

143

43 - 2001

# ACTA CHIRURGIAE PLASTICAE

INTERNATIONAL JOURNAL OF PLASTIC SURGERY,  
MAXILLOFACIAL SURGERY, HAND SURGERY AND BURNS

Vol. 43 • 1/2001



Národní lékařská knihovna

\*2530159179\*



A 3021/89967

PUBLISHED BY THE CZECH MEDICAL ASSOCIATION J. E. PURKYNĚ

ISSN 0001-5423

INDEXED IN EMBASE/Excerpta Medica, MEDLINE/Index Medicus, BIOLOGICAL ABSTRACTS

5076

# OBNOVTE SI SVOU

# ANGLICKOU

# KNIHOVNU!

## Velký anglicko-český slovník

K. Hais, B. Hodek

Největší anglicko-český slovník zpracovaný u nás v 2. polovině 20. století. Obsahuje více než 100.000 hesel obecného i odborného jazyka (přibližně 280.000 anglických slov) a na 450.000 českých ekvivalentů. Přehledná koncepce jeho zpracování, kdy každému významu anglického hesla jsou přiřazeny ekvivalentní české překlady a použití v kontextu je přiblíženo pomocí příkladů a vysvětlivek, se během let existence tohoto slovníku ukázala jako velmi vyhovující širokému spektru uživatelů. Slovník vychází v koedici s nakladatelstvím Academia po přepracování a doplnění cca 8.000 hesel v nové grafické úpravě (přehlednější zápis hesel, např. frázových sloves, palcový index pro snazší vyhledávání písmen) a v praktickém dvousvazkovém provedení.

Doporučená cena: 1.250,- Kč, formát A5, váz., 2 díly, 2918 str., 1. vydání. ISBN 80-85927-37-3 – soubor.

Elektronická verze: Doporučená cena: 9.600,- Kč, pro školství, zdravotnictví a jednotlivce 7.680,- Kč.

## Velký česko-anglický slovník

J. Fronek

Zcela nový, dosud největší česko-anglický slovník naší anglistické lexikografie, obsahující 100.000 hesel a podhesel, 200.000 slovních spojení a frazeologismů a 400.000 ekvivalentů zaplňuje po mnoha letech citelnou mezeru na našem trhu. Slovník je svým rozsahem i zpracováním všestranně použitelný jak pro začátečníky, tak i pro profesionální práci učitelů, překladatelů a tlumočnicků. Ve slovníku je zpracována slovní zásoba přibližně posledních sta let. Slovník vyniká přehlednou prezentací materiálu, uvádí množství slovních spojení a frazeologismů, kontextových i dalších vymezení, která značně usnadňují výběr vhodného ekvivalentu. Tento systém po všech stránkách umožňuje aktivní používání jazyka. Anglicky mluvícím uživatelům přijde vhod jednoduchý, ale přesný přehled českého tvarosloví, ke kterému je u každého hesla slovníku důsledně odkazováno.

Doporučená cena: 850,- Kč, formát B5, váz., 1648 stran, 1. vydání. ISBN 80-85927-54-3

## English Conversation Practice (Anglická konverzace)

V. Urbanová, V. Rejtharová, V. Vařecha

Přepracované vydání oblíbené příručky anglické konverzace pro pokročilé, tentokrát doplněné ilustracemi a audiokazetou. Obsahuje aktualizované dialogy z každodenního života, bohatý materiál pro lexikální, konverzační i gramatická cvičení a klíč ke cvičením. Vhodné pro předmaturní a vyšší studium, intenzivní jazykové kursy i pro samostatné studium.

Doporučená cena: učebnice: 219,- Kč, formát V2, brož., 272 str. Kazeta: 199,- Kč, 1. vydání. ISBN 80-85927-49-7

## Anglicko-český lékařský slovník – ELEKTRONICKÝ

Přibližně 29.000 anglických termínů s přepisem výslovnosti a 54.000 českých ekvivalentů a překladů.

Doporučená cena: 2.910,- Kč

Publikace z produkce nakladatelství LEDA spol.s r.o. si můžete objednat na adrese:  
Nakladatelské a tiskové středisko ČLS JEP, Sokolská 31, 120 26 Praha 2, fax 02-2426 6226.

## ZÁVAZNÁ OBJEDNÁVKA

Objednávám tímto .....kusů titulu nakladatelství LEDA:

☐ Velký anglicko-český slovník (Hais, Hodek)

☐ kniha, ☐ elektronická verze, ☐ obojí

☐ Velký česko-anglický slovník (Fronek)

☐ English Conversation Practice

(Urbanová, Rejtharová, Vařecha)

☐ Anglicko-český lékařský slovník – ELEKTRONICKÝ

Jméno \_\_\_\_\_

Firma \_\_\_\_\_

Adresa vč. PSČ \_\_\_\_\_

ICO \_\_\_\_\_ DIČ \_\_\_\_\_

Podpis \_\_\_\_\_ Razítko \_\_\_\_\_ Datum \_\_\_\_\_

# ACTA CHIRURGIAE PLASTICAE

---

No. 1, 2001

## EDITORIAL BOARD

Chairman  
**Miroslav Tvrdek, M.D.**  
Praha

Vicechairman  
**Zbyněk Šmahel, Ph.D.**  
Praha

## MEMBERS

<b>Lubomír Brož, M.D., Praha</b>	<b>Jiří Kozák, M.D., Praha</b>
<b>Aleš Nejedlý, M.D., Praha</b>	<b>Radana Königová, M.D., Praha</b>
<b>Jiří Veselý, M.D., Brno</b>	<b>Jan Válka, M.D., Brno</b>

## COLLABORATORS

**Zoran M. Arnež, M.D., Ljubljana**  
**Zdenko Stanec, M.D., Zagreb**  
**Konstantin Troshev, M.D., Varna**

## CONTENTS

Veselý J., Stupka I., Dražan L., Holuša P., Licata G., Corradini B.: DIEP Flap Breast Reconstruction – New Experience . . . . .	3
Colić Miodrag M., Colić Milan M.: The Use of Pedicled TRAM Flap for Delayed Breast Reconstruction . . . . .	7
Dražan L., Veselý J., Leybold J., Julínek J., Lžičáková E.: Microsurgery in the Diabetic Foot . . . . .	11
Report on Congress . . . . .	16
Hrbatý J., Molitor M.: Traumatic Skin Loss from the Male Genitalia . . . . .	17
Hladík M., Tymonová J., Zaoral T., Kadlčík M., Adámková M.: Treatment by Continuous Renal Replacement Therapy in Patients with Burn Injuries . . . . .	21
Mezzana P., Sonnino M., Madonna Terracina F. S., Valeriani M.: Treatment of Atrophic Scars with Er:YAG Laser: Our Experience . . . . .	26
Czech Summaries . . . . .	29
Annals of Burns and Fire Disasters – No. 3/2000 . . . . .	31
Instructions to authors . . . . .	32



253A022465



A3021/189967

## SCOPE AND LIMITATIONS

Acta Chirurgiae Plasticae is an international journal with a long-standing tradition respected by the professional public worldwide. It is published in English four times per year. The journal contains clinical, experimental and theoretic studies from the discipline of plastic, reconstructive and aesthetic surgery, surgery of the hand, craniofacial surgery, treatment of burns and allied surgical disciplines (traumatology, orthopaedics, gynaecology etc.). In the journal you will also find reviews, case-histories, innovations, comments, reports from study trips and congresses, reviews of books and various announcements.

# ACTA CHIRURGIAE PLASTICAE

## SUBSCRIPTION AND FEES

Price for a single issue: Kč 71,- (Czech Republic), Sk 81,- (Slovak Republic).

2001 subscription rate: Kč 284,-, Sk 324,-, respectively.

Information on subscription rate for other countries provides: CzMA JEP, Sokolská 31, 120 26 Prague 2, Czech Republic.

Subscription orders should be sent to the Publishing Division of the Czech Medical Association JEP, Sokolská 31, 120 26 Prague 2, Czech Republic, or by fax No. +4202/24 26 62 26 or by e-mail: [nts@iol.cz](mailto:nts@iol.cz),  
<http://www.clsjep.cz>



I hereby subscribe to Acta Chirurgiae Plasticae

Name .....

Date .....

Full address .....

.....

.....

Signature .....

## ACTA CHIRURGIAE PLASTICAE

© Czech Medical Association J. E. Purkyně, Prague 2001

Editorial board: M. Tvrdek, chairman, Z. Šmahel, vicechairman, L. Brož, J. Kozák, R. Königová, A. Nejedlý, J. Válka, J. Veselý, members. Published four times a year by the Czech Medical Association J. E. Purkyně, Sokolská 31, 120 26 Prague 2, Czech Republic. Printed by Miroslav Housar - MTT, Za Poříčskou bránou 9, 186 00 Prague 8. Distribution for the Czech Republic and Slovak Republic: Jana Vávrová, ADLEX System, Právouhlá 26, 150 00 Prague 5. Distribution abroad: ABONT, s. r. o., Blatenská 2180, 148 00 Prague 4. Price for a single issue: Kč 71,- (Czech Republic), Sk 81,- (Slovak Republic). 2001 subscription rate: Kč 284,-, Sk 324,-, respectively. Subscription orders should be sent to the Publishing Division of the Czech Medical Association JEP, Sokolská 31, 120 26 Prague 2, Czech Republic, or by fax No. +4202/24 26 62 26. Manuscripts should be sent to Acta Chirurgiae Plasticae, Šrobárova 50, 100 34 Prague 10, Czech Republic. Advertisement and inquiries concerning conditions of advertising should be sent to Advertisement Department of the Czech Medical Association JEP, Vršovická 17, 101 00 Prague 10, Czech Republic, e-mail: [ntsinzerce@iol.cz](mailto:ntsinzerce@iol.cz). Registrační značka MK ČR F 4844. Indexed in Excerpta Medica/EMBASE, Index Medicus/MEDLINE, Biological Abstracts. Internet service provider: EuroNet. Cz., spol. s r. o., Štěpánská 18, 110 00 Prague 1, phone number: +4202/22 23 07 02, fax: +4202/22 23 07 08; e-mail: [medical@euronet.cz](mailto:medical@euronet.cz); internet: [www.medical.cz](http://www.medical.cz).





Fig. 1. One year after mastectomy of right breast and subcutaneous mastectomy of left breast.



Fig. 2. Bilateral DIEP flaps reconstruction.



Fig. 3. Just after finishing of right breast reconstruction, the flap for left breast is prepared by deepithelisation of great part of skin island.



Fig. 4. The donor site morbidity after flaps dissecting.



Fig. 5. Frontal view the 8<sup>th</sup> post-operative day of the same patient.



Fig. 6. Left view – the same patient.

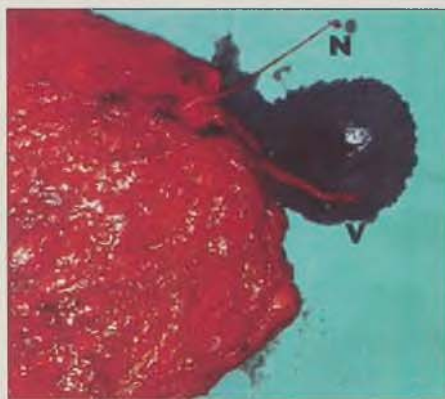


Fig. 8. Pedicle of other flap: V – vessels, N – sensitive nerve.

Fig. 7. Another case, long perforator pedicle is well seen.

rectus abdominis muscles (Hartramf et al., 1982; Hartramf and Bennett, 1987); bulging of the abdominal wall at the site of collection of the flap may occur, and hernia may develop.

Our recent experience provides evidence that single perforator can supply a relatively large flap, which is transferred without signs of circulatory deficiency. After our experience so far, we are testing the required size of the vessels in the perforator. A danger is involved in using vascular perforators with small veins; in this

case it is better to select another of the numerous perforators. Another advantage is the sensory nerve passing along with the nourishing vessels of the flap and the possible sensory innervation of the flap, which is doubtful in classical TRAM flaps.

The disadvantage of this surgical procedure is the necessity of precise dissection of very small vascular bundles and thus the danger of their injury. We did not encounter vascular spasms in the perforators because we use magnesium sulphate for injection of the perforators into the thin perivascular connective tissue and adventitia. The time required for the operation is prolonged by ca 30 minutes as compared with isolation of a free TRAM flap.

### CONCLUSION

In the hands of an experienced surgeon, the DIEP is a safe flap. It maximally reduces the morbidity of the donor site, the reconstruction of which is easy. It is possible to isolate a large skin flap of varying size from the abdomen for defects on the extremities, head and trunk. This flap in the hypogastrium is an important substitute for the musculocutaneous TRAM flap. The perforator DIEP flap is the first choice in our practice for breast reconstruction. Further studies should

confirm the hypothesis that this flap does not damage the abdominal wall.

