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ARTICOLI ORIGINALI - *ORIGINAL ARTICLES*

Postablative laser management: mupirocin 2% *vs.* gentamicin 0.1% ointment

Gestione post laser ablativo: mupirocina 2% vs. gentamicina 0,1% unguento

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Abstract - Riassunto

Aim. *Mupirocin is widely used for topical treatment of infections. Gentamicin is an interesting alternative for both gram-positive and gram-negative bacteria. Aim of this open study was to compare effectiveness and comfort of mupirocin 2% ointment (excipients: macrogol 400 g/mol and 3350 g/mol - PEG ointment) versus gentamicin 0.1% ointment (excipients: liquid paraffin and white soft paraffin) in postoperative injuries caused by ablative and non-ablative lasers.*
Methods. *Forty subjects with a variety of benign cutaneous and mucous lesions, localized in different anatomical sites have been enrolled. Patients were treated with ablative (10.600 nm wavelength) CO_2 laser, microablative CO_2 laser with bipolar radio frequency (RF), 595 nm dye laser, and 532-1064 nm Q-switched (QS) Nd:Yag laser. Patients were divided into two groups for the postoperative management: the first group was treated with daily application of mupirocin 2% ointment and the second one with daily application of gentamicin 0.1% ointment.*
Results. *Patients undergoing ablative CO_2 laser removal of skin lesions showed complete resolution of the wounds, absence of permanent atrophic or hypertrophic scarring, absence of dyschromia and no infectious complications. Also, patients treated with combined microablative CO_2 laser and bipolar RF or with non ablative lasers, showed complete healing. Both antibiotic ointments have been well tolerated without any cutaneous adverse side effect.*
Conclusion. *Our study, based on a relatively small number of patients focused primarily to assess safety and comfort of the two different antibiotic ointments. The peculiar PEG vehicle contained in the mupirocin 2% formulation assures an effective, safe and comfortable profile to this ointment in postlaser wound management even if the antibacterial activity may be comparable to gentamicin 0.1%.*

KEY WORDS: lasers, dye - mupirocin - gentamicins

Obiettivo. La mupirocina 2% è un farmaco ampiamente studiato nel trattamento topico delle infezioni. La gentamicina 0,1% è un'alternativa interessante, con attività sia nei confronti dei germi gram-positivi che gram-negativi. L'oggetto del nostro studio è la comparazione dell'efficacia e della fruibilità della mupirocina 2% unguento (eccipienti macrogol 400 g/mol e 3350 g/mol – PEG unguento) nei confronti della gentamicina 0,1% unguento (eccipienti paraffina liquida, vaselina bianca) nella medicazione di ferite generate dall'utilizzo di laser chirurgici (vaporizzazione) o di laser selettivi (trattamento di lesioni vascolari e cicatriziali ipertrofiche, vascolarizzate e cheloidee o pigmentarie, endogene ed esogene).
Metodi. Il nostro studio ha arruolato 40 soggetti, 20 maschi e 20 femmine di età compresa tra 26 e 72 anni, con varie lesioni cutanee e mucose benigne, localizzate in diverse sedi anatomiche, che sono state trattate mediante laser CO_2 ablativo 10600 nm di lunghezza d'onda, laser CO_2 microablativo con radiofrequenza (RF) bipolare, dye laser 595 nm, e laser Q-switched 532-1064 nm. I pazienti arruolati sono stati divisi in due gruppi per i quali sono state predisposte medicazioni con mupirocina 2% unguento nel primo e gentamicina 0,1% unguento nel secondo. Per lesioni cutanee bilaterali del volto o extravolto (es. sede inguinale o ascellare) si è proceduto con una medicazione comparata. Sono stati esclusi pazienti con infezione attiva. I pazienti sono stati istruiti sull'applicazione quotidiana dei farmaci e sulla gestione generale delle ferite.
Risultati. I pazienti sottoposti a rimozione delle lesioni cutanee mediante laser CO_2 ablativo hanno mostrato risoluzione completa delle ferite, miglioramento globale della pigmentazione cutanea, assenza di esiti cicatriziali atrofici o ipertrofici permanenti, assenza di esiti discromici e assenza di complicanze infettive. Anche i pazienti sottoposti a trattamento con laser CO_2 microablativo ed RF bipolare o con laser selettivi (dye laser 595 nm e laser Q-switched 532-1064 nm), hanno mostrato un andamento postoperatorio nella

