 - 0.50	
HEMOGLOBINE GLYCOSYLEE	***10.1***	%	4.2 - 6.20	
Sujet non diabétique : 4.2 - 6.20 %				
Sujet diabétique équilibré : < 7 %				
Sujet diabétique mal équilibré : > 7.5 %				
LDL- CHOLESTEROL	1.35	g/l	inf à 1.60	
25 OH Vitamine D				
25 hydroxyvitamine D2/D3		ng/ml		
Carence			inf 20	
Insuffisance	22		20 - 29	
Taux recommandés			30 - 100	

Horaires d'ouvertures : Samedi à Jeudi de 08h00 à 17h00

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Médecin traitant :

HEMATOLOGIE

	SYSMEX Résultats	Unités	Valeurs de référence	Antériorités
NUMERATION-FORMULE SANGUINE (NFS)				
GLOBULES BLANCS	***10600***	/MM3	4000 - 10000	
GLOBULES ROUGES	5.18	million/MM3	4.2 - 5.7	
HEMOGLOBINE	***10.0***	G/100ML	14.0 - 17	
HEMATOCRITE	***29.5***	%	40 - 52	
V.G.M	***57.0***	µ3	80 - 95	
T.G.M.H	***19.3***	PG	28 - 32	
C.C.M.H	33.8	g/dl	30 - 35	
PLAQUETTES	229	mille/MM3	150 - 450	
EQUILIBRE LEUCOCYTAIRE				
POLYNUCLEAIRE NEUTROPHILE	70.0	%	47 - 70	
POLYNUCLEAIRE EOSINOPHILE	3.0	%	01 - 05	
POLYNUCLEAIRE BASOPHILE	0.7	%	0 - 01	
LYMPHOCYTES	21.5	%	20 - 40	
MONOCYTES	4.8	%	3 - 7	

HORMONOLOGIE

	ARCHITECT Résultats	Unités	Valeurs de référence	Antériorités
FREE T4 (FT4)	***13.05***	pmol/l	0.300 - 4.500	
FREE T3 (FT3)	3.14	pmol/l	2.00 - 4.20	
THYREOSTIMULINE (TSH 3eme GEN)	2.420	µUI/ml	0.300 - 4.500	
Ac ANTI Tg	***134.06***	UI/ML	< 95	

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Age : 55 ans

Médecin traitant :

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N°: 5051

Ac ANTI TPO	24.26	UI/mL	< 30.0
P.S.A TOTAL	1.680	ng/ml	< 4

HEMOSTASE

STAGO

	Résultats	Unités	Valeurs de référence	Antériorités
TAUX DE PROTHROMBINE (TP)				
TEMPS DE QUICK	12.5	Sec	11 - 14	
TAUX DE PROTHROMBINE	100	%	70 - 100	
I.N.R	1.0		1 - 2	

ENZYMOLOGIE

ARCHITECT ABBOTT

	Résultats	Unités	Valeurs de référence	Antériorités
BILIRUBINE				
BILIRUBINE TOTALE	10	mg/L	0 - 10	
BILIRUBINE DIRECTE	***04***	mg/L	0 - 2.5	
BILIRUBINE INDIRECTE	06	mg/L	0 - 7.5	
GAMMA G.T ENZYME SERIQUE	***80***	UI/L	11 -50	
Résultat vérifié.				
TRANSAMINASES				
SGOT/ASAT	20	UI/L	inf à 38	
SGPT/ALAT	21	UI/L	inf à 40	
PHOSPHATASES ALCALINES (PAL)	226	UI/L	98 - 279	

MICROBIOLOGIE

	Résultats	Unités	Valeurs de référence	Antériorités

Horaires d'ouvertures : Samedi à Jeudi de 08h00 à 17h00

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- bacteriological study by swab of the wound which has revealed a klebsiella sp infection sensitive to imipenem.

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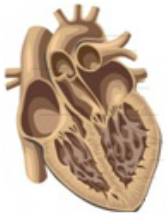
Age : 55 ans [redacted]
Médecin traitant : [redacted]

Alger le, 06/08/2020
N°: 5051

ECB DIVERS	
Type de prelevement:	Plaie
BACTERIOLOGIE	
Aspect	Trouble
Hematies	Absence
Leucocytes	+
CULTURE	POSITIVE
Germes	klebsiella sp
MYCOLOGIE	NEGATIF
levures	NEGATIF
ANTIBIOGRAMME	
PRISTINAMYCINE	RESISTANT
CIPROFLOXACIN	RESISTANT
IMIPENEM	SENSIBLE
GENTAMICIN	SENSIBLE
AUGMENTIN	SENSIBLE
CLOXACILLIN	RESISTANT
AMPICILLINE	SENSIBLE
CEFALEXIN	RESISTANT
ACIDE FUCIDIQUE	RESISTANT

- An arterial and venous Echodoppler revealed an atheromatous arterial disease with bilateral thrombosis of the two Pedal Arteries, the right being almost complete. There are no venous complications.

CABINET MÉDICAL
CARDIOLOGIE
Dr AIT BELKACEM Samir
Spécialiste des Maladies du cœur et des Vaisseaux
CARDIOLOGUE
ECG - Echodoppler Couleur
Cardiaque et Vasculaire - MAPA
Holter ECG - Epreuve d'Effort



SPÉCIALISÉ EN

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03 lot Vincent - Bouzaréah
ALGER (face à la BNA)
Tél. /Fax : 021 90 97 23
Mob : 0770 33 84 18

-RENDU D'ECHODPPLER ARTERIEL DE MI

NOM : [redacted]	PRENOM : [redacted]	Age/né(e) :1965	Date : 05/08/20

Demandé par DR BOUDJENAH

- MEMBRE INFRIEUR GAUCHE :