### REFERENCES

1. BLONDEEL, PN., BOECKX, WD. Refinements in free flap breast reconstruction: the bilateral deep inferior epigastric perforator flap anastomosed to the internal mammary artery. *Br. J. Plast. Surg.*, 1994, 47: 495-501.
2. BLONDEEL, PN. One hundred free DIEP flaps breast reconstructions: a personal experience. *Br. J. Plast. Surg.*, 1999, 52: 104-111.
3. GALLI, A., ADAMI, M., BERRINO, P., LEONE, S., SANTI, P. Long term evaluation of the abdominal wall competence after total and selective harvesting of the rectus abdominis muscle. *Ann. Plast. Surg.*, 1992, 28: 409-413.
4. HARTRAMPF, CR., SCHEFLAN, M., BLACK, PW. Breast Reconstruction with a transverse abdominal island flap. *Plast. Reconstr. Surg.*, 1982, 69: 216.
5. HARTRAMPF, CR., BENNETT, GK. Autogenous tissue reconstruction in mastectomy patients: a critical review of 300 patients. *Ann. Surg.*, 1987, 205: 508-518.
6. KOSHIMA, I., SOEDA, S. Inferior epigastric artery skin flap without rectus abdominis muscle. *Br. J. Plast. Surg.*, 1989, 42: 645-648.
7. SOEDA, S., KOSHIMA, I. *Inferior epigastric artery skin flap without rectus abdominis muscle*. X. IPRAS Congress, Madrid 1992.

Address for correspondence:

J. Veselý  
Clinic of Plastic and Aesthetic Surgery  
Berkova 34  
612 00 Brno  
Czech Republic

## THE USE OF PEDICLED TRAM FLAP FOR DELAYED BREAST RECONSTRUCTION

*Colić Miodrag M., Colić Milan M.*

Clinic for Burns, Plastic and Reconstructive Surgery,  
Belgrade University School of Medicine, Belgrade, Yugoslavia

### SUMMARY

The pedicled TRAM flap based on superior epigastric artery is very safe and reliable flap which provides sufficient autologous tissue for natural breast reconstruction. Depending on quantity of abdominal tissue used for the reconstruction, the breast can be sufficiently large and ptotic to achieve symmetry in a single operative procedure. The importance of appropriate patient selection should never be underestimated, especially in risky patients like heavy smokers, those with previous vascular diseases or heavy scarring of the abdominal wall, where delayed procedure is strongly indicated. Adequate patient selection, preoperative management, monitoring of the flap and routine postoperative care with oxygenation, together with the selection of proven surgical technique is the key for the safety of the procedure and reduced patient morbidity.

### ZUSAMMENFASSUNG

#### Die Anwendung des TRAM Stiel Lappens bei der verschobenen Brustrekonstruktion

*Colić Miodrag M., Colić Milan M.*

Das Stieletramlappen, dessen Basis von der Arterie Superior Epigastric gebildet wird, ist sehr zuverlässig und sicher. Der Lappen versichert die Fülle des autogenen Gewebes für eine natürliche Brustrekonstruktion. Im Einklang mit der Menge von dem abdominalen Gewebe, das für die Brustrekonstruktion angewandt wird, kann die Brust genug gross und geformt sein, damit die Symmetrie erreicht wird. Besonders in dem Falle wenn nur eine Brust operiert wird. Man darf nie die Patientenauswahl unterschätzen, besonders bei den Risikofällen wie starke Raucher, Patienten mit vorhergehenden Vaskulärerkrankungen oder mit schweren Vernarbung der Bauchwand. Hier wird die verschobene Operative eindeutig indiziert. Die geeignete Patientenauswahl, operative Leitung, Lappenmonitoring und rutine postoperative Behandlung mit Oxygenation zusammen mit Auswahl der beglaubigten chirurgischen Technik bilden die Basis, die die Sicherheit des erwählten Verfahrens gewährleistet und beschränkt die Patientenmorbidity.

**Key words:** TRAM flap, breast reconstruction, delayed TRAM flap

In most cases of mastectomy where the reconstruction is indicated after 2-3 years of safe period with no signs of recurrence, it is usually performed as a two-stage procedure. In the first stage the volume and possible symmetry is achieved, while the second stage is reserved for the procedure on the opposite breast to achieve more symmetry and for the nipple-areola reconstruction. Basic principles of breast reconstruction should be always kept in mind for the safety of the procedure and whenever possible autologous tissue is used. For these reasons the lower pedicled TRAM (transverse rectus abdominis muscle) flap is considered one of the most widely used flap which requires special surgical attention to create symmetry, inframammary line, breast projection, sufficient degree of ptosis and creation and location of the inframammary fold.

Appropriate patient selection is very important in order to achieve a good result and that

means that the patient should be strongly motivated and in good condition, apart from some absolute and relative contraindications which are to be considered. They are related to bad prognosis of the cancer, diabetes, arteriosclerosis, morbid obesity, severe chronic pulmonary and cardiovascular diseases and previous transection of superior epigastric vessels as absolute indications, while relative contraindications include smoking habit, abdominal scars, obesity, psychosocial instability etc.

In preoperative evaluation of the patient the volume and dimensions of the mastectomy defect and donor site are assessed and appropriate measures taken in standing position related to the opposite breast (Fig. 1). From the technical point of view, the flap is divided into fourths, each representing a zone: zone I corresponds to the muscle pedicle, zone II to the contralateral rectus muscle, zone III to the part of the flap to



be deepithelialized and buried and to give the bulk and ptotic appearance, and the most lateral zone IV which is going to be discarded. The amount of the abdominal tissue available for the transfer is estimated and some excess skin and fat tissue of the lower abdomen makes a good candidate for both breast reconstruction and abdominoplasty. Previous scarring of which the vertical laparotomy scar is most often (Fig. 2) represents the strong indication for delayed procedure. That usually means outline and elevation of the abdominal flap to the level of the rectal fascia, and then return of the flap in place where it is sutured and the whole procedure continued again in three weeks. That period allows redistribution of the vascular network and reduces the risk of flap failure.

In general, our preferred choice is the the single pedicle TRAM flap based on the contralateral rectus muscle which is considered safe enough for reconstruction. In patients with no significant risk factors some 60 % of the TRAM flap can be safely transposed into mastectomy site, while in cases with existing risk factors the size of the flap should be limited to the area over periumbilical perforators in order to avoid fat necrosis and even partial flap loss, or the bipediced TRAM flap is to be used.

## SURGICAL TECHNIQUE

### Elevation of the flap

After all abdominal and chest wall markings have been completed, we first place the transverse lower incision suprapubically as for the aesthetic abdominoplasty and upper incision at the periumbilical level. We always prefer contralateral rectus muscle because of ease of rotation into mastectomy site. The umbilicus is then circumscribed and separated, but left attached to the linea alba by its stalk and the upper abdominal flap elevated above the rectus muscle sheath until the costal margin laterally and the xyphoid medially (Fig. 3). Two rows of perforators from the anterior rectus sheath are identified and will serve as a guide for the location of periumbilical perforators. The rectus sheath incisions are then marked and will continue until above the costal

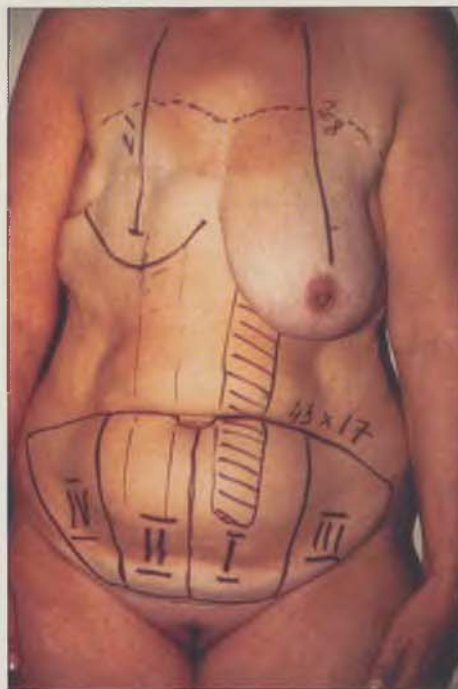


Fig. 1. Appropriate measures taken in standing position of the patient.



Fig. 2. Vertical laparotomy scar is the most often indication for delayed procedure.



Fig. 3. Upper abdominal flap elevated to the costal margins and xyphoid.

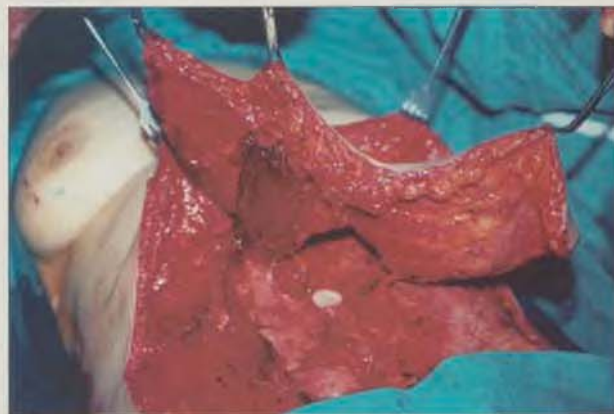


Fig. 4. The TRAM flap completely dissected and lifted upwards.



margin superiorly and inferiorly until the lower edge of the flap at the level of the linea arcuata. This segment of sheath to be included into the flap is usually 3 to 4 cm in width with two rows of perforators. Muscle splitting dissection is carried out bluntly from the umbilicus upwards to the costal margin and the origin of the rectus muscle. It is done along the posterior rectus sheath upwards and downwards by placing tension on the muscle, but the strip of the muscle 1–2 cm should be left intact laterally, although we most often include the whole width of the muscle leaving only the strip of the anterior rectus sheath to make the closure easier.

Now we turn attention to the lower part of the flap. The random side of the flap is elevated first above the anterior rectis fascia 1 cm beyond the midline, paying special attention to the periumbilical perforators. The pedicle side of the flap is elevated to the lateral edge of the rectus muscle where the fascia is incised and incision continued upwards including row of perforators. Medial fascial incision is usually done 1 cm from the midline, so 4–5 cm of fascia is included with the entire rectus muscle, and enough fascia left for the direct closure. The rectus abdominis muscle is then transected just below the semicircular line and the inferior epigastric pedicle ligated. To avoid the lower abdominal bulge at this point we use the remaining distal part of the muscle to cover the semicircular line which is the potential site of weakness because of the absence of the posterior sheath below. The whole flap is then gently lifted upwards to check the complete dissection route along the posterior rectus sheath (Fig. 4).

#### Mastectomy site dissection and flap transfer

The mastectomy scar is completely excised and dissection carried out upwards to the future limit of the upper pole of the breast and downwards to the future inframammary fold. The abdominal and chest wall dissections should never be connected except for the tunnel for passage of the flap. The tunnel should be wide enough to allow easy passage and to avoid any tension on the flap. Once the flap is transferred into the mastectomy site (Fig. 5) one should check again its viability due to excessive torsion or stretching and then continue with the molding of the breast. Zone IV is discarded, zone III deepithelialized and turned under to create ptotic



Fig. 5. The TRAM flap transferred into mastectomy site.

appearance and zones I and II left outside with additional trimming of the flap if necessary. Great care should be taken not to exceed the reliable limits of the vascular perfusion leaving too much tissue, because fat necrosis and even partial flap loss could occur. Usually the umbilical area of the flap is placed at the medial point of mastectomy scar to ensure more conical projection of the breast. The flap is supported in position with few external sutures fixed superiorly and medially. The nipple areola complex is reconstructed in the second stage; we prefer free nipple graft from the opposite side and areola tattoo or free perineal skin graft.

#### Abdominal wall closure

It is usually done by another team of surgeons, while the first team is molding the breast. Upper border of the rectus muscle is reattached to the semicircular line to strengthen this area



Fig. 6 and 7. Pre and postoperative view of the patient.

and prevent bulging or pseudohernia in the suprapubic region. Abdominal wall donor defect is then closed in two layers. First lateral and medial edges of anterior rectus sheath and preserved muscle are approximated and then external oblique fascia and muscle are separated from internal oblique on both sides and approximated to the midline fascia. Synthetic mesh can be used in cases of unusually tight repair or as a mesh overlay when bilateral reconstruction is done or double pedicle used. The umbilicus is placed in the new location in usual „V” or „Y” manner, the skin is closed in two layers and suction drainage placed bilaterally.

### Postoperative care

Routine use of intravenous fluids and antibiotics in the warm recovery room and in the semisitting position, oxygenation through a nasal catheter and permanent monitoring of the flap are essential. The flap is usually pale and a little cool at the beginning, but the color and warmth recuperate gradually if the blood pressure and venous drainage are normal. If not, early surgical exploration is indicated.