norma. Tutti i pazienti hanno tollerato bene entrambi i tipi di unguento antibiotico senza riferire alcun fenomeno irritativo. La nostra osservazione ha confermato un andamento post-trattamento privo di qualsiasi reazione avversa ai farmaci topici utilizzati.
Conclusioni. Il nostro studio, basato su un numero relativamente piccolo di pazienti e di lesioni e su un controllo a distanza piuttosto breve, si è soffermato soprattutto sulla fruibilità, intesa come maneggevolezza, gradimento e facilità di rimozione di questi due unguenti antibiotici da parte dei pazienti. Il particolare veicolo PEG contenuto nella formulazione di mupirocina 2% assicura per questo unguento un profilo efficace, sicuro e confortevole nella gestione di ferite laser anche se l'attività antibatterica può essere paragonabile a quella della gentamicina 0,1%.

Parole chiave: dye lasers - mupirocina - gentamicina.

Importance in prevention of skin infections has been emphasized in position Statement on reducing the risks of peritoneal dialysis-related infections [1] recent guidelines. Skin infections after laser therapy can be controlled with daily application of mupirocin 2% ointment.[2] Our group has evaluated the effectiveness and comfort of topical mupirocin 2% in the treatment of wounds generated by ablative laser vaporization of cutaneous or mucous tissue. These medications were also assessed when used after non ablative lasers such as the 595 nm dye laser, used in the treatment of vascularized keloids, hypertrophic scarring or flat and plantar warts (unconventional applications of the 595 nm dye laser). Futhermore, injuries derived from treatment with Q-switched (QS) laser (benign pigmented lesions and tattoos) were treated. Considering the well known effectiveness of gentamicin ointment in the prevention of infections during wound healing, we wanted to perform a comparative study between mupirocin 2% and gentamicin 0.1%, through the evaluation of the healing process in patients treated with dermatological lasers. Wound healing is the physiological body's ability to repair damaged tissue. It can occur via two mechanisms: regeneration, when damaged tissues are replaced with the same cell types, or by replacement, if damaged tissues are replaced by connective tissue with the formation of fibrosis.

Healing of cutaneous injuries may occur by first intention, as in the case of cuts determined for example by the surgical wounds with linear and well defined margins, where healing is favored by the matching and suture of the skin flaps. It may occur also by secondary intention, as in the case of burns with loss of substance, cuts and grazes, or in any case where the matching of the margins is difficult. In these cases the granulation tissue that is necessary to the healing process will begin to form on the bottom of the wound and work progressively upwards until reaching the surface. Wound environment is very peculiar as it holds a marked defect of the skin's barrier function.[3] Cell regeneration, by second intention, occurs by migration of dermal cells from the edges and bottom of the lesion towards the center. Newly formed cells slide over each other to fill the loss of tissue empty space. This process may be slowed down by the presence of "slough" formed by necrotic tissue and debris.

In a humid environment, cell migration proceeds much faster.[4] The theory of moist wound healing has been developed in a study that highlighted the principles previously described. Crusting and drying of tissues make cell migration difficult and expensive, especially on the metabolic level. Subsequently, numerous studies have been carried out on healing environment of wounds. A series of products has therefore been developed in order to provide the best moisture conditions and thus enable "advanced dressing systems".

The term "advanced dressing" refers to the cover material that has biocompatibility features and ensures the creation of a moist environment at the interface between wound and dressing. Therapeutic approach to chronic skin lesions should follow two main lines: local therapy and the etiopathogenetic therapy. The expression "local therapy" refers to measures that aim to eliminate the local factors that hinder the healing process in order to encourage the process of tissue repair. In the presence of a necrotic lesion our goal will be to eliminate necrosis that may interphere with cell migration and promote a possible bacterial growth. In a wound that shows a fibrinous floor and abundant exudate, a complete removal of the fibrinous material should be needed. Presence of these materials will help to stop the process of tissue repair by preventing the formation of granulation tissue, essential step for lesion repair. Re-epithelization should be facilitated in lesions with advanced granulation in the background, through the maintainance a moist environment. Wounds should be cleansed before any topical treatment. Cleansing promotes a proper evaluation, allows the removal of debris and residues of previous medication that may be present and dilutes the bacterial load.