*ARTERE FEMORALE COMMUNE : VEL=cm/s.
-Paroi épaissi ; Les courbes de vélocités sont correcte
*ARTERE FEMORALE PROFO NDE : VEL=cm/s.
Paroi épaissi ; Les courbes de vélocités sont correcte
*ARTERE FEMORALE SUPERFICIELLE : VEL=cm/s.
- Paroi épaissi et le flux est correcte
*ARTERE POPLITEE : VEL=cm/s.
- paroi peu épaisse, à lumière vasculaire libre .Les courbes de vélocités sont *correcte*
*ARTERE TIBIALE POSTERIEURE : VEL=cm/s.
- *Paroi épaissi* avec un flux *correcte*
*ARTERE TIBIALE ANTERIEURE : VEL=cm/s.
- -*Paroi épaissi* , Les courbes de vélocités sont *correcte*
*ARTERE PEDIEUSE: VEL=cm/s.
- *Paroi épaissi* avec une **thrombose incomplète distale segmentaire**

- MEMBRE INFRIEUR DROIT :

-Mêmes données hémodynamiques et morphologiques qu'à gauche **même:**
*ARTERE PEDIEUSE :VEL=cm/s.
- *Paroi épaissi* avec **thrombose quasi-complète**

C O N C L U S I O N :

. Artériopathie athéromateuse avec thrombose bilatérale des deux A PED

Merci

DR AIT BELKACEM. S.

CABINET MÉDICAL
CARDIOLOGIE
Dr AIT BELKACEM Samir
Spécialiste des Maladies du cœur et des Vaisseaux
CARDIOLOGUE
ECG - Echodoppler Couleur
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-COMPTE-RENDU D'ECHODOPPLER VEINEUX DES MI

NOM : [redacted]	PRENOM [redacted]	Age/nee : 1965	Date : 05/08/20

Demandé par Dr Boudjenah

MEMBRE INFERIEUR GAUCHE:

-RESEAU VEINEUX PROFOND :	
LE NIVEAU PROXIMALE	-VEINE FEMORALE COMMUNE : Facilement compressible, lumière libre et flux spontané normal. -VEINE FEMORALE SUPERFICIELLE : -Compressible sur tout son étendu, perméable, sans image intra – luminale visible. -VEINE POPLITE : -Paroi souple, pas d'image intra-luminale visible, drainant normalement les veines d'amont.
LE NIVEAU SURAL :	-LES VEINES JAMBIERES : (veines tibiale postérieur et péronière) Paraissent perméable de dimensions normales et continentes. -LES VEINES MUSCULAIRES :(veines jumelles et soléaire) Paraissent perméable de dimensions normales et continentes.
-RESEAU VEINEUX SUPERFICIEL :	
-VEINE SAPHENE INTERNE : -Légèrement dilatée, perméable, et sans signes d'incontinence ostiale et tronculaire. -VEINE SAPHENE EXTERNE : -Dimensions normales perméable, et continente.	

MEMBRE INFERIEUR DROIT :

Mêmes données hémodynamiques et morphologiques qu'à gh

-C O N C L U S I O N:

-Examen ECHODOPPLER VEINEUX DES MI trouve des axes veineux profonds perméables, facilement dépressibles, sans image intra luminale visible, non dilaté, a paroi souple, avec des courbes de flux correctes.

-Le réseau superficiel est perméable et continent.

-présence de varicosites, varices réticulaires mal systématisées bilatérale de taille variable, ***non thrombosée***

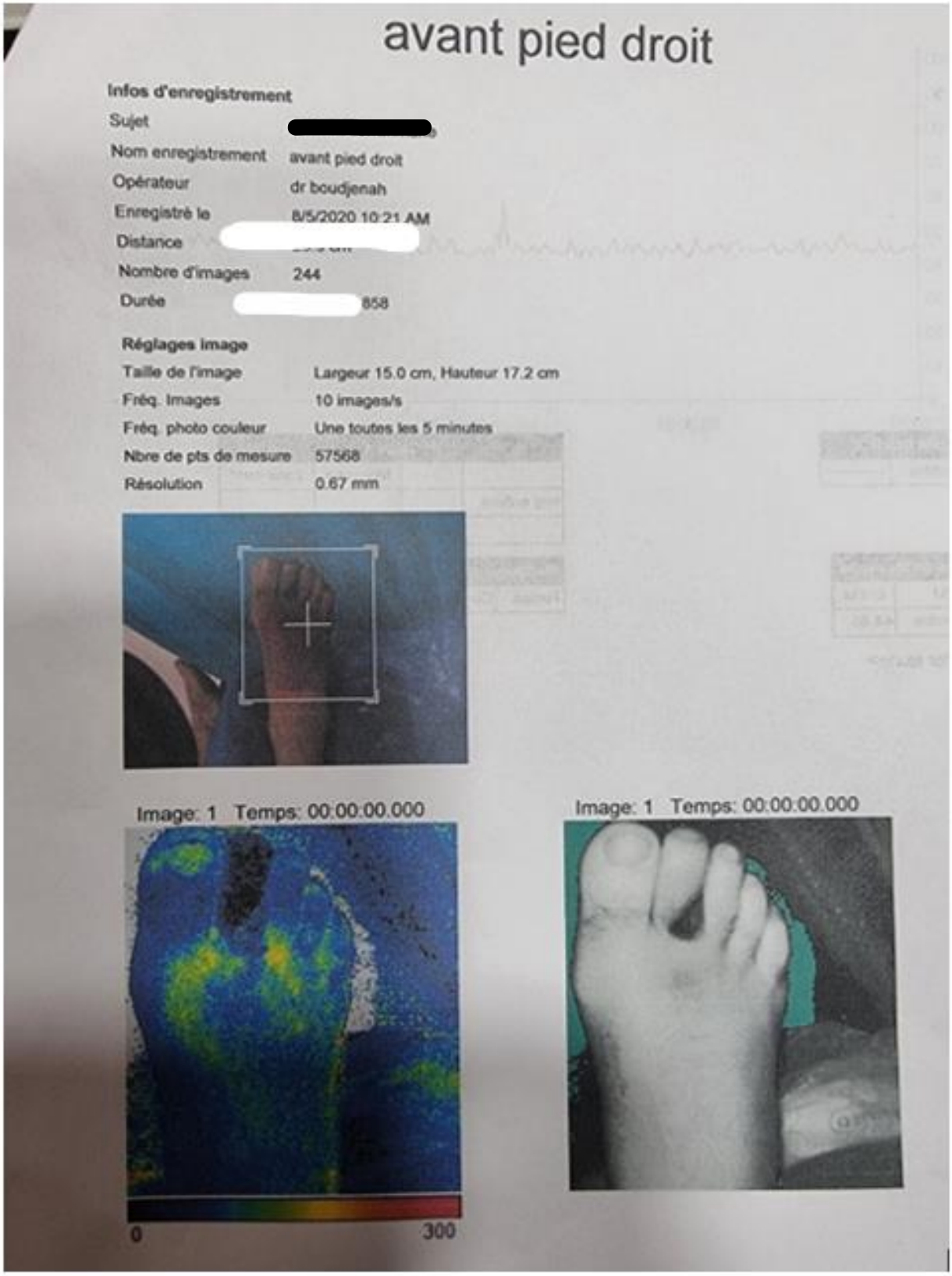
Avec contraste spontanée intense dans RESEAU VEINEUX PROFOND ++