Generally speaking, in experienced hands very satisfactory results (Fig. 6 and 7) can be obtained using pedicled TRAM flap in a single operative procedure and with a long-term predictability.

### REFERENCES

1. BOHMERT, H., GABKA, C.J. *Plastic and reconstructive surgery of the breast*. Stuttgart, New York : Thieme, 1997.
2. BOSTWICK, J., III. *Plastic and reconstructive breast surgery*. St. Louis : Quality Medical Publishing, 1990.
3. HARTRAMPF, CF., SCHEFLAN, M., BLACK, PW. Breast reconstruction with a transverse abdominal island flap. *Plast. Reconstr. Surg.*, 1982, 69: 216.
4. HARTRAMPF, CR. *Breast reconstruction with living tissue*. New York : Raven Press, 1991.
5. KROLL, SS., NETSCHER, DT. Complications of TRAM flap breast reconstruction in obese patients. *Plast. Reconstr. Surg.*, 1989, 84: 886.
6. LEJOUR, M. Reconstruction of the breast with a contralateral epigastric rectus myocutaneous flap. *Chir. Plast.*, 1982, 6: 181.
7. MOON, HK., TAYLOR, GI. The vascular anatomy of the rectus abdominis musculocutaneous flaps based on the deep superior epigastric system. *Plast. Reconstr. Surg.*, 1988, 82: 815.
8. SCHEFLAN, M., DINNER, MI. The transverse abdominal island flap. Part I. Indications, contraindications, results and complications. *Ann. Plast. Surg.*, 1983, 10: 24.
9. SCHEFLAN, M., DINNER, MI. The transverse abdominal island flap. Part II. Surgical technique. *Ann. Plast. Surg.*, 1983, 10: 120.
10. SLAVIN, SA., GOLDWYN, RM. The midabdominal rectus abdominis myocutaneous flap: review of 236 flaps. *Plast. Reconstr. Surg.*, 1988, 81: 189.
11. VASCONEZ, LO., PSILLAKIS, J., JOHNSON-GIEBERK, R. Breast reconstruction with contralateral rectus abdominis myocutaneous flap. *Plast. Reconstr. Surg.*, 1983, 71: 668.
12. VASCONEZ, L., LEJOUR, M., GAMBOA-BADILLA, M. *Atlas of breast reconstruction*. Philadelphia : J. B. Lippincott, New York, London : Gower Medical Publishing, 1991.
13. WATTERSON, PA., BOSTWICK, J., III, HESTER, TR., jr., BRIED, JT., TAYLOR, GI. TRAM flap anatomy correlated with a 10-year clinical experience with 556 patients. *Plast. Reconstr. Surg.*, 1995, 95: 1185.

Address for correspondence:

Miodrag M. Colić  
Bul. Kralja Aleksandra 280  
11000 Belgrade  
Yugoslavia  
Tel. +381 11/340 8309  
Fax. +381 11/340 6434  
E-mail: drcolic@eunet.yu

## MICROSURGERY IN THE DIABETIC FOOT

*Dražan L.<sup>1</sup>, Veselý J.<sup>1</sup>, Leybold J.<sup>2</sup>, Julínek J.<sup>3</sup>, Lžičařová E.<sup>4</sup>*

<sup>1</sup>Clinic of Plastic and Aesthetic Surgery

<sup>2</sup>Second Surgical Clinic

<sup>3</sup>First Medical Clinic

<sup>4</sup>Institute of Pathological Anatomy

St. Ann University Hospital, Brno, Czech Republic

### SUMMARY

The treatment of serious tissue defects on the diabetic foot is complicated and tedious because of a combination of pathogenetic mechanisms that influence healing. Diabetic neuropathies (sensory, motor, vegetative), ischaemia and microangiopathies contribute in varying degrees to the adverse healing.

The submitted three-year prospective study was focused on an analysis of the pathogenetic factors with the objective of defining the indications for one of three types of microsurgical transfer: 1. a free flap sutured directly to the vessels at the site of the defect (in predominantly neuropathic defects); 2. a free flap sutured to a popliteo-pedal bypass (in predominantly ischaemic defects); 3. a „nourishing” flap sutured by means of a long venous graft to vessels of the medial and upper leg (in patients in whom an inadequate outflow tract does not make re-vascularisation possible).

In the first year of the investigation, thirteen patients were operated on by means of a free muscle flap incl. three „nourishing” and ten sutured at the site of the defect. Twelve flaps were flaped healed; one patient died from myocardial infarction on the second day after surgery.

### ZUSAMMENFASSUNG

#### Mikrochirurgie bei einem diabetischen Fuss

*Dražan L., Veselý J., Leybold J., Julínek J., Lžičařová E.*

Die Behandlung von schweren Defekten des Gewebes am diabetischen Fuss ist kompliziert und dauert lange wegen der Kombination von pathogenetischen Mechanismen, die die Behandlung beeinflussen. Die diabetische Neuropathie (sensitiv, motorische und vegetative), die Ischämie und die Mikroangiopathie beteiligen sich im verschiedenen Masse an der Heilung.

Die dreijährige prospektive Studie befasste sich mit der Analyse der pathogenetischen Faktoren mit dem Ziel der Indikation einer der drei folgenden mikrochirurgischen Verfahren: 1. direkt an den Ort des Defektes fixierter freier Lappen (überwiegend bei neuropathischen Defekten), 2. ein freier Lappen angenäht an ein Popliteo-pedal Bypass (überwiegend bei ischämischen Defekten), 3. ein versorgender freier Lappen angenäht mittels eines langen venösen Lappens an die Vene der mittleren oder oberen Etage des Schienbeins (bei Patienten, wo ein ungenügender Abfluss keine Revaskularisation ermöglicht).

Im ersten Jahr dieser Studie wurden 13 Patienten operiert mit der Methode der Freien Muskelübertragung. Drei Lappen waren ernährend und 10 Lappen wurden an den Ort des Defektes angenäht. Bei 12 Lappen folgte eine Heilung, ein Patient starb an ein Herzinfarkt am zweiten Tag nach Operation.

**Key words:** microsurgery, diabetic foot

Trophic defects on the feet of diabetic patients heal slowly and with difficulty and are always a potential risk for the development of gangrene and later the necessity to amputate below the knee. Until recently the solution of these defects was gradual debridement, conservative promotion of granulation tissue growth, promotion of epithelization and transplantation of thin skin grafts. Traditionally, the cause of impaired wound healing in diabetics was ascribed to affections of the small vessels. It was assumed that occlusion of arterioles caused pe-

ripheral tissue ischaemia, thus explaining the persistent ulceration on the foot in the close vicinity of well-pulsating peripheral arteries. This theory of the affection of the small vessels was accepted after the publication of the work of Gold-enberg et al. in 1959 (1) in which he examined tissue specimens from amputated diabetic feet. In the walls of arterioles beneath the intima, he found PAS (periodic acid-Schiff) positive substances and considered the latter specific for the lower extremities of diabetics.





Later studies summarized in LoGerfo's monograph of 1984 (2), however, did not confirm these assumptions, and transcutaneous assessment of partial oxygen pressure did not confirm that mainly occlusive disease of the small vessels is involved in diabetics (3). It was found that the larger vessels in the area of the leg play a greater part than occlusion of the minor arterioles (2).

At present, the main responsibility for the development of defects of the diabetic foot is ascribed to diabetic neuropathy and ischaemia as a consequence of atherosclerosis of the leg vessels (4-9, 11).

Diabetic neuropathy comprises three groups:

1. Motor neuropathy – which causes the development of paralysis of the minor muscles of the foot with subsequent changes in the position of joints, in particular the metatarsophalangeal (hyperextension) and proximal interphalangeal joints (flexion). This creates conditions for the development of pressure sores, most frequently above the head of the I<sup>st</sup> and V<sup>th</sup> metatarsal bones.
2. Sensory neuropathies – hypaesthesia to anaesthesia retards the defence reaction to foreign bodies in footwear, tight footwear or minor injuries. From a minor insult a major defect develops.
3. Visceral neuropathy – manifested by a paralysis of the sympathico-adrenergic regulation of the precapillary sphincter with subsequent opening of A-V shunts. The nutritive capillary bed is reduced and this can lead to poorer healing. The metabolic basis for visceral neuropathy is the absence or reduction of nerve growth factors.

**Objective of the current investigation:** to analyze the pathogenetic mechanisms and risk factors for the development of the diabetic foot and create an indication pattern for microsurgical

free tissue transfer to achieve results comparable with those in non-diabetic patients.

## MATERIAL AND METHOD

Patients with the following characteristics were included in the study:

1. the defect developed or persists in direct relation with the patient's diabetes;
2. the defect is at least 2x2 cm in size and resists common conservative treatment (debridement, epithelization, substances promoting growth of granulation tissue, split thickness skin graft);
3. on the floor of the defect, important structures are exposed (periosteum, bone, tendon, ligaments etc.).

Preoperative examination of the patient:

- by ultrasound – character of the pulse wave, ABI pressure indexes (ankle-brachial);
- examination of the skin sensitivity by means of a tuning fork, brush, and assessment of discriminating perception;
- examination by arteriography from the aortal bifurcation to the periphery of the lower extremity.

Examination of the patient during surgery: sampling and histological examination of the vessels of the pedicle of the flap and recipient vessels in order to assess the degree of atherosclerosis.

Examination after surgery:

- quantitative assessment of blood flow through the flap by a laser Doppler flowmeter, incl. monitoring of vasomotion;
- follow-up of healing of the defect.

Based on the ultrasonographic and angiographic examinations, we select one of the following three procedures:

1. Free muscle flap with a skin graft, sutured to vessels near the defect in patients without



Fig. 2. Patient No 1. Same defect after radical débridement.

Fig. 1. Patient No 1. Defect of right foot after repeated amputation and failing conservative treatment.



Fig. 3. Patient No 1. Three months after latissimus dorsi transfer. Anastomosis to dorsalis pedis vessel was performed.



Fig. 4. Patient No 2. Gangrene of left foot resulted in defect of soft tissue over the heel.



Fig. 5. Patient No 2. Four months after serratus ant. muscle transfer, anastomosis through venous graft to posterior tibial artery and vein was performed.



Fig. 6. Patient No 3 with severe atherosclerosis of large vessels. Below knee amputation on left extremity and transmetatarsal amputation on the right lower extremity resulted in chronic defect.



Fig. 7. Patient No 3 and his arteriography of his right foot showing insufficient outflow and impossible revascularisation by popliteo-pedal bypass.



Fig. 8. Patient No 3 and his vessels in middle leg suitable for microanastomosis.

- a marked ischaemic component, mostly neuropathic defects (patient 1, 2).
2. In case of ischaemia due to atherosclerosis of the leg vessels, and when the „outflow tract” in the periphery is satisfactory, revascularization by means of a venous popliteo-pedal bypass graft is indicated, either in situ or by a reverse graft from the saphenous vein. A free muscle flap is sutured end-to-side to a revascularizing graft.
  3. If revascularization cannot be implemented because the outflow tract is unsuitable, healing of the



Fig. 9, 10. Patient No 3 three months after „nourishing” latissimus dorsi muscle flap using 21 cm long vein graft to reach middle leg vessels.



foot by a so-called nourishing flap can be attempted. The muscular flap is connected by means of a long venous graft to the first suitable vessels in the leg (patient 3).

## RESULTS

In 1999, fifteen diabetic patients with defects suitable for microsurgical transplantation of a flap were examined. One patient did not attend the next session after the primary examination and after obtaining detailed information on the operation and later had the leg amputated. One patient was contraindicated on account of a critically ischaemic limb after repeated failed autologous and allogenic reconstructions of the vascular bed from the bifurcation of the aorta to the popliteal artery.

We operated on thirteen patients in whom we transferred eight latissimus dorsi muscles, three rectus abdominis muscles, one serratus anterior muscle, and one forearm flap. One patient died from myocardial infarction on the second day after surgery; in the remainder the flaps were integrated and the defects closed. Ten flaps were sutured to the vessel at the site of the defect, which was assessed as mainly neurotrophic; three flaps were of the „nourishing” type using a long venous graft connected to the medial portion of the leg. In these patients revascularization was not indicated due to advanced vascular changes of the ankles (unsuitable outflow tract).

In one instance we revised the pedicle of a flap due to venous thrombosis; eight flaps were skin transplanted secondarily, and in one instance resection of a drying-up superficial necrosis of the muscle and its skin transplantation were necessary. The mean period of hospitalisation was 36.5 days as compared with 21.5 days in similar transplantations on the lower extremity in non-diabetic patients.