Cleansing may be distinguished in enzymatic, autolytic, mechanical and surgical. Enzymatic cleansing uses proteolytic enzymes such as protease and collagenase; it does not cause pain to the patient, it does not generate bleeding and is not selective; it requires, moreover, a long time and is ineffective in the presence of necrotic or fibrinous tissue. Autolytic cleansing is based on the use of hydrogels, products that act hydrating the necrotic and/or fibrin material adherent to the bottom of the lesion, favoring detachment. This turns out to be painless, the cleansing is selective for necrotic tissue and does not cause bleeding. The cleansing process is slow. This type of cleansing should not be used on

TABLE I. — *Patient demographics, material and methods.*

Patient, age, sex	Indication, area	Laser treatment	Ointment used	Follow up
A.A., 57, M	S., face	CO_2 laser	Mupirocin 2%	7, 15, 30 days
A.M., 38, M	C.A., anal	CO_2 laser	Gentamicin 0.1%	7, 15, 30 days
A.T., 43, F	P.W., sole	Dye laser	Gentamicin 0.1%	7, 15, 30 days
B.A., 67, F	S.A., face	CO_2 laser	Mupirocin 2%	7, 15, 30 days
B.E., 52, F	X., face	CO_2 laser	Mupirocin 2%	7, 15, 30 days
B.K., 33, F	S.K.,inguinal fold	CO_2 laser	Mupirocin 2%	7, 15, 30 days
B.L., 58, F	C.W., hand	CO_2 laser	Gentamicin 0.1%	7, 15, 30 days
B.M., 62 M	S.K., neck	CO_2 laser	Mupirocin 2%	7, 15, 30 days
B.S., 71 M	S.K., trunk	CO_2 laser	Gentamicin 0.1%	7, 15, 30 days
B.V., 62 M	S.K.,face	CO_2 laser	Mupirocin 2%	7, 15, 30 days
C.A., 56 F	S., face	CO_2 laser	Gentamicin 0.1%	7, 15, 30 days
C.B., 54 F	Fi.W., eyelid	CO_2 laser	Mupirocin 2%	7, 15, 30 days
C.C., 70 M	S.S., sternum	Dye laser	Gentamicin 0.1%	7, 15, 30 days
C.F., 30 M	F.W., face	Dye laser	Mupirocin 2%	7, 15, 30 days
C.M., 35 F	C.A., genital	CO_2 laser	Mupirocin 2%	7, 15, 30 days
C.S., 69 M	S.A., temporal	CO_2 laser	Gentamicin 0.1%	7, 15, 30 days
C.V., 69 F	S.K., face	CO_2 laser	Gentamicin 0.1%	7, 15, 30 days
D.M., 45 F	C.A., anal	CO_2 laser	Mupirocin 2%	7, 15, 30 days
G.N., 48 F	F.W., face	Dye laser	Gentamicin 0.1%	7, 15, 30 days
G.R., 41 M	P.W., sole	Dye laser	Mupirocin 2%	7,15, 30 days
G.S., 58 M	C.W., foot	CO_2 laser	Gentamicin 0.1%	7, 15, 30 days
I.D., 53 M	T., arm	Q-switched laser	Gentamicin 0.1%	7, 15, 30 days
L.E., 70 F	S.K., underarms	CO_2 laser	Mupirocin 2%	7, 15, 30 days
M.A., 59 F	S.S., nose	CO_2 laser+dye laser	Mupirocin 2%	7, 15, 30 days
M.E., 45 M	X., face	CO_2 laser	Gentamicin 0.1%	7, 15, 30 days
M.P., 58 M	S.K.,face	CO_2 laser	Gentamicin 0.1%	7, 15, 30 days
M.S., 63 M	P.L.,face *	Q-switched laser	Mupirocin 2%	7, 15, 30 days
N.I., 42 M	T., leg	Q-switched laser	Mupirocin 2%	7, 15, 30 days
N.M., 28 M	A.S., face	CO_2 fractional-RF	Gentamicin 0.1%	7, 15, 30 days
P.C., 53 F	H.S.V., arm	Dye laser	Gentamicin 0.1%	7, 15, 30 days
P.P., 65 M	C.W., hand	CO_2 laser	Mupirocin 2%	7, 15, 30 days
R.L., 26 F	A.S., face	CO_2 fractional-RF	Gentamicin 0.1%	7, 15, 30 days
R.M., 59 M	S.K., inguinal fold	CO_2 laser	Mupirocin 2%	7, 15, 30 days
S.E., 66 F	P.L., face *	Q-Switched laser	Gentamicin 0.1%	7, 15, 30 days
S.G., 28 M	S.C., face	CO_2 fractional-RF	Gentamicin 0.1%	7, 15, 30 days
S.M., 72 F	S.K., neck	CO_2 laser	Mupirocin 2%	7, 15, 30 days
S.V., 33 M	T.S., leg	CO_2 fractional-RF	Mupirocin 2%	7, 15, 30 days
T.L., 62 F	C.W., hand	CO_2 laser	Gentamicin 0.1%	7, 15, 30 days
T.S., 29 F	A.S., face	CO_2 fractional-RF	Mupirocin 2%	7, 15, 30 days
V.C., 56 F	K., shoulder	Dye laser	Gentamicin 0.1%	7, 15, 30 days