Intérêt de prendre l'Aspégic

-PAS DE THROMBOSE VEINEUSE PROFONDE

Confraternellement

- A PeriCam, a microcirculation exam:



- A Périflux 6000, a macrocirculation exam, has revealed that this patient has 25 mmHg at the level of the right ankle, which testifies to a critical ischemia of the right limb and suggesting a difficulty in healing.

Examen circulation distale

Date	12/08/2020	Patient	[redacted]	ID	h
Examen	49-00117-04 - ABI TBI TCP	Opérateur	dr boudjenah	Sce.	

Notes d'examen

Historique médical

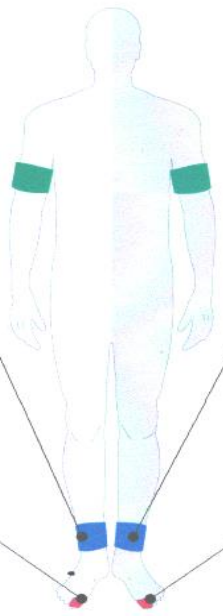
Fumeur	Non	Maladie cardiaque	non
Diabètique	Oui	Maladie pulmonaire	non
Neuropathie	Oui	Hypertension	oui

	Douleur à la marche	Douleur au repos	Plaies	Pouls palpable
Gauch	Oui	Non	Non	oui
Droite	Oui	Non	Oui	oui

Examen des pressions périphériques

Reference	
(Bras GAUCHE)	M
mmHg	128

Valeurs de références	
ABI	0,91 - 1,40
TBI	> 0,70
Pression Cheville	> 70 mmHg
Pression Orteil	> 50 mmHg



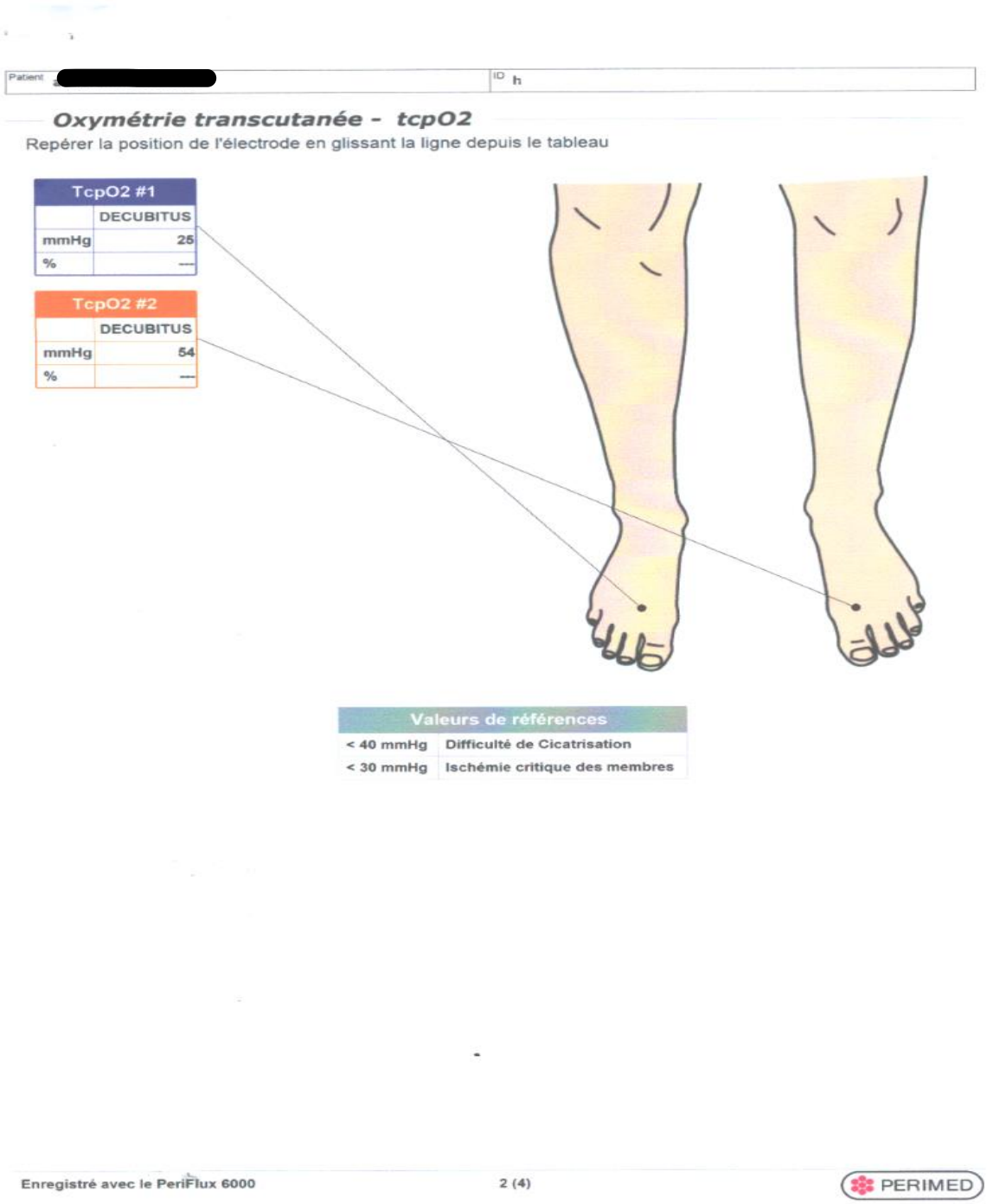
Cheville DROITE		
(Bras GAUCHE)	2	M
mmHg	132	132
ABI	1,03	1,03