## DISCUSSION

Patients included in the investigation had defects of the feet that developed in conjunction with diabetes mellitus. With regard to the character, size and previous resistance to conservative treatment, they were indicated for free tissue transfer. For evaluating the state of the vessels, arteriography was used in which occlusions and stenoses between the bifurcation and the ankles were evaluated (12, 13). The blood flow in the vessels was evaluated by Doppler ultrasound. For direct use we indicated as recipient vessels only those with a biphasic or triphasic curve or with a monophasic curve but a high slender peak. In some instances the shape of the curve did not correlate with the values of the assessed pressures, which were high due to the rigidity of the vascular wall as a result of sclerosis and medial calcinosis. In the majority of patients (11 of 13),

we observed during the surgery a more advanced sclerosis of the vessels of the lower extremity, i.e. on the recipient vessels, as compared with the vessels of the flap, i.e. vessels of the trunk. In one instance the atherosclerosis was equal and in one instance even more advanced on the vessels of the flap than in the area of the ankles.

In twelve patients we used muscular flaps to cover the defects, consistent with the general opinion that muscle, which is amply perfused tissue, can improve the blood supply of the surrounding tissue after integration. The view predominates that an integrated, well-consolidated muscle with a skin graft is more resistant in the area of the sole than a skin flap.

Due to the short postoperative follow-up period, it is not possible to express an opinion as to the contribution of this method from the aspect of long-term prevention of amputation. However, even our short-term follow-up indicates that the patient's motivation and his care of the healed foot is very important, similarly as is subsequent special prosthetic care (10). Suitable footwear that distributes the weight on the whole sole and selective relieves the overburdened sites prevents relapses and/or hastens dramatically the healing of incipient ulceration.

## CONCLUSION

Based on our short-term experience, we may offer the following conclusions:

- Defects on the feet of diabetic patients can be successfully healed by radical debridement and microsurgical transfer of muscular flaps.
- The main complicating factor of the diabetic foot is atherosclerosis of the popliteal vessels and vessels of the leg rather than microangiopathy.
- Arteriography and the shape of the pulse wave during ultrasonographic examination are the most important indicating factors for successful free flap transplantation.
- Collaboration of the vascular and plastic surgeon is the basis of progress in the treatment of complicated defects of the diabetic foot.

## REFERENCES

1. GOLDENBERG, S., et al. Nonatheromatous peripheral vascular disease of the lower extremity in diabetes mellitus. *Diabetes*, 1959, 8: 261.
2. LOGERFO, FW., COFFMAN, JD. Vascular and microvascular disease of the foot in diabetes. *N. Engl. J. Med.*, 1984, 311: 1615.
3. WYSS, CR., MATSEN, FA., SIMMONS, CW., et al. Transcutaneous oxygen tension measurements on limbs of diabetic and nondiabetic patients with peripheral vascular disease. *Surgery*, 1984, 95: 339.
4. SERLETTI, JM., DEUBER, MA., GUIDERA, PM., et al. Atherosclerosis of the Lower Extremity and Free-tissue Reconstruction of Limb Salvage. *Plast. Reconstr. Surg.*, 1995, 96: 1137.
5. ATIYEH, BS., SFEIR, RE., HUSSEIN, MM., et al. Preliminary Arteriovenous Fistula for Free Flap Reconstruc-



tion in the Diabetic Foot. *Plast. Reconstr. Surg.*, 1994, 95: 1063.

6. KARP, NS., KASABIAN, AK., SEIBERT, JW., et al. Microvascular Free-flap Salvage of the Diabetic Foot: A-5-Year Experience. *Plast. Reconstr. Surg.*, 1995, 94: 834.

7. ATTINGER, CE. *Foot and Ankle Preservation. Grabb and Smith's Plastic Surgery*. Fifth Edition, Philadelphia: Lippincott-Raven Publishers, 1997, 1959 p.

8. BARBER, CC., MCPHAIL, NV., SCOBIE, TK., et al. A prospective study of lower limb amputations. *Can. J. Surg.*, 1983, 26: 339-341.

9. BRIGGS, SE., BANIS, JC., Jr., KAEBNICK, H., et al. Distal revascularization and microvascular free tissue transfer: An alternative to amputation in ischemic lesions of the lower extremity. *J. Vasc. Surg.*, 1985, 2: 806-811.

10. RYSAVY, Z., et al. *Diabetická noha. Diagnostika a terapie v praxi*. Praha: Galén, 1998.

11. COLEN, LB. Limb salvage in the patient with severe peripheral vascular disease: The role of microsurgical free tissue transfer. *Plast. Reconstr. Surg.*, 1987, 79: 389-395.

12. SHESTAK, KC., FITZ, DC., NEWTON, ED., et al. Expanding horizons in treatment of severe peripheral vascular disease using microsurgical techniques. *Plast. Reconstr. Surg.*, 1990, 85: 406-411.

13. GREENWALD, LL., COMEROTA, AJ., MITRA, A., et al. Free vascularized tissue transfer for limb salvage in peripheral vascular disease. *Ann. Vasc. Surg.*, 1990, 4: 244-254.

**This study was financially supported by Internal Grant Agency of the Ministry of Health Care, Grant No. ND 5219-3.**

*Address for correspondence:*

Luboš Dražan  
Clinic of Plastic and Aesthetic Surgery  
Berkova 34  
612 00 Brno  
Czech Republic  
e-mail: ldrazan@med.muni.cz

---

### List of journals concerning the discipline available in the National Medical Library, Prague, in 2001:

American Journal of Surgery (New York)  
Annals of Surgical Oncology (Philadelphia)  
British Journal of Oral and Maxillofacial Surgery (London)  
British Journal of Plastic Surgery (Edinburgh)  
Clinics in Plastic Surgery (Philadelphia)  
Dermatologic Surgery (New York)  
Handchirurgie, Mikrochirurgie, Plastische Chirurgie (Stuttgart)  
Journal of Oral and Maxillofacial Surgery (Chicago)  
Lasers in Surgery and Medicine (New York)  
New England Journal of Medicine (Boston)  
Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontics (St. Louis)  
(online)  
Plastic and Reconstructive Surgery (Baltimore)

## REPORT ON CONGRESS

On September 28–30, 2000, a conference entitled Joint Meetings State of the Art Symposium Skin Substitutes: Quality and Standards of the European Burns Association (E.B.A.) and the 5th Central European Burn Conference were held in Brno. This conference is convened every year within the framework of the E.B.A. The opening ceremony was followed by awarding the Honor Membership of the Czech Burn Society to some internationally important and active members of the E. B. A.: David P. Mackie, Johannes C. Bruck, Ján Koller and Ján Babík. The scientific program of the Symposium was focused on the subject of thermal injuries in children, adult patients and geriatric patients, incl. electrical injuries. The single stages of burns disease were evaluated in detail and supplemented by new findings.

On the subsequent two days the lectures were devoted to the subject of skin substitutes, new possibilities for the replacement of the epidermis and dermis, and the use of different components and combinations in extensive thermal injuries.

During the Congress a session of the European Tissue Bank Association was also held. The Conference was attended by 90 guests from abroad, most of whom presented papers. There

were 30 Congress participants from the Czech Republic. During the Congress 17 firms had exhibitions of their products.

The total number of lectures presented during the Congress was 76. The most interesting lectures from abroad included, e.g., papers read by Dr. Sheridan and Dr. Schermer from the USA, Dr. Horsch, Dr. von Donnersmarck and Dr. Bruck from the FRG, Dr. Koller from Austria, Dr. Barisoni from Italy, Dr. Latarjet from France, and Dr. Bábík and Dr. Koller from the Slovak Republic. As to Czech participants at the Congress, Prof. Königová and assoc. Prof. Brychta presented their experience. Within the framework of the Congress the general meeting of the European Burn Association was also held. Assoc. Prof. Pavel Brychta, Ph.D., was elected a member of the Skin Substitute Committee EBA (European Burn Association) and chairman of the Skin Council EATB (European Association Tissue Banks). Apart from lectures and discussions during the Congress, the participants had the opportunity to exchange experiences at a social event held in Židlochovice castle. Guests from abroad appreciated the excellent organization of the Congress as well as the presented papers.

*Pavel Brychta, Radana Königová*

## TRAUMATIC SKIN LOSS FROM THE MALE GENITALIA

*Hrbatý J., Molitor M.*

Clinic of Plastic and Aesthetic Surgery, St. Ann University Hospital,  
Brno, Czech Republic

### SUMMARY

The authors present the case-report of a 35-year-old patient with traumatic losses of the scrotum and penis. For acute and final treatment, they used a free transfer of a fasciocutaneous flap. They selected a sensitive Chinese flap for reconstruction of the scrotum; the penis was treated by transplantation using dermoepidermal grafts. The patient recovered without major complications. In the authors' opinion, the advantage of this method, as compared with other methods, is the almost normal appearance of the scrotum and the normal physiological site of the testes. Sexual intercourse was resumed after less than four months.

### ZUSAMMENFASSUNG

#### Verlust der äussere Männerreschlechtsorgane als die Folge der Verwundung

*Hrbatý J., Molitor M.*

Autoren die Kasuistik des 35jährigen Patienten mit dem Verlust an Verwundung des Hodensacks und des Penis präsentieren. Für die akute und gleichzeitig endgültige ärztliche Behandlung haben sie die frei Übertragung des fasciocutaneus Lappens angewandt. Die Rekonstruktion des Hodensacks wurde mit der Hilfe des sensitiv chinesisches Lappens gemacht, das Penis wurde mit der Hautspaltbedeckdt. Der Patient ohne bedeutsame Komplikationen abheilen war. Vorzug der angewandte Methode die Autoren nicht nur in fast normales Aussehen des Hodensacks, aber auch in physiologischer Ablagerung des Hoden hervorheben. Die Rückkehr zum sexuelle Zusammenleben ist nach unvollendete 4 Monate weldet.

**Key words:** male genitalia, injury, skin loss, reconstruction

The authors present the case-report of a man, age 35 years, who suffered avulsion of the skin cover of the genitalia. The injury on February 28, 2000 occurred when his overalls were caught in the shaft of the rear wheel of a tractor. The injury involved scalping of the skin of the penis and the

loss of the scrotal skin including the cover of the testes. The testes lacked visible signs of impaired vascularization. Primary treatment was provided at the surgical department where the wound was only provided with a sterile dressing, and from there he was referred to our Clinic for further



Fig. 1. Status on admission.

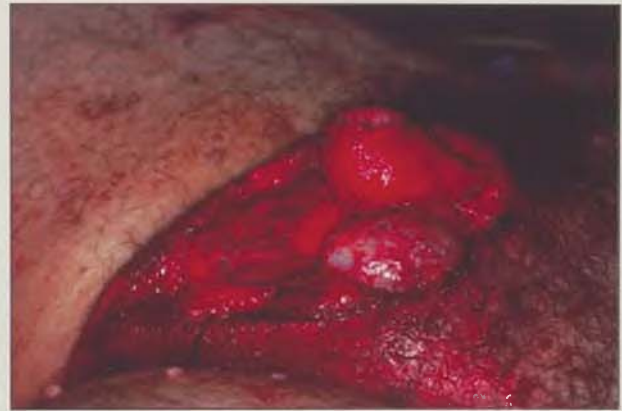


Fig. 2. Detail of the condition.





Fig. 3. Status on admission.



Fig. 5.



Fig. 4. Design of Chinese flap.



Fig. 6.

specific treatment. On admission the patient was in a state of cardiopulmonary compensation; the wounds did not bleed (Figs 1-3).

### METHOD

There were two possibilities for specific treatment. The first was to close the wound by direct suture with the testes sutured into the subcutaneous layer in the region of the perineum and to use a dermoepidermal graft for covering the loss of penile skin. We selected the second possibility in order to restore the normal position of the testes in the scrotum. To replace the skin cover we used a free fasciocutaneous flap from the left forearm, a „Chinese flap”, which seemed most suitable also with regard to its sensitivity.

First we revised the injury proper, made the necessary débridement to macroscopically sound tissues. The corpora cavernosa were examined to rule out their possible injury, and without difficulty a balloon urinary catheter ch. 18 was inserted to rule out serious injury of the urethra. Furthermore, we tested the vitality of the testes, ruled out torsion of supplying arteries and made a preliminary suture of the remaining covers of the testes. Before the subsequent reconstruction operation, we ensured careful haemostasis to prevent the development of an extensive haematoma. The reconstruction proper was started by



Fig. 7

Fig. 5-7. Condition after reconstruction.

dissecting the vessels vasa epigastrica inferior profunda dx and the sensory nerve n. ilioinguinalis from an incision above the hairy portion (Pfannenstiel).