M: male; F: female; SK: seborrheic keratosis; AS: acne scar; SS: surgical scar; TS: traumatic scar; SC: scar from chickenpox; SA: sebaceous adenoma; CA: condyloma acuminata anal, genital; CW: common warts; FW: flat warts; FiW: filiform warts; PW: plantar warts; X: xanthelasma; S: syringomas; HSV: hypertrophic scar vascularized; K: keloid; T: tattoo; PL: pigmented lesion. *Dermoscopic evaluation.

very exuding lesions because you run the risk of macerating the margin and the surrounding skin. This creates a favorable condition for the development of infectious processes. Mechanical cleansing is guaranteed by application of a wet gauze on the lesion; the gauze will dry on the bottom of the lesion; its removal will help to get rid of the fibrinous debris of the wound. Disadvantage is represented by the elimination of tissue in formation. Surgical cleansing is painful and can cause bleeding. When an infected lesion occours, autolytic cleansing is contraindicated as it is in lesions with fibromembranous material.

In the presence of granulation, several strategies are carried out in order to accelerate tissue restoration, and at this stage the dressing plays a prominent role. In recent years, concept of wound dressing has been object of a complex metamorphosis. The trend is leading us towards medica-

TABLE II. — *Objective results.*

Patient	Ointment	Wound healing	Side effects	Satisfaction
A.A.	Mupirocin 2%	8	Minor erythema	9
A.M.	Gentamicin 0.1%	8	No	8
A.T.	Gentamicin 0.1%	7	Purpur	8
B.A.	Mupirocin 2%	8	Minor erythema	9
B.E.	Mupirocin 2%	7	Minor erythema	9
B.K.	Mupirocin 2%	7	No	5
B.L.	Gentamicin 0.1%	8	No	8
B.M.	Mupirocin 2%	8	No	7
B.S.	Gentamicin 0.1%	7	No	5
B.V.	Mupirocin 2%	8	Persistent erythema	8
C.A.	Gentamicin 0.1%	7	Minor erythema	7
C.B.	Mupirocin 2%	7	No	9
C.C.	Gentamicin 0.1%	7	Purpur	6
C.F.	Mupirocin 2%	7	Purpur	8
C.M.	Mupirocin 2%	8	No	6
C.S.	Gentamicin 0.1%	8	No	7
C.V.	Gentamicin 0.1%	8	No	8
D.M.	Mupirocin 2%	8	No	6
G.N.	Gentamicin 0,1%	8	Persistent purpur	9
G.R.	Mupirocin 2%	7	Purpur	8
G.S.	Gentamicin 0.1%	8	No	6
I.D.	Gentamicin 0.1%	7	No	7
L.E.	Mupirocin 2%	8	Persistent erythema	5
M.A.	Mupirocin 2%	6	Purpur	8
M.E.	Gentamicin 0.1%	7	No	9
M.P.	Gentamicin 0.1%	8	No	5
M.S.	Mupirocin 2%	7	No	9
N.I.	Mupirocin 2%	8	No	8
N.M.	Gentamicin 0.1%	7	No	5
P.C.	Gentamicin 0.1%	7	Persistent purpur	7
P.P.	Mupirocin 2%	7	No	8
R.L.	Gentamicin 0.1%	8	No	7
R.M.	Mupirocin 2%	8	No	4
S.E.	Gentamicin 0.1%	8	No	8
S.G.	Gentamicin 0.1%	7	No	6
S.M.	Mupirocin 2%	8	No	8
S.V.	Mupirocin 2%	8	No	7
T.L.	Gentamicin 0.1%	7	No	6
T.S.	Mupirocin 2%	8	No	5
V.C.	Gentamicin 0.1%	7	Purpur	6

Visual Analogue Scale (VAS) for wound healing 0-10.
Satisfaction after independent medical observation, VAS 0-10.

tions that maintain a moist environment that is more suitable to the healing process.