Cheville GAUCHE		
(Bras GAUCHE)	2	M
mmHg	182	182
ABI	1,42	1,42

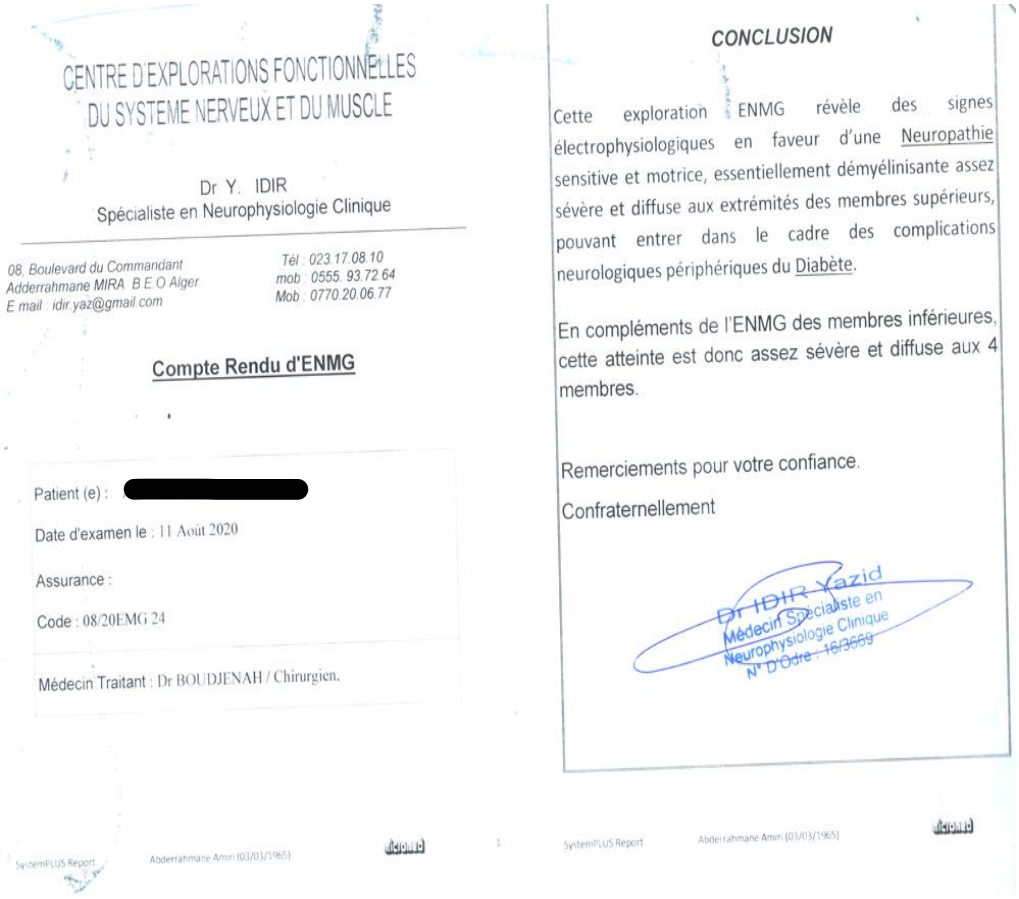
Orteil DROIT		
(Bras GAUCHE)	1	M
mmHg	66	66
TBI	0,51	0,51

Orteil GAUCHE		
(Bras GAUCHE)	1	M
mmHg	97	97
TBI	0,76	0,76

Enregistré avec le PeriFlux 6000 1 (4) PERIMED



An ENMG revealed a severe and diffuse demyelinating Neuropathy in the four limbs, predominating in the lower limbs, as evidenced by the complement we requested following an ENMG of the lower limbs carried out on 06/22/2020.



CENTRE D'EXPLORATIONS FONCTIONNELLES
DU SYSTEME NERVEUX ET DU MUSCLE

Dr Y. IDIR
Spécialiste en Neurophysiologie Clinique

08, Boulevard du Commandant
Adderrahmane MIRA B.E.O Alger
E mail : idir.yaz@gmail.com

Tél : 023.17.08.10
mob : 0555. 93.72.64
Mob : 0770.20.06.77

Compte Rendu d'ENMG

Patient (e) : [redacted]

Date d'examen le : 11 Août 2020

Assurance :

Code : 08/20EMG 24

Médecin Traitant : Dr BOUDJENAH / Chirurgien.

SystemPLUS Report Abderrahmane Amiri (03/03/1965)

CONCLUSION

Cette exploration ENMG révèle des signes électrophysiologiques en faveur d'une Neuropathie sensitive et motrice, essentiellement démyélinisante assez sévère et diffuse aux extrémités des membres supérieurs, pouvant entrer dans le cadre des complications neurologiques périphériques du Diabète.

En compléments de l'ENMG des membres inférieures, cette atteinte est donc assez sévère et diffuse aux 4 membres.

Remerciements pour votre confiance.

Confraternellement

Dr IDIR Yazid
Médecin Spécialiste en
Neurophysiologie Clinique
N° D'Ordre : 16/3669

SystemPLUS Report Abderrahmane Amiri (03/03/1965)

In a didactic concern, we will detail our support chapter by chapter.

In relation to diabetes:

- the *HbA1c* level was 10,1%. We have started a controlled diet eradicating all sugar intake. It is based on the ingestion of vegetables apart from potatoes and, in the absence of renal insufficiency, on moderate protein intake accompanied by a lot of drinking.

- Controlled physical activity.

This support made it possible to reduce and even stop the insulin supply and treat the patient only by oral anti-diabetics:

His *HbA1c* control after 12 months was at 6,4% and was very stable.

Other anomalies noted during the exams have been corrected.