Subsequently, we took a „Chinese flap” from the left forearm (Fig. 4) including the sensory n. cutaneus antebrachii lat. from the n. musculocutaneus. The vascular stalk of the flap was passed through a subcutaneous tunnel around the root of the penis from the right side. The vasa epigastrica were dissected to the umbilical level and subsequently ligatured. The peripheral stump was moved in a caudal direction. With regard to the inadequate length of the stalk of the flap, it



Fig. 8. Prior to discharge.



Fig. 9. Condition seven weeks postoperatively.



Fig. 10-11. Seven weeks postoperative.



was necessary to bridge the defect of the artery and vein by venous grafts. The latter were taken from branches of the v. saphena magna of the

right lower extremity in the region of the dorsum of the foot. The radial artery of the flap was sutured end-to-end, followed by end-to-end suture of the dominant concomitant vein of the flap to the corresponding recipient vein. The n. cutaneus antebrachii of the lat. flap was sutured to the right-side ilioinguinal nerve. The testes in the neoscrotum were fixed by several chromic catgut stitches to prevent possible torsion (Figs 5-7).

Finally we modelled the flap into a shape resembling that of the scrotum. The skin loss of the penis was resolved by a dermoepidermal graft from the thigh of the left lower extremity; the transplants were sutured into a spiral by catgut stitches without compression. Compression was substituted by tension of the transplants on the convex surface of the penis.

Subsequently we covered the secondary defect of the left forearm by a dermoepidermal graft using compression. Fixation was by means of a dorsal plaster splint. Finally, after a check of the vascular stalk of the flap, the so-called „last look”, we sutured the fascia, subcutaneous layer and skin of the abdominal wall. Redon suction into the neoscrotum from the left, and into the subcutaneous layer of the abdominal wall.

The following treatment was administered: Oxacillin 4x1.0 g for 9 days, Gentamycin 3x80 mg for 6 days, rheodextran infusion 4 days - 20 ml per hour. For a period of 10 days, anopyrine was administered, 2x1/2, curantyl 4x1 for 4 days, then 3x1. The urinary catheter was removed after 8 days; after 10 days both Redon drains

were removed (Fig. 8). The postoperative course was complicated locally only by small necroses of the graft on the forearm and exceptionally on the



Fig. 12. Three months after surgery.



Fig. 13. Donor site three months after surgery.



penis. The patient was discharged into home care on March 17, 2000, i.e. after 18 days in hospital. He recovered completely within 6 weeks, incl. the mentioned necroses (Fig. 9).

## RESULTS

The patient resumed sexual activity 2 months after the injury; at first he reported painful erections and pain during coitus. After another month the patient no longer had unpleasant sensations during sexual intercourse. His condition at the end of May is shown in Figures 10–13. Half a year after the accident the patient reports activities and subjective sensations comparable with his state before the injury. The data were also confirmed by his partner. These data are not necessarily quite relevant.

The patient was offered a further modelling of the flap after half a year. At present the patient refuses as he is quite satisfied with the result of the reconstruction from the cosmetic as well as functional aspect. The function of the left arm is not restricted after collection of the graft. The patient has no objections to the scars on the left forearm.

## DISCUSSION

The reason for the described, relatively demanding reconstruction was not only to recon-

struct the scrotum from a „cosmetic” aspect, but also because it was necessary to replace the testes to match the condition before the injury. From this aspect, microsurgery offered a unique opportunity to treat the loss. We feel that despite the demanding character of the described method, the provided treatment of the injury is optimal.

## REFERENCES

1. FROHLICH, G., STRATMEYER, R. Die Rekonstruktion des Skrotums mittels Hautexpander. *Der Urologe*, 1994, 33: 159-162.
2. HODONOU, RK., DIALLO, A., AKPO, EC., KOURA, A., HOUNASSO, PP., GOUDOTE, E. Traumatismes des organes genitaux externes masculins. *Ann. Urol.*, 1997, 31: 318-321.
3. HORTON, CE., DEAN, JA. Reconstruction of traumatically acquired defects of the phallus. *World J. Surg.*, 1990, 14: 757-762.
4. McAninch, JW. Management of genital skin loss. *Urol. Clin. N. Amer.*, 1989, 16: 387-397.
5. SONDA, LP., WANG, S. Evaluation of male external genital diseases in the emergency room setting. *Emer. Med. Clin. N. Amer.*, 1988, 6: 473-486.

Address for correspondence:

Josef Hrbatý  
Dept. of Plastic and Aesthetic Surgery  
Berkova 34  
612 00 Brno  
Czech Republic  
e-mail: jhrbaty@iol.cz



## TREATMENT BY CONTINUOUS RENAL REPLACEMENT THERAPY IN PATIENTS WITH BURN INJURIES

Hladík M.<sup>2</sup>, Tymonová J.<sup>1</sup>, Zaoral T.<sup>2</sup>, Kadlčík M.<sup>1</sup>, Adámková M.<sup>1</sup>

<sup>1</sup>Burn Centre and <sup>2</sup>Centre for Child Dialysis and Nephrology,  
University Hospital Ostrava, Czech Republic

### SUMMARY

Continuous renal replacement therapy (CRRT) is a relatively new therapeutic procedure which helps in the treatment of critically ill patients with renal failure as well as those without renal failure. CRRT effectively removes urea and creatinine and maintains a balanced milieu interieur and water balance. A role in the elimination of pro-inflammatory cytokines is also ascribed to this method. Most frequently venovenous haemofiltration and venovenous haemodiafiltration are used. The authors present their experience with the CRRT treatment of 40 patients in the Burn Centre Ostrava and with the results attained.

### ZUSAMMENFASSUNG

#### Die Behandlung mithilfe der kontinuierlichen Eliminationsmethoden bei Patienten mit Verbrennungstrauma

Hladík M., Tymonová J., Zaoral T., Kadlčík M., Adámková M.

Die kontinuierlichen Eliminationsmethoden (continuous renal replacement therapy – CCRT) stellen ein ziemlich neues Behandlungsverfahren dar, das in der Behandlung bei kritisch Erkrankten mit oder ohne Nierenversagen hilft. Das CCRT beseitigt wirksam Urea und Kreatinin, erhält eine ausgeglichene innere Umwelt und Wasserbilanz. Der CCRT wird auch die Rolle bei Elimination der entzündlichen Cytokinen anerkannt. Am meisten wird die venovenöse Hemofiltration und venovenöse Hemodiafiltration benutzt.

Die Autoren führen seine Erfahrungen mit Behandlung von 40 Patienten mithilfe der CCRT am Verbrennungszentrum in Ostrava und seine Ergebnisse ein.

**Key words:** continuous renal replacement therapy, renal and non-renal indications, systemic inflammatory response

The continuous development of medicine makes possible ever newer therapeutic and diagnostic procedures. Areas that develop very dynamically also include the treatment of critical conditions, concerned with the treatment of patients affected with multiple organ dysfunction syndrome (MODS) or their failure – multiple organ failure (MOF). Several medical disciplines participate in the solution of this problem in patients who are in serious or critical condition, in particular the disciplines of intensive care, surgery, nephrology, microbiology, radiology, biochemistry, immunology, haematology, and others, if necessary.

For a long time nephrologists were not included among the specialists engaged in problems of critical conditions. Till recently they were able to offer, when renal replacement therapy was necessary, only classical intermittent haemodialysis. During the last two decades, based on findings of changes that develop in severely afflicted patients, the sub-discipline, critical care nephrology, developed. The basic therapeutic procedure

in this sphere is continuous renal replacement therapy (CRRT).

The history of CRRT is relatively short. Its beginning was in 1977 when Kramer, while introducing a catheter into the femoral vein before haemodialysis, accidentally inserted the catheter into the femoral artery. He realized the possibility of using the arteriovenous gradient for filtration of blood and fluid elimination. He replaced the excessive losses by continuous infusion of substituting solutions. He used for the method the term continuous arteriovenous haemofiltration (CAVH). This was the first step in CRRT.

#### Principle of action of CRRT and its implementation

The basic principle of action of CRRT is the elimination of inflammatory mediators, urea, creatinine and uraemic toxins from the organism. At the same time it makes possible the maintenance of a stable milieu intérieur and water balance. It makes use of four physical principles: ultrafiltration, convection, diffusion and adsorption.

Inflammatory mediators (cytokines, thromboxane A<sub>2</sub>, leukotrienes and prostaglandins) serve as regulatory agents of the defense response of the organism. They influence the growth, differentiation and mobility of immune cells and act directly on the causal, most frequently bacterial, agent. They function thus as activating and defense factors of inflammation and have the main role in localizing the inflammation and its elimination. They thus create conditions for repair of the affected organ. If, however, the inflammatory mediators extend beyond the focus (in the case of extensive multiple injuries, burns or septicæmia), generalization of the inflammatory response occurs, manifested clinically (hyperpyrexia, destabilization of the circulation, procoagulation activity, development of DIC, ARDS, renal and hepatic failure) and by laboratory indicators (leucocytosis, high CRP, high lactate, decline of albumin, decline of AT III, thrombocytopenia, acidosis, changes of biochemical parameters of the function of different organs). Generalization of the inflammatory response thus leads to the systemic inflammatory response syndrome – SIRS. Its consequence is usually MODS or possibly MOF.

CRRT has the capacity to eliminate inflammatory mediators, depending on the type of filter used, up to 30 000–50 000 daltons (D). The basic mediators and their molecular weights are given in Table 1.

Table 1. Some mediators of SIRS/septicæmia

Mediator	Molecular weight (D)
Thromboxane A <sub>2</sub>	352
PAF	524
Leukotrienes	600
Complement 3a	10 000
Complement 5a	11 200
Interleukin 1, 2	15 000
Tumor necrosis factor alpha	17 000
Interleukin 6	25 000
Endotoxin	100 000

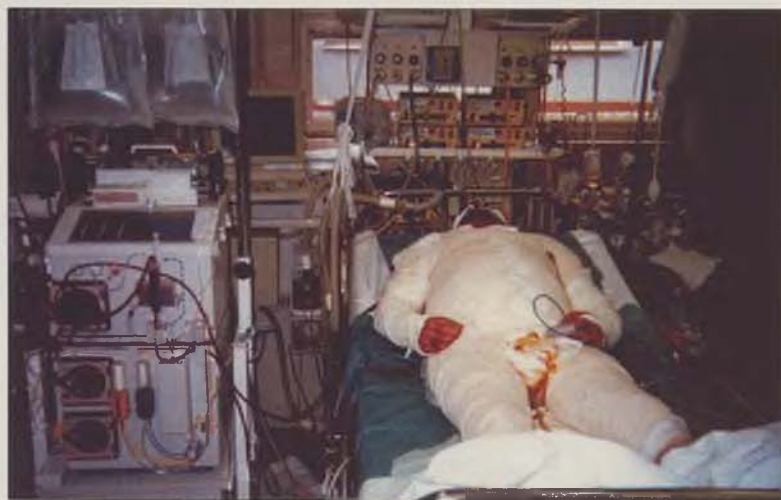


Fig. 1. Treatment of a patient in critical condition with burns.

To ensure adequate elimination of these mediators, urea and creatinine in the CRRT filtration system, the patient must be rinsed by at least 1.5–2 litres of substitution solution/1.73 m<sup>2</sup>/hour. The composition of the solution depends on the state of the milieu intérieur of the patient. Presently, arteriovenous methods, in which the heart is driven by an extracorporeal system, are practically not used. Almost exclusively venovenous methods are used with pumps with a venous access by means of double-lumen catheters.

A basic and complex problem of CRRT is the use of anticoagulation to maintain a functional extracorporeal system. So far there is no fully biocompatible material for extracorporeal circulation that does not induce blood coagulation and the formation of inflammatory mediators during the procedure. In order to prevent this undesirable phenomenon, depending on the patient's status and his coagulation status, several anticoagulation methods are used: a) anticoagulation by non-fractionated heparin (UFH), b) anticoagulation by low-molecular heparin (LMWH) and c) citrate anticoagulation by means of 4% sodium citrate.

#### The most frequent modifications of CRRT

At present, venovenous continuous elimination methods are used almost exclusively. The most frequently used method is continuous venovenous haemofiltration (CVVH), in which the patient is rinsed with a substitution solution. This method is based on the physical principle of convection. While diuresis is maintained, the amount of supplied solution is equal to the amount of filtered liquid. If the patient does not pass urine, the system makes it possible to maintain the balance of the patient by filtering a larger volume of fluid than the volume of supplied solution.

Another continuous method is continuous venovenous haemodiafiltration (CVVHDF). The method is based on the principle of convection supplemented by diffusion known from classical haemodialysis. CVVHDF is used in case if CVVH is not sufficient for maintaining urea and creatinine levels. The diffusion rate in CVVHDF is, however, many times lower than in classical intermittent haemodialysis, and thus the patient does not run the danger of disequilibrium syndrome due to sudden and rapid changes of the milieu intérieur. This method imitates very well the external excretory renal function.