Cleansing of wounds after laser therapy, should be performed using sterile techniques with abundant sterile saline solution. If there is an infection, antisepsis should be executed after cleansing. Antiseptics that we recommend are represented mainly by chlorhexidine or hydrogen peroxide. Antiseptic should dry after application in order to allow antibacterial action. It should be then removed with saline solution in order to avoid interactions with the dressings that are applied later, bacterial resistance and sensitization.

Dressings should remain in place for as long as possible, according to the clinical conditions and in accordance with medical recommendations.

Premature or frequent removal of adhesive dressings can damage both the surrounding skin, because of epithe-

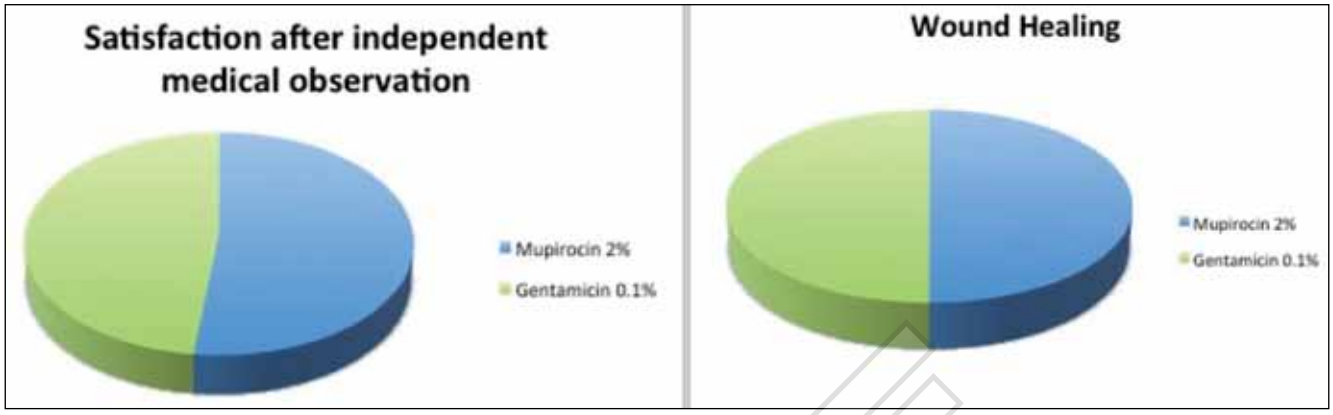

Figure 1.—Wound healing and satisfaction after independent medical observation.

lial cells stripping, and the wound bed itself. Dressings are defined as primary, when the dressing material is placed in direct contact with the injured tissues, secondary, when the dressing material is used to fill a cavity or performs the function of securing the primary dressing. The ideal dressing should be able to allow the absorption of exudate excess to provide a moist sterile microenvironment, not to waste residue in the wound, reduce pain, be easy to use, not to be allergenic, not to cause trauma to the removal, be impermeable to micro-organisms, provide thermal insulation. The choice of an appropriate dressing should take into account a number of factors such as, type of injury, site, size, presence of infection, type and amount of exudate.

Materials and methods

Forty subjects, 20 males and 20 females aged between 26 and 72 years, with skin type I-III according to Fitzpatrick, who had different types of benign skin lesions, localized in different anatomical sites, were treated with 10.600 nm ablative or microablative (fractional) CO_2 laser, 595 nm dye laser and 532-1064 nm QS laser (Table I). Patients were enrolled after a careful medical analysis (skin type, clinical symptoms, health status, use of medications, lifestyle, clinical and instrumental evaluation of lesions). Informed consent for each type of treatment was obtained. The study was approved by the committee on research ethics at the institution in which the research was conducted and any informed consent from human subjects was obtained as required.