Regarding the Diabetic Neuropathy:

- the patient's altered state of consciousness, which led to proven stupefaction, is due to a massive intake of Lyrica 50--ten tablets per day. We asked the patient to reduce the doses gradually. However, he did not listen to us and wanted to quickly get rid of this addiction abruptly stopping his treatment. This was followed by a major depressive state with unbearable pain in the lower limbs and above all cutaneous hyperesthesia prohibiting the slightest contact.

- Moreover, aggravating his condition, this patient no longer had sexual intercourse due to a lack of erection and ejaculation. He was seriously perturbated psychologically.

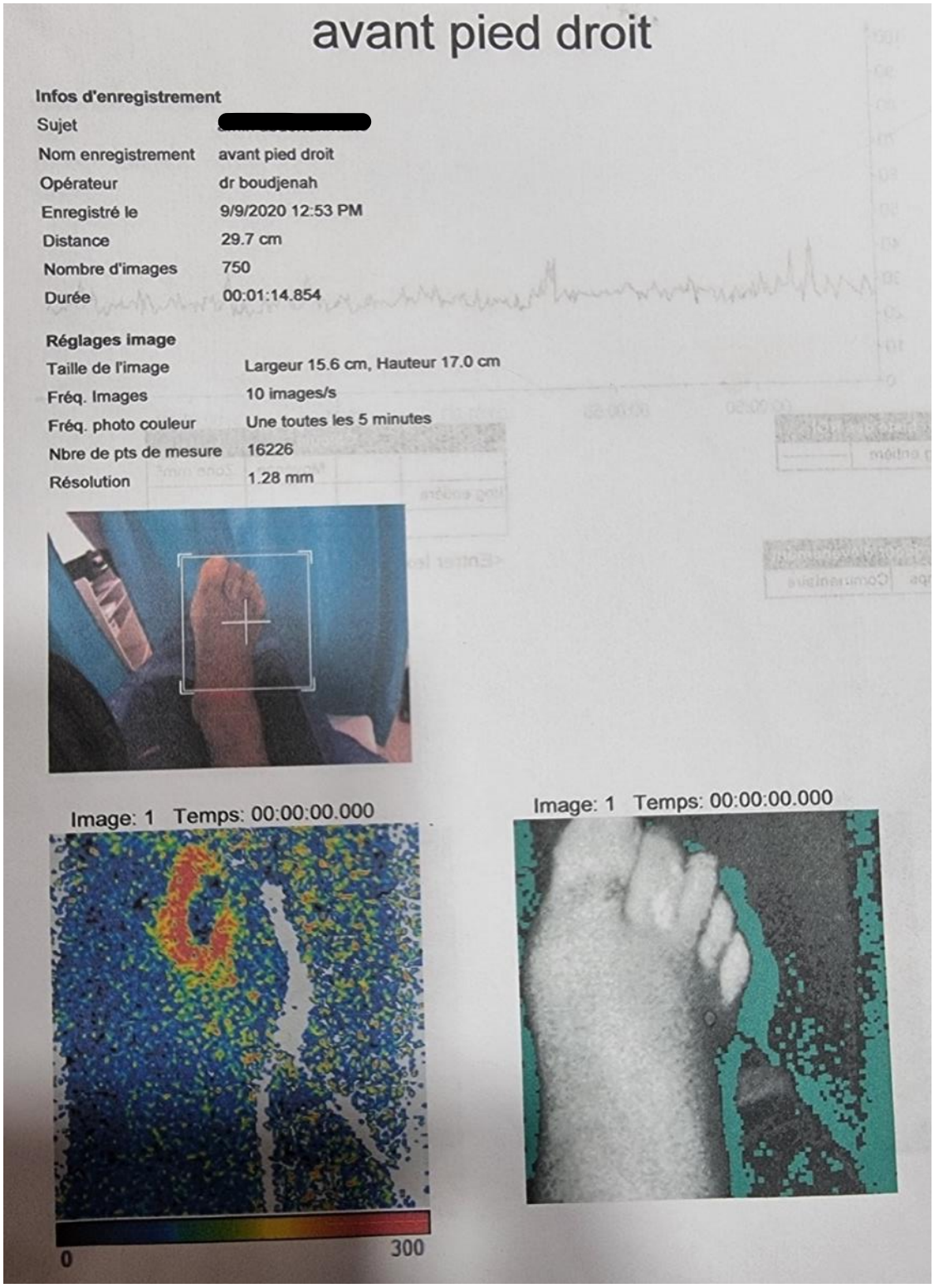
Once the problems of Neuropathy with erectile dysfunction were clearly identified, we offered the patient a psychiatric consultation which he received without conviction because, to help him get rid of his addiction, he was offered other medications like Lyrica 50, which he categorically refused.

We therefore took him back to treat his Neuropathy by carrying out a full weekly Carbomedtherapy (Carbon Dioxide Therapy) sessions for six months, then every two weeks thereafter. These sessions were painful at the beginning, but the important motivation of the patient helped him cope very well with it.

Currently and after 18 months of care, this patient who was on sick leave has returned to service (he holds a position of responsibility). He no longer feels pain, practices sports regularly, has a fulfilling sex life and above all, he is no longer addicted to any product.

Periodic checks were carried out and showed improvement in vascular and neurological conditions.

- PeriCam exam: control after 4 weeks from 1st scan.



- Périflux 6000 exam shows that the patient has moved out of the danger zone.

Examen circulation distale

Date	04/05/2022	Patient	[redacted]	ID	H
Examen	49-00117-04 - ABI TBI TCP	Opérateur	DR BOUDJENAH	Sce.	