#### Indications of CRRT

During SIRS a modification of MODS and MOF develops and within their framework the kidney may or may not be affected. Also, in conditions without renal affection,



CRRT is fully indicated for eliminating inflammatory mediators that damage other organs. Therefore, the indications for CRRT are divided into renal and non-renal. In MODS with renal failure, both indications are interconnected.

### Renal indications

They are obvious from the term. The main indication is oliguric renal failure, in which it is possible to eliminate by CRRT fluid in renal hyperhydration and create more space for parenteral nutrition and drug administration. Balancing takes place as required evenly throughout 4 hours. At the same time a stable milieu intérieur is maintained and urea, creatinine, uraemic toxins and cytokines are eliminated evenly.

### Non-renal indications

This group comprises:

- congestive heart failure not responding to diuretics
- patients with sepsis, septic shock with MODS and MOF
- patients with progressing SIRS before development of MODS and MOF
- some intoxications
- refractory shifts of the milieu intérieur (ions, ABR)
- ARDS (adult respiratory distress syndrome)
- refractory hyperpyrexia
- prevention of the tumour-lysis syndrome

### Disadvantages and complications of CRRT

In the indications for CRRT in critically ill patients, contraindications are not considered because methods are involved that can revert fatal disease. Before they are applied, however, it is necessary to consider and minimize possible disadvantages and complications:

- long-term interactions between blood and the membrane employed, with possible manifestations ensuing from material incompatibility
- removal of substrate by filtration (glucose, amino acids)
- risk of haemorrhage during long-term anticoagulation, risk of heparin use (thrombocytopenia, hypercholesterolaemia)
- loss of heat due to extracorporeal system
- complications associated with insertion of central venous catheter
- high price of materials

## MATERIALS AND METHODS

From June 1996 till April 2000, the authors treated, using CRRT, 40 patients of the Burn Centre of the Faculty Hospital in Ostrava hospitalized in the intensive care unit. Age of patients in this group was 18–72 years, mean 47.2. The reason for admission was in all instances grade III burns covering 9 to 87 % of the body surface. In 16 patients (40 %) burns of the airways were also involved. Twenty-two patients (55 %) developed shock, which was in the majority of cases associated with sepsis and concurrent, otherwise refractory, hyperpyrexia and circulatory failure.

Ten patients (25 %) developed renal failure, 30 patients (75 %) were treated due to non-renal indications.

Patients who developed renal failure were first treated by intermittent haemodialysis. During onset of oliguria, CVVH and CVVHDF were started.

As to venous approaches, the authors used the right internal jugular vein eight times, four times the left internal jugular vein, ten times the right subclavian vein and eighteen times the femoral vein. Selection of the vascular approach was limited by the site of the burns. The authors used double-lumen catheters GamCath (Joka GmbH, Hechingen, Germany) with a diameter of 11 F and a length of 15 and 25 cm.

CVVH is implemented on an ADM 08 apparatus from the Fresenius Co., and for CVVHDF a Prisma Hospital apparatus is used. In CVVH on a ADM 08 apparatus, high-flux polysulphone capillaries are used and for the Prisma Hospital apparatus high-flux polyacrylonitrile AN 69 is, however considered a better elimination medium with greater biocompatibility. It is, however, also considerably more expensive. During the procedure we prefer predilution connection of the substitution solution and thus replace the filtered-off amount of fluid by supplying the substitution solution before the capillary. This prolongs the service life of the filter, but to a certain extent the effectiveness of haemofiltration is reduced. As the substitution and dialysis solution, Medisol is used, produced by Medites Pharma (Rožnov pod Radhoštěm, CR). The composition is given in Table 2.

The type of solution was selected with regard to laboratory results, in particular the potassium

Table 2. Composition of substitution and dialysis solution Medisol

Name	Na mmol/l	Cl mmol/l	Ca mmol/l	Mg mmol/l	K mmol/l	Lactate mmol/l	Glucose g/l	Osmolality mosmol/l
M 0	140	106.5	1.5	0.75	0	40	1	295
M 02	140	106.5	1.5	0.75	2	40	1	296
M 04	140	106.5	1.5	0.75	4	40	1	297



blood level. Lactate serves as an alkalinization substitution in these solutions, and is transformed in the liver into bicarbonate. Therefore, patients with hepatic insufficiency or failure were given as substitution and dialysis solution saline or Ringer's solution and metabolic acidosis was corrected by bicarbonate.

The period of treatment by CRRT varied from 48 to 408 hours. The haemofilter was changed once in 24 to 48 hours. As an anticoagulant for the extracorporeal system, non-fractionated heparin was used in 12 patients, in 27 patients low-molecular heparin (Clexane) and in one patient citrate. The rate of the blood pump varied from 100 to 130 ml/min. The volume of the substitution solution was maintained at 1500–2000 ml/l. 73 m<sup>2</sup>/h. The volume of ultrafiltration was adjusted according to the hydration state of the patient, values of the central venous pressure, the amount of administered crystalloids and nutritive solutions and losses by diuresis, catheters and perspiration. During the procedure the haemogram, thrombocytes, ionogram, ALT, AST, urea, creatinine and ABB were checked at 6–12-hour intervals. As to haemocoagulation examinations, at the mentioned intervals the following were performed: Quick's test, APTT, and thrombin time. Once a day fibrinogen was examined and as necessary the activity of antithrombin III.

From the total number of treated patients, 12 (30 %) survived and 28 (70 %) died. In three patients with an unstable circulation, CVVH was performed during extensive necrectomy and application of a xenotransplant. The large-volume haemofiltration stabilized the patients and made undisturbed general anaesthesia possible and reduced the risk of the procedure.

## DISCUSSION AND CONCLUSION

The hitherto widespread use of intermittent dialysis in patients in critical condition has revealed a number of pitfalls. They include circulatory instability and a marked drop in blood pressure during the procedure. This is due in particular to the elimination of a large volume of fluid during a brief time, but in hypotension the bicarbonate component of the dialysis solution also participates as well as the inadequate elimination of inflammatory mediators.

During intermittent haemodialysis, a rapid drop of intravascular urea occurs and after the procedure a shift of urea, depending on the concentration gradient, from extravascular spaces into the blood vessels. Therefore rapid re-equilibration occurs, and it is necessary to repeat haemodialysis as frequently as twice a day. Belomo and Ronco compared two groups of critically ill patients with acute renal failure. The first group, which they treated by intermittent haemodialysis, had a median urea level of 35 mmol/l, while the group treated by CVVH had a median urea level of 23.4 mmol/l. To achieve

the same result, daily seven-hour haemodialysis would be necessary involving the risk of marked variability of the osmolality of the serum, a considerable drop of urea during the procedure and its subsequent rise.

Multiorgan failure involves a great risk for the patient. With failure of two organ systems the lethality is 30–40 %, with failure of three systems it is 60–70 %, and with failure of four systems 80–100 % of patients die. According to available data, CRRT reduces the mortality by 18 % to 28 %.

CRRT makes a controlled fluid balance possible, which may have a decisive effect on the improvement of a number of critical conditions. According to data in the literature and the authors' experience, a marked regression of pulmonary oedema and acute respiratory distress syndrome occurred in MODS/MOF during septic conditions. Standard intermittent haemodialysis is in these instances less effective due to its short-term action. The authors observed repeatedly, when attempting to eliminate a major volume of fluid by intermittent haemodialysis in oliganuric patients, severe hypotension that did not develop during CRRT. When ultrafiltration is discontinued during intermittent haemodialysis, an adequate amount of fluid is not eliminated and further infusion treatment leads to hyperhydration of the patient.

CRRT also make an adequate supply of nutrients possible by creating space for a greater turnover of protein nitrogen. An adequate protein supply (1.5–2 g/kg/day) has a favourable effect on the general condition of critically ill subjects, in particular by invigorating the respiratory muscles, and it promotes cell regeneration of renal tissue.

The results obtained in large groups confirmed that during properly conducted CRRT, disequilibrium syndrome does not develop. In the group treated by the authors, disequilibrium syndrome was not manifested clinically in any patient and a possible risk of its development was not found in laboratory examinations.

Nephrologists and specialists in intensive care agree that CRRT has a positive effect on the condition of critically ill patients. A controversial point remains the elimination of cytokines and the possible favourable consequences when they are eliminated from the circulation. With regard to the permeability of haemofilters, interleukins 1 and 2 and platelet activating factor should be eliminated directly and interleukin 6, tumour necrosis factor and endotoxins by adsorption onto the surface of the material of the haemofilter. So far there is no uniform view on their elimination by CRRT, and some authors have doubts about the elimination of mediators. At present two multicentre prospective studies are underway that should contribute towards the elucidation of these controversial problems.

## REFERENCES

1. BELLOMO, R., FARMER, M., WRIGHT, C., PARKIN, G., BOYCE, N. Treatment of sepsis-associated severe acute renal failure with continuous hemodiafiltration: clinical experience and comparison with conventional dialysis. *Blood Purif.*, 1975, 13: 246-254.
2. BELLOMO, R., TIPPING, P., BOYCE, N. Continuous veno-venous hemofiltration with dialysis removes cytokines from the circulation of septic patients. *Crit. Care Med.*, 1993, 21: 552-556.
3. BHANDARI, S., TURNEY, JH. Survivors of acute renal failure who do not recover function. *Q. J. Med.*, 1996, 89: 418-421.
4. CALANDRA, T., BAUMGARTNER, JD., GRAU, GE., WU, MM., LAMBERT, PH., SCHELLEKENS, J., VERHOEF, J., GLAUSER, MP. Prognosis values of tumor necrosis factor, interferon alfa and interferon gamma in the serum of patients with septic shock. *J. Inf. Dis.*, 1990, 161: 982-987.
5. DE VRIESE, AS., VANHOLDER, RC., PASCUAL, M., LAMEIRE, NH., COLARDYN, FA. Can inflammatory cytokines be removed efficiently by continuous renal replacement therapies? *Intens. Care Med.*, 1999, 25: 903-910.
6. FRANKENFIELD, DC., REYNOLDS, HN., WILLES, CE., BADELLINO, MM., SIEGEL, JN. Urea removing during Continuous hemofiltration. *Crit. Care Med.*, 1994, 22: 407-412.
7. GARZIA, F., TODOR, R., SCALEA, T. Continuous arteriovenous hemofiltration countercurrent dialysis (CAVH-D) in acute respiratory failure (ARDS). *J. Trauma*, 1984, 31: 1277-1285.
8. GULY, UM., TURNEY, JH. Posttraumatic acute renal failure. *Clin. Nephrol.*, 1990, 34: 281-284.
9. HLADÍK, M. Rhabdomyolysis and its treatment from the aspect of the nephrologist (in Czech). *Úraz. Chir.*, 1999, 7: 22-27.
10. HLADÍK, M., ZAORAL, T. Continuous venovenous haemofiltration in children (in Czech). *Čs. Pediat.*, 1998, 53: 459-464.
11. JOCHIMSEN, F., SCHAFFER, JH., MAURERE, A., DISTLER, A. Impairment of renal function in medical intensive care. *Crit. Care Med.*, 1990, 18: 480-485.
12. JOURNOIS, D., CHANU, D., DAFRAN, D. Pump-driven haemofiltration. *Lancet*, 1991, 337: 985.
13. KAPLAN, AA. Extracorporeal blood purification in the treatment of acute renal failure with multiorgan involvement. *Blood Purif.*, 1996, 14: 86-93.
14. KODAMA, M., TANI, T., HANASAWA, K. Treatment of sepsis by plasma endotoxin removal. *J. Endotoxin Res.*, 1997, 4: 293-300.
15. MCDONALD, BR., MEHTA, RL. Decreased mortality in patients with acute renal failure undergoing continuous arteriovenous hemodialysis. *Contrib. Nephrol.*, 1991, 93: 1-12.
16. PARILLO, JE. Pathogenetic mechanism of septic shock. *N. Engl. J. Med.*, 1995, 328: 1471-1477.
17. RONCO, C., BELLOMO, R. *Critical Care Nephrology*. Dordrecht, Boston, London : Kluwer Academic Publishers, 1998, 1590 p.
18. SIEBERTH, HG., STUMMVOLL, HK., KIERDORF, H. *Continuous extracorporeal treatment in multiple organ dysfunction syndrome*. Basel : Karger, 1995, 187 p.