The inclusion criteria were: interruption of photosensitizing drugs or oral retinoids for at least eight months before treatment, a distance of at least eight months after any surgical treatment, the absence of active infection, known allergy to gentamicin 0.1% or mupirocin 2%, inability to apply the medication, and inability to give consent. Selected candidates were informed of the study protocol used. They were taught to apply the medication sparingly where they received laser therapy after careful daily cleansing. The two medications were assigned to patients randomly. Each patient was informed about the application technique of the dressing, with particular attention to the drug action and possible side effects. Any adverse reactions or sensitization was reported on chart, and, if necessary, monitored during post-treatment visits. Patients were followed until complete healing. Exclusion criteria were: inflammatory diseases, pregnancy or lactation, systemic diseases, photosensitivity, risk of hyperpigmentation or keloid formation. Ablative CO_2 laser was used just once on different lesions (Table I). This system allows precise laser vaporization of different dermatological lesions even in particularly sensitive locations such as the periorbital area, the outer ear and the pseudomucous or mucous sites. In this study ablative CO_2 laser was used to treat the follwing lesions: seborrheic keratoses of the face and trunk, sebaceous adenomas, condylomata acuminata (genital and anal), warts (common and filiform), xanthelasmas and syringomas. An application of a wax mixture of 2.5% lidocaine and 2.5% prilocaine was used on 18 patients. During laser sessions a dynamic cooling system was used in order to reduce the intraoperative pain.

Standard safety measures such as eye protection for the patient and for the operators and the use of efficient vacuum systems and protective masks to prevent inhalation of particles of tissue, were always used. Ablative CO_2 laser treatments had the following operative settings: 0.3-3.5 W average power (pulsed emission), 5-10Hz frequency. Microablative (fractional) CO_2 laser associated with bipolar radio frequency (RF), was used for the correction of acne and chickenpox scars using the following operative parameters: 12-18 W power, pulse duration 800-900 ms, distance between points 500-750 micron, 30-40 W bipolar RF for 2-3 sec. In all patients, immediately after the laser treatment a cold compression with a gauze soaked in saline solution was applied, with the aim of reducing the sensation of pain and post-operative edema. All patients were instructed on the proper cleansing of the wound and subsequent application of antibiotic ointment mupirocin 2% or gentamicin 0.1% ointment, for the period immediately after treatment and until full normalization, in order to prevent crusting and

TABLE III. —*Patient's compliance***.**

Patient	Comfort	Visibility	Satisfaction	Ointment
A.A.	7	8	9	Mupirocin 2%
A.M.	7	7	8	Gentamicin 0.1%
A.T.	8	7	7	Gentamicin 0.1%
B.A.	8	7	8	Mupirocin 2%
B.E.	7	7	9	Mupirocin 2%
B.K.	7	8	7	Mupirocin 2%
B.L.	8	5	8	Gentamicin 0.1%
B.M.	8	6	7	Mupirocin 2%
B.S.	8	6	6	Gentamicin 0.1%
B.V.	8	7	8	Mupirocin 2%
C.A.	6	6	8	Gentamicin 0.1%
C.B.	5	6	9	Mupirocin 2%
C.C.	7	6	7	Gentamicin 0,1%
C.F.	8	6	8	Mupirocin 2%
C.M.	7	6	7	Mupirocin 2%
C.S.	8	6	8	Gentamicin 0.1%
C.V.	8	7	8	Gentamicin 0.1%
D.M.	7	7	7	Mupirocin 2%
G.N.	6	8	9	Gentamicin 0.1%
G.R.	4	8	8	Mupirocin 2%
G.S.	4	8	8	Gentamicin 0.1%
I.D.	7	8	8	Gentamicin 0.1%
L.E.	5	8	5	Mupirocin 2%
M.A.	8	8	9	Mupirocin 2%
M.E.	7	6	9	Gentamicin 0.1%
M.P.	7	7	7	Gentamicin 0.1%
M.S.	8	7	9	Mupirocin 2%
N.I.	8	7	9	Mupirocin 2%
N.M.	7	8	4	Gentamicin 0.1%
P.C.	7	8	7	Gentamicin 0.1%
P.P.	8	8	8	Mupirocin 2%
R.L.	4	7	7	Gentamicin 0.1%
R.M.	5	7	5	Mupirocin 2%
S.E.	8	8	8	Gentamicin 0.1%
S.G.	7	8	8	Gentamicin 0.1%
S.M.	8	7	9	Mupirocin 2%
S.V.	7	7	7	Mupirocin 2%
T.L.	6	6	6	Gentamicin 0.1%
T.S.	6	6	6	Mupirocin 2%
V.C.	4	6	7	Gentamicin 0.1%

VAS Comfort 0-10. VAS Visibility 0-10. VAS Patient's satisfaction 0-10.