Notes d'examen

Historique médical

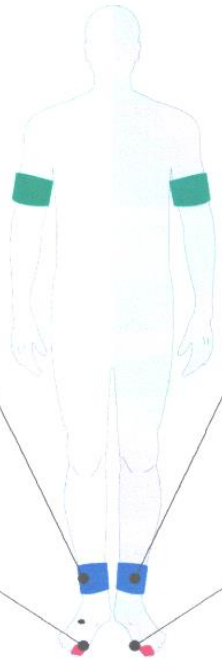
Fumeur	Non	Maladie cardiaque	NON
Diabètique	Oui	Maladie pulmonaire	NON
Neuropathie	Oui	Hypertension	OUI

	Douleur à la marche	Douleur au repos	Plaies	Pouls palpable
Gauch	Non	Non	Non	OUI
Droite	Non	Non	Non	OUI

Examen des pressions périphériques

Reference	
(Bras DROIT)	M
mmHg	129

Valeurs de références	
ABI	0,91 - 1,40
TBI	> 0,70
Pression Cheville	> 70 mmHg
Pression Orteil	> 50 mmHg



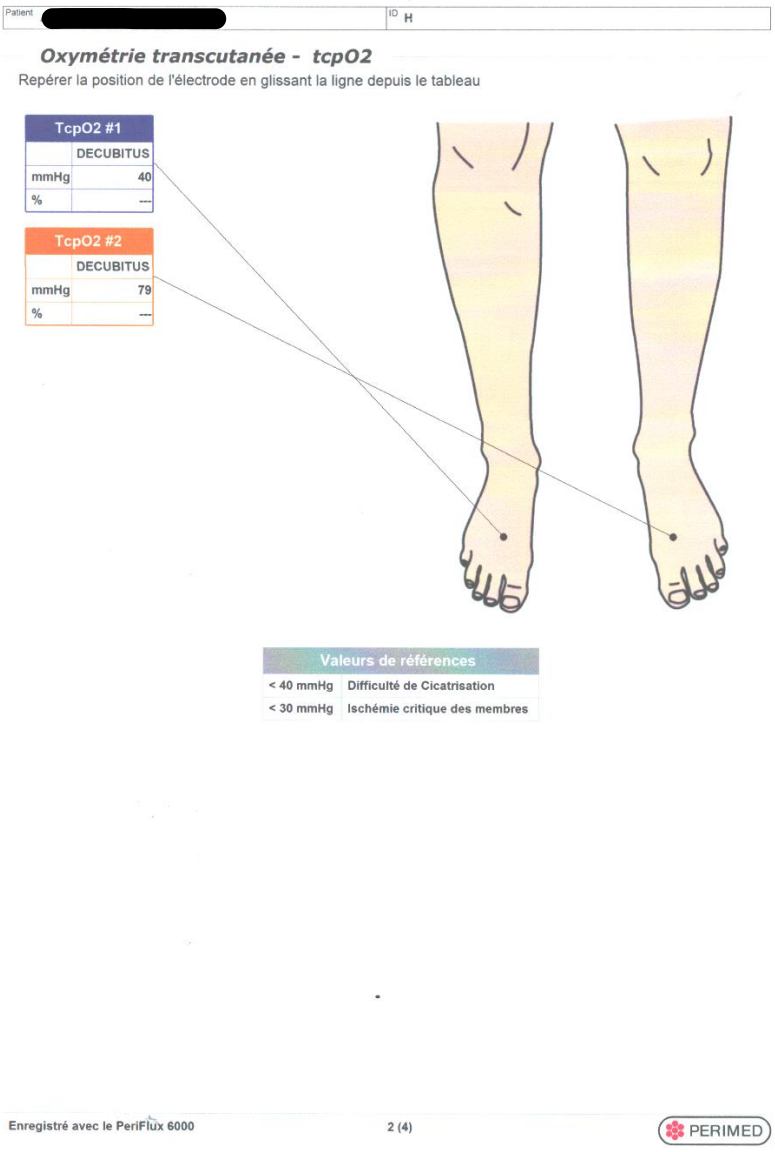
Cheville DROITE		
(Bras DROIT)	1	M
mmHg	104	104
ABI	0,81	0,81

Cheville GAUCHE		
(Bras DROIT)	1	M
mmHg	119	119
ABI	0,92	0,92

Orteil DROIT		
(Bras DROIT)	1	M
mmHg	109	109
TBI	0,85	0,85

Orteil GAUCHE		
(Bras DROIT)	1	M
mmHg	126	126
TBI	0,98	0,98

Enregistré avec le PeriFlux 6000 1 (4) PERIMED



Patient [redacted] ID H

Oxymétrie transcutanée - tcpO2

Repérer la position de l'électrode en glissant la ligne depuis le tableau

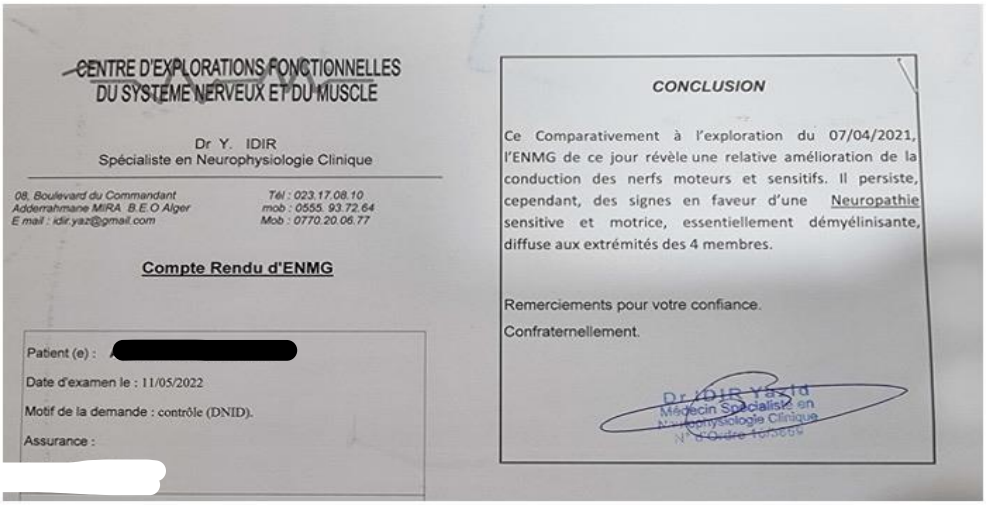
TcpO2 #1	
	DECUBITUS
mmHg	40
%	---

TcpO2 #2	
	DECUBITUS
mmHg	79
%	---

Valeurs de références	
< 40 mmHg	Difficulté de Cicatrisation
< 30 mmHg	Ischémie critique des membres

Enregistré avec le PeriFlux 6000 2 (4) PERIMED

- The most recent ENMG shows a marked improvement and clinically confirmed by the patient.