Address for correspondence:

J. Tymonová  
Burn Center  
17. listopadu 1790  
708 52 Ostrava  
Czech Republic

## List of journals with the highest impact factor:

New England Journal of Medicine (Boston)	28.857
Annals of Surgical Oncology (Philadelphia)	02.427
Dermatologic Surgery (New York)	02.279
Lasers in Surgery and Medicine (New York)	02.230
American Journal of Surgery (New York)	01.721
Plastic and Reconstructive Surgery (Baltimore)	01.482
Laser Med Sci	01.000
Cleft Palate-Craniofac Journal	00.994
Clinics in Plastic Surgery (Philadelphia)	00.981
Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontics (St. Louis)	00.908
British Journal of Plastic Surgery (Edinburgh)	00.826

## TREATMENT OF ATROPHIC SCARS WITH Er:YAG LASER: OUR EXPERIENCE

Mezzana P., Sonnino M., Madonna Terracina F. S., Valeriani M.

Operative Unit of Plastic Surgery, S. Filippo Neri Hospital,  
Rome, Italy

### SUMMARY

Laser resurfacing is a new method to treat atrophic scars. The pulsed erbium YAG laser has been shown to be effective in the treatment of this variations of the skin texture secondary to a lot of conditions. Er:YAG laser allows precise epidermal ablation with minimal thermal injury to surrounding tissues. The goal of this study was to evaluate the effectiveness of the Er:YAG laser in the treatment of atrophic scars with multiple applications.

In agreement with previously reported studies our results show that multiple treatments with erbium YAG laser are safe and effective to improve atrophic scars.

### ZUSAMMENFASSUNG

#### Ärztliche Behandlung der atrophische Narben mit dem Er:YAG Laser: unsere Erfahrungen

Mezzana P., Sonnino M., Madonna Terracina F. S., Valeriani M.

Behandlung der Hautoberfläche mit der Hilfe des Lasers die neue Methode der ärztliche Behandlung der atrophischen Narben ist. Bei der Behandlung diese Variante der Hautbeschädigung, welche sekundärer Nachwirkung der dichte Reihe der Umstände ist, das pulser Er:YAG Laser ist gebraucht.

Er:YAG Laser ermöglicht präzise Verwischung der epidermale Narben mit der minimale Warmbeschädigung der umliegende Gewebe. Ziel der vorgelegte Studie die Auswertung der Effektivität des Er:YAG Lasers in der ärztliche Behandlung der atrophischen Narben mit repetierenden Applicationen war.

In Übereinstimmung mit früher publizierten Studien unsere Ergebnisse die Sicherheit und die Effektivität der ärztlichen erbium YAG Laserbehandlung der atrophische Narben bestätigen.

**Key words:** erbium, atrophic scar, laser resurfacing, laser surgery

The formation of atrophic scars is common after some surgical procedures, and as a result of a trauma or acne.

Atrophic scars have been notoriously complex to treat owing to the extensive underlying collagen destruction. Chemical peelings, dermabrasion, surgical excision or implantable fillers are the therapies most commonly used in the treatment of atrophic scars; laser resurfacing has been increasingly used as an alternative therapy (1). Especially for the treatment of acne atrophic scars, dermabrasion has been considered an effective therapy for quite a long time. The outcome of the technique results from the surgeon ability and experience in performing the surgical procedure as well as the patient healing ability (2, 3).

A high-energy pulsed CO<sub>2</sub> laser was recently developed (4, 5). This pulsed CO<sub>2</sub> laser, with a wavelength of 10,600 nm, has high water absorption coefficient. The CO<sub>2</sub> laser removes the epidermis, layer by layer, efficiently. Unfortunately

it produces excessive thermal damage, 50–100 µm, that increases during successive passages (6).

In order to reduce thermal injury to the skin during laser resurfacing treatment an alternative laser was developed, the Er:YAG laser based on light emission by a stimulated erbium crystal.

The Er:YAG laser with a wavelength of 2,940 nm, has a higher water absorption coefficient than CO<sub>2</sub> laser, and a short pulse duration. The depth of ablation of the Er:YAG laser is less than the CO<sub>2</sub> one, and the zone of thermal necrosis is less than 30 µm. Moreover the extension of thermal damage is constant regardless of the number of passages (7). Er:YAG allows precise epidermal ablation with minimal thermal injury to surrounding tissues (7). The goal of this study was to evaluate the effectiveness of the Er:YAG laser in the treatment of atrophic scars with multiple applications.



## MATERIALS AND METHODS

33 patients were treated in toto. The mean age was 27.6 years, and they were all Fitzpatrick skin phototypes II–IV. 22 patients (19 females, 3 males) of those 33 patients were treated for acne scars, 6 (5 females, 1 male) for post-surgical atrophic scars, 4 (2 females, 2 males) for trauma scars and 1 (female) for vascular laser treatment scar. In 23 cases the scars were located on the face, in 4 cases on the abdomen, in 4 cases on the legs, in 2 cases on the arms.

Laser treatments were done with an Er:YAG supErb:XL® (BAASEL Lasertech GmbH). Epiluminescence images were taken preoperatively and postoperatively.

In all cases the treatment was performed under local contact anesthesia with lidocaine and prilocaine based cream (EMLA® Astra) 1 hour before; 22 patients, all treated for acne scars, were then sedated with propofol 1% (Diprivan®) intravenously.

The first time, patients were all treated with low energy laser beam, 200–300 mJ/pulse with a 5 mm spot size, a repetition rate of 5 Hz and a pulse duration of 0.16 milliseconds. This procedure allowed us to evaluate the patient response to the laser treatment. A second treatment with an energy of 400–800 mJ/pulse, a repetition rate of 5–8 Hz, with a 5 mm spot size was performed after fifteen days. A spot size of 3 mm with an energy of 150–200 mJ/pulse was used for the treatment of small size scars. Following the same protocol a third and a fourth treatments were performed after a month and after three months.

Pinpoint bleeding appeared after five to seven passages, when tissue ablation reached the dermo-epidermal junction. Laser treatment was stopped at the time of pinpoint bleeding on the margins of the scar. It is very important all the margins to be ablated more deeply than the fibrous tissue of the base of the scar. Only if the ablation is done in that way the skin of the margins regenerates less than the skin of the base.

The patients with acne scars underwent full face laser resurfacing procedure as well as the treatment of the single lesions. After laser treatment, topical low dose antibiotic and cortisonic ointment (chloramphenicol 1%, acetate hydrocortisone 0,5%), were applied twice a day for five days. One week after the laser treatment topical jaluronic acid ointment was applied to hydrate the skin.

The results of the different treatments were evaluated clinically at 4 months by a board certified dermatologist with the help of epiluminescence analysis, based on the scale: *no response*, when the scar did not improve, *good response* when the scar improved with a strong attenuation of the defect, *excellent response* when the scar almost disappeared.

## RESULTS

18 of the 22 patients treated for acne scars had good response, 4 had excellent response.

1 of the 6 patients treated for surgical scar had no response, 4 had good response, 1 had excellent response.

All the 4 patients treated for trauma scars had good response.

1 patient treated for laser scar had excellent response.

Erythema on laser irradiated area appeared in all patients and lasted about 36 hours. Thin crusts appeared after erythema and lasted about one week. No hypopigmentation was observed. One patient, treated for acne scars, developed a minimal postinflammatory hyperpigmentation. No other side effects were observed.

## DISCUSSION

Laser resurfacing is a new method for the treatment of atrophic scars. Cutaneous laser re-



Fig. 1. Preoperative epiluminescence image of acne scars.



Fig. 2. Four months postoperatively epiluminescence image of the same area.

surfacing allows controlled tissue ablation and dermal heating with neocollagenesis and collagen remodeling (8).

A lot of clinical and histopathologic studies have previously shown the efficacy and safety of high energy pulsed CO<sub>2</sub> laser in the treatment of atrophic scars (9–11).

Owing to the extremely precise tissue ablation and minimal thermal damage to surrounding tissues, the pulsed Er:YAG laser is more effective and safe than CO<sub>2</sub> laser, but multiple treatments are required to obtain good results (12).

Laser resurfacing procedure side effects, like hypo-/hyperpigmentation, long lasting erythema, hypertrophic scarring, are almost absent with Er:YAG laser (13, 14).

An excessive thermal damage more evident with CO<sub>2</sub> laser is directly related to a higher incidence of complications (15). On the other hand, CO<sub>2</sub> laser brings profound collagen remodeling; this phenomenon seems less evident with Er:YAG laser (8, 12).

On the basis of histologic findings recently was demonstrated, that the Er:YAG laser effects on superficial layers of dermis are almost the same as the effects of the pulsed CO<sub>2</sub> laser resurfacing (16). More than one application is necessary to obtain the same results as the carbon dioxide laser but the outcome is the same without the risk of worsening the scar.

In agreement with perviously reported studies (12, 17), our results show that multiple treatments with erbium laser are safe and effective to improve atrophic scars (Figs 1–2).

**Acknowledgement:** We would like to extend our gratitude to Dr. Emanuela Volpi for the revision of the manuscript.

## REFERENCES

1. ALSTER, TS., WEST, TB. Treatment of scars: a review. *Ann. Plast. Surg.*, 1997, 39: 418.
2. ORENTREICH, N., ORENTREICH, D. Dermabrasion. *Dermatol. Clin.*, 1995, 13: 313.
3. SOLOTOFF, SA. Treatment for pitted acne scarring: postauricular punch grafts followed by dermabrasion. *J. Dermatol. Surg. Oncol.*, 1986, 12: 1079.
4. ALSTER, TS., LEWIS, AB. Dermatologic laser surgery: a review. *Dermatol. Surg.*, 1996, 22: 797.
5. FITZPATRICK, RE., GOLDMAN, MP., RUIZ-ESPARZA, J. Clinical advantages of the CO<sub>2</sub> laser superpulsed mode. *J. Dermatol. Surg. Oncol.*, 1994, 20: 449.
6. ROSS, EV., DOMANKEVITZ, Y., SKROBAL, M. Effects of CO<sub>2</sub> laser pulse duration in ablation and residual thermal damage: implications for skin resurfacing. *Lasers Surg. Med.*, 1996, 19: 123.
7. KAUFMANN, R., HIBST, R. Pulsed 2,940 nm Er:YAG laser skin ablation: experimental results and first clinical applications. *Clin. Exp. Dermatol.*, 1990, 15: 389.
8. WALIA, S., ALSTER, TS. Prolonged clinical and histologic effects from CO<sub>2</sub> laser resurfacing of atrophic acne scars. *Dermatol. Surg.*, 1999, 25: 926.
9. HO, C., NGUYEN, Q., LOWE, NJ., GRIFFIN, ME., LASK, G. Laser resurfacing in pigmented skin. *Dermatol. Surg.*, 1995, 21: 1035.
10. LOWE, NJ., LASK, G., GRIFFIN, ME., MAXWELL, A., LOWE, P., QUILADA, F. Skin resurfacing with the ultrapulse carbon dioxide laser. *Dermatol. Surg.*, 1995, 21: 1025.
11. NEHAL, KS., LEVINE, VJ., ROSS, B., ASHINOFF, R. Comparison of high-energy pulsed carbon dioxide laser resurfacing and dermabrasion in the revision of surgical scars. *Dermatol. Surg.*, 1998, 24: 647.
12. CHO, SI., KYM, YC. Treatment of atrophic facial scars with combined use of high-energy pulsed CO<sub>2</sub> laser and Er:YAG laser: a practical guide of the laser techniques for the Er:YAG laser. *Dermatol. Surg.*, 1999, 25: 959.
13. ALSTER, TS., WEST, TB. Resurfacing of atrophic facial acne scars with a high-energy pulsed carbon dioxide laser. *Dermatol. Surg.*, 1996, 22: 151.
14. NANNI, CA., ALSTER, TS. Complications of carbon dioxide laser resurfacing: an evaluation of 500 patients. *Dermatol. Surg.*, 1998, 24: 315.
15. PEREZ, MI., BANK, DE., SILVERS, D. Skin resurfacing of the face with the erbium:YAG laser. *Dermatol. Surg.*, 1998, 24: 653.
16. COTTON, J., HOOD, AF., GONIN, R., BEESON, WH., HANKE, CW. Histopathologic evaluation of preauricular and postauricular human skin after high-energy, short pulse carbon dioxide laser. *Arch. Dermatol.*, 1996, 132: 425.
17. KYE, YC. Resurfacing of pitted facial scars with a pulsed Er:YAG laser. *Dermatol. Surg.*, 1997, 23: 880.