superinfections. Patients were also asked to avoid direct sun exposure during treatment. After 595 nm dye laser (12 mm spot diameter, 6.5-7 J/cm^2 fluence), 532 nm QS laser (spot diameter 2.5 mm, 1.8-2 J/cm^2 fluence), 1064 nm QS laser (4 mm spot diameter, 5,5-7 J/cm^2 fluence) and fractional CO2 laser with RF, application of antibiotic ointments without excessive cleansing of the lesions was suggested.[5-7] Deep cleansing of the wounds was performed only after treatments of hypertrophic vascularized scars and keloids (595 nm dye laser), dark tattoos (1064 nm QS laser), when vesiculation and large abrasions occurred. Pigmented lesions treated with QS laser were previously examined with dermoscopy. Each patient underwent optical assessment before, immediately after each treatment, and during follow-up sessions, through digital and multispectral photography. During follow-up, an independent medical evaluation was carried out. Results were assessed with a Visual Analogue Scale (VAS) from 0 to 10. Results from 8 to 10 were con-

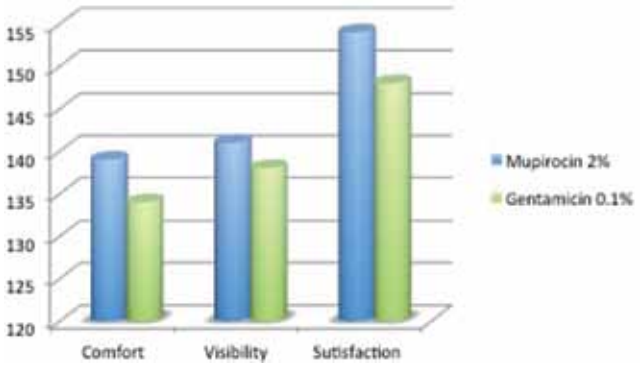

Figure 2.—Comfort, visibility and satisfaction for patients.

sidered as "very satisfying", from 5 to 7 as "satisfying", from 3 to 4 as "not very satisfying", and as "unsatisfying" when 0 to 2 points were obtained (Table II, Figure 1). Questionnaires regarding patient's compliance (comfort, visibility and overall satisfaction in relation to the type of ointment used) were given and analyzed (Table III, Figure 2).

Results

Forty patients were enrolled in this open study; all of them completed it. The study has been carried out for 6 months. Follow-up visits were carried out at 7, 14 and 30 days and at complete remission. Results were analyzed by an independent physician and objective parameters such as post op wound healing, presence of superinfection and physician's satisfaction were monitored during every follow up visit. VAS was used to assess wound healing (0-10) and overall satisfaction (0-10). Mean VAS for wound healing was 7.55 out of 10 for mupirocin 2% ointment whereas it was 7.55 for gentamicin 0.1%. Mean VAS for physician's satisfacion was 7.45 for mupirocin 2% and 6.9 was the result for gentamicin 0.1%. Regarding subjective opinion the following results were obtained: mean comfort for mupirocin 2% was 6.95 for gentamicin 0.1% was 6.7. Mean visibility of the oinment was 7.05 for mupirocin 2%, whereas it was 6.9 for gentamicin 0.1%. Overall patient's satisfaction was 7,7 for mupirocin 2% users and 7.4 for gentamicin 0.1% users.

Patients that underwent ablative CO_2 laser evidenced complete wound healing, improvement of cutaneous pigmentation without any atrophic or hypertrophic scars, and no dispigmentation or superinfection. Thirty-two patients (80%) obtained a complete remission with no side effects (class 1), 4 patients (10%) obtained total remission with transient side effects (class 2), 2 patients (5%) experienced a non complete remission of the lesions (class 3) and 2 patients (5%) obtained very poor results in terms of remission (class 4).

A satisfaction questionnaire was analyzed and 32 patients answered as "very satisfied", 4 as "satisfied", 3 were "not quite satisfied" and 1 was "unsatisfied". Only minor side effects due to the medical procedure were reported (Table II). Despite some common side effects we did not see any serious complications such as hyper-or hypopigmentation, edema, bleeding, itch, atrophic-hypertrofic scarring or infections. Postoperative antibiotic ointment was well tolerated in all patients; no irritative reaction was observed. Our observation confirmed the that the ointments used were free of any side effect (Figures 3, 4). All the results, including objective and subjective VAS are summarized in Tables II, III.