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Tél : 023.17.08.10
mob : 0555. 93.72.64
Mob : 0770.20.06.77

Compte Rendu d'ENMG

Patient (e) : [redacted]
Date d'examen le : 11/05/2022
Motif de la demande : contrôle (DNID).
Assurance :

CONCLUSION

Ce Comparativement à l'exploration du 07/04/2021, l'ENMG de ce jour révèle une relative amélioration de la conduction des nerfs moteurs et sensitifs. Il persiste, cependant, des signes en faveur d'une Neuropathie sensitive et motrice, essentiellement démyélinisante, diffuse aux extrémités des 4 membres.

Remerciements pour votre confiance.
Confraternellement.

Dr IDIR Yazid
Médecin Spécialiste en Neurophysiologie Clinique

However, medical support for the patient is not over. As we have described it, it can last up to 36 months.

Regarding the wound:

1. During the first week, on arrival:

A As local treatment:

- We recommend foot baths with a mixture of water and hydrogen peroxide daily.
- Every day, we cover the wound with a cream Belcic*, and complete with a light dressing which is made by compresses and gauze bands.
- The rehydration of the feet is ensured by Coconut*, a locally made cream.
- For mycosis, we use Belmyc* drops and Belmyc spray*.

B As medical treatment after bacteriological tests:

- Antibiotic therapy: Imipenem for 1 week
- Anticoagulants: Aspegic 100, Plavix and Lovenox.

2. During 2nd week:

- local treatment + Maggot Therapy.

- Depending on the results of the antibiogram, we put the patient on Ciprofloxacin and Metronidazole, and we continue the anticoagulants.

- Once the necrosis had been eliminated, we used Altrazeal powder* once a week to accentuate the budding allowing complete healing after 15 weeks' time. Figure below:

First visit: AUGUST 05, 2020

Maggot Therapy: AUGUST 19, 2020

OCTOBER 14, 2020

Healed: NOVEMBER 18, 2020

-Carbomedtherapy (Carbon Dioxide Therapy): 1st session on the first day focusing only on the lower limbs. After obtaining the ENMG results, we started the treatment of the Peripheral Diabetic Neuropathy, therefore upper limbs, and lower limbs.

Diabetes is the main cause of Neuropathy worldwide. More than 50% of diabetics worldwide, whether type 1 or 2, are affected.

Neuropathy is a consequence of microcirculatory damage in diabetics. The damage caused destroys the nerves. It is caused by the aggression of hyperglycemia. Treating Diabetic Neuropathy is a big challenge. As an outpatient clinic specializing in the treatment of diabetic foot, over 95% of our patients have Neuropathy.

Clinical examination of the patient finds the classic Neuropathy signs: tingling, numbness, cramping, pain, electric shock, loss of especially plantar sensitivity, sensitivity disorder otherwise. In the upper limbs, we look for lesions of the carpal tunnel, as well as lesions of the tarsal canal for the lower limbs. In addition, we note the degree of dryness of hyperkeratosis, the existence of a diabetic foot ulcer or a Charcot foot. Amyotrophy is correlated with the severity of the disorder. It can cause paralysis. We have noticed that the first neurological damage is the Oto-Rhino Laryngitis sphere--we noticed a decrease in hearing. The diastasis-recti is a late sign and expresses the severity of Neuropathy. The diagnosis is confirmed by the realization of an ENMG of the four limbs.

So, for this fact and to relieve our patients, we first start by stabilizing the diabetes:

- The HbA1c should be around 6, which we get easily by enforcing strict diet, hydration, physical activities and above all, psychological support - awareness is an important factor.
- We correct the usual Vitamin D3 deficits after dosing.
- We stop all analgesic treatments because we see it as an overwhelming of our patients who reduce considerably their activities, gain weight, unbalance their diabetes to finally worsen their Neuropathy to the point of destroying everything and no longer feeling anything--Paralysis sets in.
- We offer Carbomedtherapy (Carbon Dioxide Therapy) treatment sessions.

So, what is Carbomedtherapy (Carbon Dioxide Therapy)?

The carbon dioxide therapy is called Carbomedtherapy for diseases, and carboxytherapy for aesthetics. The CDT consists of transcutaneous injections of carbon dioxide. This technic was first practiced, in 1932, by Dr Barrieu, at Royat-Chamalières, France. Initially the indications were purely vascular especially for Raynaud's syndrome, arteriopathy of the lower limbs, leg ulcers, and of course, in the care of the diabetic foot.

What are the benefits of Carbomedtherapy?

. On the vascular level: An improvement for faster healing of the wounds and improvement of a walking perimeter.

. On the neurological level**:** Repair of vasa nervorum leads to neurological regeneration which allows a reduction or even disappearance of pain, tingling and numbness.

- Prevent the onset of other complications as well as the obesity related issues: kidney failure and hypertension.
- Decrease or even disappearance of the reported disorders thereby improving considerably the quality of life.
- Better static balance thereby allowing the return to ambulation, thus increasing the autonomy.

• Carbomedtherapy sessions allow gradually the recovery of plantar sensitivity, the best prevention of foot wounds, thereby reducing the rate of amputation.

Carbon Dioxide Therapy indications for diabetics

Diabetic foot: We have two separate tables:
1) Patients with wounds.
2) Patients without wounds, but with vascular or neurological disease. Unfortunately, very often these aspects are simultaneously entangled.
3) Diabesity

What are the Contraindications?

As a precaution, women who are pregnant. By obligation, patients with an imbalance of tares, especially respiratory and cardiac; Patients who had a recent acute stroke; Patients with active cancers and active viral infections; finally, with anaerobic germ infections. These situations can be reversed, however.

What are the side effects?

They are benign and above all reversible. There are superficial micro-hematomas at the injection points, which can sometimes follow a session especially if the patient is frankly de-coagulated. They disappear quickly and are not painful. There is no risk of gas embolism. The CO_2 pressures delivered by this machine are adjusted to avoid this problem even during accidental injection. The risks of infection should not exist. It is a simple matter of hygiene.

How to inject?