Address for correspondence:

Paolo Mezzana  
Via Ruggero Bonghi 11  
00184 Rome  
Italy  
e-mail: paomezza@tiscalinet.it

## ANNALS OF BURNS AND FIRE DISASTERS

Official publication of The Mediterranean Club for Burns and Fire Disasters (MBC)

VOLUME XIII

NUMBER 3

SEPTEMBER 2000

### CONTENTS

- 131 **TRAITEMENT ET PRONOSTIC DE LA BRULURE GRAVE AU CENTRE DES BRULES DE DOUALA, CAMEROUN** (BEYIHA G., BINAM F., BATAMACK J. F., SOSSO M. A. - CAMEROUN)
- 136 **MANAGEMENT OF PAEDIATRIC BURNS** (ATTIYEH B. S., RUBEIZ M., GHANIMEH G., NASSER A. N., AL-AMM C. A. - LEBANON)
- 143 **PREVENTION OF HOSPITAL-ACQUIRED INFECTIONS IN THE PALERMO BURNS CENTRE** (TORREGROSSA M. V., VELANTINO L., CUCCHIARA P., MASELLIS M., SUCAMELI M. - ITALY)
- 148 **ANALYSIS OF PROLIFERATION/DIFERENTIATION AND IMMUNOGENICITY OF CULTURED HUMAN KERATINOCYTES AND NORMAL HUMAN EPIDERMIS** (GARCIA FERNANDEZ E., MARURI N., ARRIETA A., RIÑON M., ARRANZ M. C., BEJAR J. M., GARCIA MASDEVALL M. D., GABILONDO F. J. - SPAIN)
- 155 **THE METHOD OF MICROGRAFTING IN THE TREATMENT OF LARGE AREA FULL-THICKNESS BURNS** (HADJIISKI O. - BULGARIA)
- 159 **L'EXCISION TANGENTIELLE PRECOCE AU SECOURS DES BRULURES PROFONDES DE LA MAIN** (CHAFIKI N., BAHECHAR N., BOUKIND E. H. - MAROC)
- 164 **HYPERTROPHIC SCARS AND KELOIDS: IMMUNOPHENOTYPIC FEATURES AND SILICONE SHEETS TO PREVENT RECURRENCES** (BORGOGNONI L., MARTINI L., CHIARUGI C., GELLI R., GIANNOTTI V., REALI U. M. - ITALY)
- 170 **THE IMPORTANCE OF EARLY PHYSICAL THERAPY TO PREVENT CONTRACTION IN THE BURNED HAND** (PETRONIC I., NIKOLIC G., MARKOVIC M., MARSAVELSKI A., GOLUBOVIC Z., JANJIC G., CIROVIC D. - YUGOSLAVIA)
- 173 **BILATERAL SHOULDER FRACTURES FOLLOWING LOW-VOLTAGE ELECTRICAL INJURY** (DUMAN H., KOPAL C., SELMANPAKOGLU N. - TURKEY)
- 175 **THE NEW BURNS CENTRE AT THE A. PERRINO HOSPITAL, BRINDISI, ITALY** (VERRIENTI P. - ITALY)
- 178 **THE WHO PAGE**
- 180 **BOOK REVIEWS**
- 182 **INTERNATIONAL ABSTRACTS**
- 184 **MBC NEWS**

EDITORS

M. MASELLIS M.D.  
S.W.A. GUNN M.D.

c/o Secretariat of The Mediterranean Club for Burns and Fire Disasters - Divisione di Chirurgia Plastica e Terapia delle Ustioni  
Ospedale Civico - Via C. Lazzaro - 90127 Palermo, Italy





## INSTRUCTIONS TO AUTHORS

**Acta Chirurgiae Plasticae**, the international journal of plastic surgery, is published in English four times a year. For publication are accepted articles dealing with problems of plastic, reconstructive and aesthetic surgery, craniofacial surgery, hand surgery, microsurgery, burns and allied branches (clinical, laboratory, experimental studies); they must be submitted in English or Czech language. They must be original and not previously published elsewhere.

Kindly send your manuscripts to the following address:  
**Acta Chirurgiae Plasticae, Šrobárova 50, 100 34 Prague 10, Czech Republic.**

The manuscript must be typewritten in two copies, one page per sheet, with doublespacing between the lines, 60 types per line and no more than 30 lines per page. There should not be more than five corrections by handwriting per manuscript. The institute where the authors work, the title of the article and the name of the author (of authors), must be stated on the first page. All other pages should be numbered consecutively. The summary with key words, the references in alphabetic order according to the surname of the first author and the legend to the Figures are to be written each on a separate page and added to both copies of the manuscript. The address of the main author must be given at the bottom of the References. The place where the Tables are to be inserted should be marked in pencil on the margin of the text. Figures are to be separate and not affixed in the text. On the back of each Figure, the author is requested to write in soft pencil his name, the short title of the paper and the consecutive number of the illustration with an arrow indicating the top of the Figure. Photographs must be clear, with good contrast and of a convenient size. Colour photographs are accepted for reproduction as well. The Tables and Graphs should be lined with Indian ink on white paper so as to make them well readable. The Tables must be numbered consecutively with Arabic numerals and typed on separate pages.

References should be quoted in the text with surname of the author and the year of publication. Two or more works by the same authors published in the same year must be marked with the suffixed a, b, c, etc. Quotations should be adjusted according to the Czech norm as follows: Articles in journal – author's surname and initials, title of the article, international abbreviation of the journal, volume, the year of issue and pages. For instance: MOTOKI, DS., ALTOBELLI, JB. Enophthalmos following orbital transposition for craniofacial malformations. *Plast. Reconstr. Surg.*, 91, 1993, p. 416-422.

Books and monographs: the name of authors, title of publication, place of issue, publisher, year of issue and - maybe -

also the page from which the quotation was taken. For instance: BURIAN, F. *Surgery of Cleft*. Praha : SZdN, 1954. Book chapters: FÁRA, M. Anatomy of unilateral and bilateral cleft lip. In BARDACH, J., MORRIS, HL. (Eds) *Multidisciplinary Management of Cleft Lip and Palate*. Philadelphia : W. B. Saunders, 1990, p. 134-144. The abbreviation et al. is not acceptable in the reference section and each reference must begin on a new line.

Manuscripts which do not comply with these requirements cannot be published. The editorial board reserves the right to suggest the publication of author's article in the form of an annotation, make corrections, or on account of comments made by the reviewers, return the manuscript to the author for redrafting. The papers must be sent to the editor in their final formulation. The galley proofs are done by the author, but no essential changes are permitted. The authors of original papers will receive issue of the Journal and 20 reprints free of charge and without special order. Additional reprints are available at the address given below.

*For those who prefer to submit Graphs printed on a laser printer:*

Please do not use grid in your Graphs. Remember that Graphs are scanned and often reproduced in a smaller size than 1 : 1. Increased density of dots then makes grids unclear and „stainy“. Use black and white areas or black lining.

*For those who prefer to submit their papers on a diskette:*

Both 3 1/2" and 5 1/4" diskettes are accepted. Use WORD (DOS) or WINWORD text editor, version 5.0 and higher, only. In WINWORD, cancel automatic SAVE before you start writing. Write doublespaced (max. 30 lines per page), do not underline, do not change typesizes, do not indent. New paragraph should be marked only by ENTER on a previous line. Do not create Tables, write them only as a text. Each diskette must be prevented from accidental erasing and accompanied by a printed text, in which you can underline and mark the desired shape of Tables. Due to increasing postage, diskettes are not returned to the authors.

*For those who wish to submit colour photodocumentation:*

Use preferably photographs, sharp, of high quality only, optimal size 10 x 15 cm, max. 21 x 15 cm. Slides are also accepted. Slides must be marked with the name of the author, the arrow indicating the top side and the Fig. number. Graphs in colours are not accepted in any form. Colour documentation is reproduced free of charge.

---

## **\* Supplementa časopisů ČLS JEP vydaná v roce 2000**

---

VII. vzdělávací a diskusní gastroenterologické dny - Karlovy Vary 2000

Aktuální gastroenterologie VI - Správná klinická praxe v gastroenterologii - Praha 2000

*(Česká a slovenská gastroenterologie)*

Perinatologie

*(Česká gynekologie)*

Doporučení diagnostických a léčebných postupů u arteriální hypertenze - verze 2000. Prevence ischemické choroby srdeční v dospělém věku

*(Vnitřní lékařství)*

Projekty lékařského výzkumu IGA MZ ČR

*(Časopis lékařů českých)*

Funkční poruchy - VI. sympozium Praktického lékaře

Zvíře - člověk - zvíře (supplementum o vybraných aspektech soužití člověka a zvířete)

*(Praktický lékař)*

Bazální - paliativní terapie

*(Anesteziologie a neodkladná péče)*

Proceedings of the 6th Meeting of the Central and Eastern European Section of SECOTOX –

Balatonföldvár 1999

*(Central European Journal of Public Health)*

Soubor vybraných prací studentů 5. a 6. ročníku 3. LF UK v Praze z oblasti preventivního lékařství

*(Hygiena)*

Myoklonus

XXVII. mezinárodní česko-slovenské neurovaskulární sympozium - Zlín 2000

*(Česká a slovenská neurologie a neurochirurgie)*

4. český pediatrický kongres s mezinárodní účastí - Hradec Králové 2000

*(Česko-slovenská pediatrie)*

Moderní zobrazovací diagnostické metody (XXXII. český radiologický kongres - Mariánské lázně 2000)

*(Česká radiologie)*

100. výročí založení časopisu Zubní lékařství

*(Česká stomatologie)*

**Pro předplatitele jednotlivých titulů jsou supplementa součástí předplatného.**

**Ostatní zájemci je mohou objednat v ceně řádného čísla časopisu na adrese:**

**Nakladatelské a tiskové středisko ČLS JEP,**

**Sokolská 31, 120 26 Praha 2, fax 02-2426 6226, e-mail jana.spal@volny.cz**

---

## **\* Tematické přílohy časopisů ČLS JEP vydané v roce 2000**

---

Renin-angiotenzinový systém - struktura, funkce a možnosti terapeutického ovlivnění.

Blokátory periferních receptorů pro angiotenzin II v klinické praxi - možnosti, indikace a perspektivy

*Gabriel Pallay*

*(Praktický lékař 6, ČLČ 12)*

Úžinové syndromy

*Eduard Ehler*

*(Česká a slovenská neurologie a neurochirurgie 6, Praktický lékař 11, ČLČ 23)*

**Přílohy jsou samostatně neprodejné.**

**Lze je objednat s některým z uvedených časopisů na adrese NTS ČLS JEP.**



# SÁZÍME NA TRADICI A KVALITU OBSAHU



## KOMPLETNÍ NABÍDKA ODBORNÝCH ČASOPISŮ ČESKÉ LÉKAŘSKÉ SPOLEČNOSTI J.E.PURKYNĚ NA ROK 2001

Časopis	periodicita	předplatné Kč
Acta chirurgiae plasticae	4 x	284,-
Anesteziologie a neodkladná péče	6 x	384,-
Central European Journal of Public Health	4 x	368,-
Časopis lékařů českých	24 x	720,-
Česká a slovenská farmacie	6 x	468,-
Česká a slovenská gastroenterologie a hepatologie	6 x	432,-
Česká a slovenská neurologie a neurochirurgie	6 x	420,-
Česká a slovenská oftalmologie	6 x	318,-
Česká a slovenská psychiatrie	8 x	328,-
Česká gynekologie	6 x	414,-
Česká radiologie	6 x	408,-
Česká revmatologie	4 x	296,-
Česká stomatologie a Praktické zubní lékařství	6 x	372,-
Česko-slovenská dermatologie	6 x	480,-
Československá fyziologie	4 x	424,-
Česko-slovenská patologie a Soudní lékařství	4 x	416,-
Česko-slovenská pediatrie	12 x	708,-
Endoskopie	4 x	216,-
Epidemiologie, mikrobiologie, imunologie	4 x	264,-
Hygiena	4 x	300,-
Klinická biochemie a metabolismus	4 x	324,-
Lékař a technika	6 x	402,-
Otorinolaryngologie a foniatrie	4 x	316,-
Pracovní lékařství	4 x	308,-
Praktický lékař	12 x	456,-
Rehabilitace a fyzikální lékařství	4 x	292,-
Rozhledy v chirurgii	12 x	912,-
Transfuze dnes	4 x	168,-
Vnitřní lékařství	12 x	756,-
Zdravotní pojištění a revizní lékařství	4 x	360,-

Časopisy jsou distribuovány výhradně na předplatné.

U časopisů *Česká stomatologie a Praktické zubní lékařství*, *Česko-slovenská pediatrie*, *Lékař a technika* a *Praktický lékař* poskytujeme studentskou slevu.

Předplatitelům v zaměstnaneckém poměru neúčtujeme poštovné.

Předplatné časopisu lze zahrnout do nákladů právnických a podnikajících fyzických osob.

**Katalog kongresů, konferencí, sympozií, přednášek 2001: 99,- Kč + poštovné**

Veškeré nabízené publikace objednávejte na adrese:

Nakladatelské a tiskové středisko ČLS JEP, Sokolská 31, 120 26 Praha 2, fax 02-2426 6226,  
e-mail [nts@iol.cz](mailto:nts@iol.cz), <http://www.clsjep.cz>