Discussion

There are very few evidences in the literature on the use of systemic or topical antibiotic treatment in the management of postoperative wounds; use of systemic drugs is not required unless signs of infection are reported. Topical antibiotics have very poor efficacy studies and may interfere with the healing process. Furthermore, medications may lead to irritative dermatitis or rarely, local allergic reactions.[8] Resident bacteria may be affected and resistance may occur. These therapies are usually uncomfortable due to the repeated applications needed and contamination of the tubes may be an issue.

As reported, when surgical procedures are performed a risk of an allergic reaction is higher than the risk of a superinfection.

A recent study [9] on the use of topical antibiotics in dermatology reported that their use is popular but the interest of the scientific community is quite low.

An ideal wound medication should be adsorbent, permeable, non adherent or toxic and easy to remove.

Its choice may affect tissue reparation. Bacterial superinfections are the worst inconveniences and need to be avoided by a correct topical treatment.

Vehicle used are usually ointments or vaseline based emulsions. The latter may interfere with the healing process as it has an occlusive action that may favour aerobic and anaerobic bacterial growth. Also, cell reparation may be inhibited.

Creams and emulsions are not ideal due to the presence of tensoactive ingredients that may interact with dermal and epidermal cell membranes.

The ideal medication should not be too adhesive in order to be easily changed without excessive trauma to the repairing tissue or bleeding and pain. It should favour gas exchange between skin and environment. Ideally it shoud favor the debris drainage without interfering with cellular replication and turnover. These features are typical of the so called PEG ointments. PEG ointment, is present in the Official Pharmacopea as a vehicle for other active principles and is not widely known by ermatologists.

PEG is a polymer with a chemical formula in which the number (n) of oxyethylene groups may change H-(O-CH_2-CH_2)n-OH. PEGs may have a low molecular weight (less than 600 g/mol) with clear, liquid and colourless features.

Figure 3.—A) Postsurgical scars on the nose; B) laser CO2 10600 nm and dye laser 595 nm treatment – mupirocin ointment 2% medication; C) results after 3 weeks.

Figure 4.—Postsurgical scars of the nose, before (A) and after (B) combined laser CO_2 10600 nm and dye laser 595 nm. Mupirocin 2% ointment was used twice a day for 10 days.

The ones that have a molecular weight above 1000 g/mol appear as solid and withish. PEG 3350 g/mol is solid, and may be combined with liquid PEG 400 g/mol, in order to obtain a semi solid ointment that appears very handy.[10]

Mupirocin 2% ointment contains two PEG vehicles (macrogol 400 g/mol and 3350 g/mol), and looks like vaseline. It favours exudate drainage with an easy removability. These PEGs are also used intravenously are non toxic and do nor alter cell replication. They match the ideal requirements for a dermatological post operative medication.

Conclusions

The aim of this study was to show the efficacy and comfort of two postoperative antibiotic oinments on a limited number of patients. Patients' feedback on the medication was also evaluated and critically analyzed.

In our experience mupirocin 2% and gentamicin 0.1% ointments showed similar efficacy in preventing superinfections of the treated areas with no significant side effects. Differences were related to the management of the wounds, especially after ablative CO_2 laser. The ablation wounds need to be cleansed properly in order to eliminate residues and debris that may interphere with the correct healing process.

In our opinion, removal of the ointment is a critical in the postoperative management and may help an ideal wound reparation. Furthermore, laser procedures are often finalized to esthetic results on very sensitive areas such as the face, neck, dorsal area of the hands. Medication needs to be comfortable and possibly non visible in order to have a better compliance without affecting social life.

Therefore, mupirocin 2% ointment offers an ideal and comfortable profile due to its peculiar PEG vehicles. It may be easily removed with water and it is less adhesive giving benefit in terms of pain and bleeding. Consistency is more fluid and less visible thus assuring a good comfort and invisibilty.

After less invasive laser procedures such as CO_2 fractional-RF for scars, dye laser at 595 nm for unconventional applications, QS 532 and 1064-nm laser for tattoo and pigmented lesion removal, the use of mupirocin 2% ointment

resulted more comfortable in comparison to gentamicin 0.1%.

In conclusion, the peculiar PEG vehicle contained in the mupirocin 2% formulation assures an effective, safe and comfortable profile to this ointment in post laser wound management even if the antibacterial activity may be comparable to gentamicin 0.1%.

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Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.
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