We use a device called CDT EVOLUTION. This device delivers heated carbon dioxide during the injections through disposable accessories: 13 mm and 30 G mesotherapy needles, and sterile tubing. The device being preprogrammed, we use the vascular program, the one which delivers 80cc of CO_2 per minute. The injections are transcutaneous and avoid well the vessels. We inject the surface of the 2 lower limbs, from the Scarpa triangle, around and on the wounds, and in the upper limbs in case of neuropathy. It is an outpatient practice. The rhythm of the sessions will depend on the severity of the case: once a week, bimonthly, or monthly

How does it work?

Hemoglobin molecules have 4 oxygen molecules at saturation. When we inject carbon dioxide, an exchange takes place between these oxygen molecules and those of CO_2. This phenomenon is described as BOHR effect (Fig. 1). We were able to record the instant nature of this exchange, by measuring PCO_2 and PO_2, during a CO_2 injection. What we found was that the PCO_2 measurement curve has not been changed while the PO_2 curve recorded an elevation.

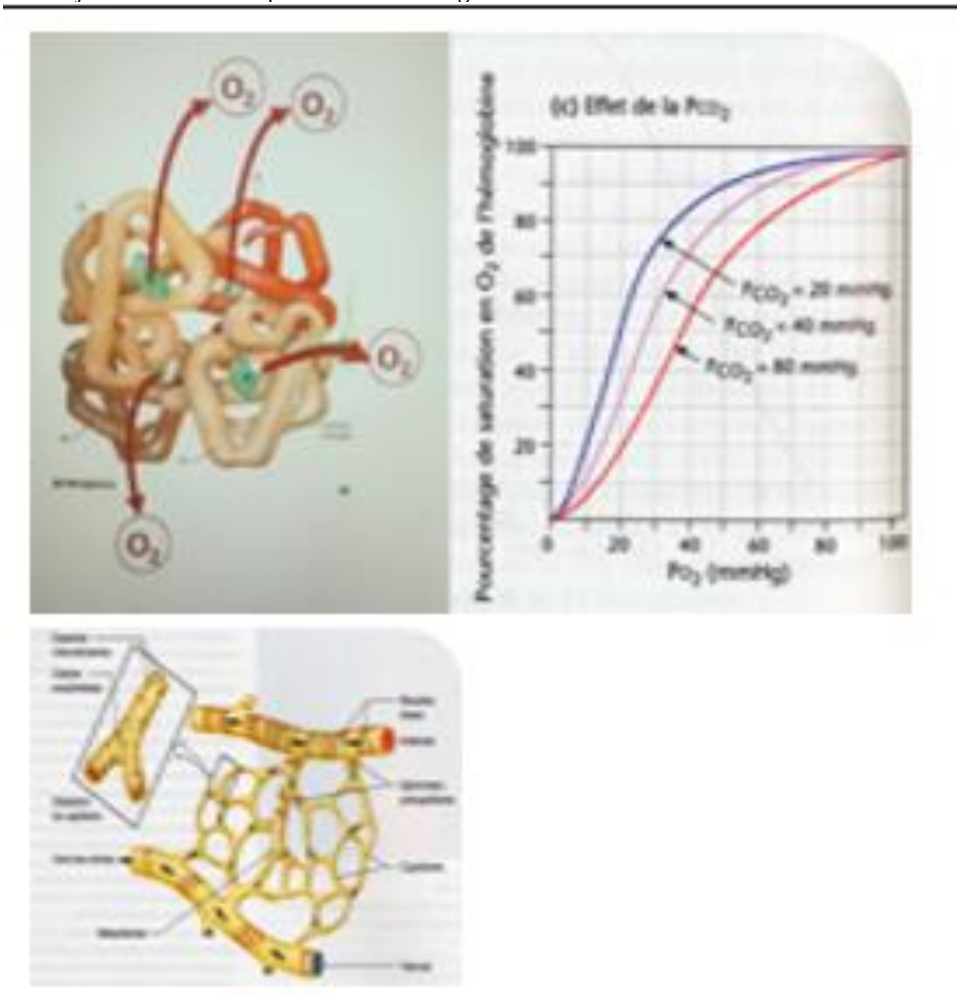

Figure 1: Otherwise, CO_2 acts as a vasodilator on the precapillary sphincters, transforming silent zones into functional vascular zones. This is what we call false angiogenesis. This action is perpetuated by the repetition of the sessions by a real angiogenesis. So, there is an influx of blood. At the cellular level, exchanges become more important.

Evolution under Carbon Dioxide Therapy treatment

The evolution under the Carbon Dioxide Therapy treatment follows a scheme described below:

. At the neurological level:

In the first place, the tingling disappears then the cramps--we believe that the correction of the Vit D3 rate is not unrelated to this. The pain gradually decreases as the Carbon Dioxide Therapy sessions progress. It is imperative to obtain a normal HbA1c level from the patient. Hyperglycemia is a real obstacle to healing by maintaining the perpetual attack of the nerves.

The second parameter is ambulation, the resumption of which remains difficult when physical activity no longer exists. Exercises performed by a third party to combat stiffness and muscle atrophy are necessary. The use of a wheeled walker allows confidence to be restored for walking autonomy. We consider the psychological problem linked to the fear that has settled in these patients with multiple histories of falls without counting the effects of the analgesic therapeutic withdrawal that we set up from the start of treatment.

The recovery of especially plantar sensitivity is done from top to bottom from the Scarpa triangle to the sole of the foot. It manifests itself by the appearance of pain during the injections made during the different Carbon Dioxide Therapy sessions.

- For carpal tunnel lesions, disappearance of pain and numbness allowing functional recovery.

Before starting the Carbon Dioxide Therapy treatment sessions, an ENMG of the four limbs is performed by an independent neurologist chosen by the patient. The control is done only after 12 to 24 sessions.

. At the vascular level:

Carbomedtherapy significantly improves vascularity. It repels ischemia and distinguishes necrotic from viable areas. We do not remove the necrosis so as not to deepen the lesions and thus obtain a well vascularized floor.

In conclusion, the Carbomedtherapy is a simple, safe, and efficient technique. Due to its learning, it is within the reach of any interested doctor. It is carried out externally, which reduces the cost of treatment. It is also within the reach of all patients.

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