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CONTENTS

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ACTA CHIRURGIAE PLASTICAE 39, 2, 1997, p. 39 - 47

CONTRIBUTION TO THE ORIGIN OF PROGENY IN MIDDLE EUROPEAN HABSBURGS: SKELETAL ROENTGENCEPHALOMETRIC ANALYSIS OF THE HABSBURGS BURIED IN PRAGUE

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SUMMARY

From comparisons of roentgencraniometric findings in the first Habsburgs on the Bohemian throne (1526-1612) reduction of the length of the anterior cranial base is obvious and is also consistent with reduction of the depth of the maxilla. The findings are consistent with the small cranium and skull capacity of these Habsburgs. The maxilla is therefore not retrusive, even in Rudolf II where it is affected by a pathological process. The body of the mandible is not reduced which causes a disproportion due to the short anterior base and the maxilla. The disproportion in Ferdinand I and Maxmilian II is compensated by posterior rotation of the mandible. In Rudolf II the body of the mandible is markedly prolonged, the lower jaw is displaced forward and the finding can be described as true progenia. It is evidenced by the shorter anterior base and maxilla of the emperor. Habsburg progenia is thus evident in Central European Habsburgs only in Rudolf II, probably due to the traits of his mother from the Spanish branch of the Habsburgs. The parameters of the lower jaw of father Maxmilian II and grandfather Ferdinand I, however, do not exclude a certain predisposition to progeny in the Central European Habsburg family.

The cranium of the first Habsburg on the Czech throne, Ferdinand I, is typical in the high maxillary portion of the face with a markedly posterior rotation of the mandible and a steep position of the upper and lower incisors. The cranium of his wife Anna Jagellonska, on the other hand, is typical in bimaxillary protrusion. In the son Maxmilian II, as a trait from the maternal side, the face is not prolonged, the incisors procline well and the occlusion is normal. In Rudolf II the face is shorter due to the overclosure of the mandible and the pathological process of the maxilla. Anthropological examination of all three generations of emperors revealed increasing brachycrania, a narrow highly vaulted forehead with a non-indented nasal root, poorly developed supraciliary arches, traces of the obliterated suture on the forehead and poorly developed sexual signs. In Rudolf II we can assume incomprehensible speech, in Maxmilian II a 7 cm long styloid process on the right may have caused neuralgia of the trigeminal and glossopharyngeal nerve.

ZUSAMMENFASSUNG

Ursachen der Progenie bei den mitteleuropäischen Mitgliedern der Habsburg-Dynastie: Röntgen-zefalometrische Analyze der in Prag beerdigten Habsburger

E. Vlček, Z. Šmahel

Der Vergleich der röntgenkraniometrischen Befunden bei den ersten drei Generationen der Habsburg-Dynastie am tschechischen Thron (1526-1612) zeigte eine Verkürzung der Länge der forderen Schädelbasis, bei gleichzeitiger Verkürzung der Tiefe des Oberkiefers. Diese Befunde dokumentieren, daß diese Habsburger ein kleines Neurokranium und eine kleine Schädelkapazität aufwiesen. Es bestand keine Retrusion des Oberkiefers und zwar nicht einmal bei Rudolph II., bei dem ein pathologischer Prozeß am Oberkiefer vorhanden war. Bei keinen dieser Mitglieder der Habsburg-Dynasie bestand eine Verkürzung des Unterkieferkörpers, was zu einer Disproportion gegenüber der kurzen forderen Schädelbasis und der Maxilla führte. Bei Ferdinand I. und Maxmilian II. war diese Disproportion durch die posteriore Rotation des Unterkiefers kompensiert. Rudolph II. hatte eine starke Verlängerung des Unterkieferskörpers, die Mandibula ragt vorwärts, dieser Befund ist charakterisch für eine Progenie. Die Progenie ist noch verstärkt durch die kürzere fordere Schädelbasis und der Maxilla bei diesem Kaiser. Bei den mitteleuropäischen Habsburgern ist die Progenie erst bei Rudolph II. nachweisbar, geerbt höchstwahrscheinlich von seiner Mutter aus dem spanischen Ast der Habsburger. Die Parametr des Unterkiefers bei dem Vater von Maxmilian II. und dem Großvater Ferdinand I. können jedoch eine gewiße Prädisposition zur Progenie bei mitteleuropäischen Habsburgen nicht ausschließen. Das Cranium des ersten Habsburges am tschechischen Thron Ferdinand I. hat eine typisch größere Kieferhöhe mit einer starken posterioren Rotation des Unterkiefers und einer steilen Position der oberen und unteren Schneidezähnen. Das Cranium seiner Gemahlin Anna Jagellonska ist im Gegensatz durch eine bimaxillare Protrusion charakterisiert. Ihr Sohn Maxmilian II. erbte von seiner Mutter eine Gesichtskonfiguration ohne eine Verlängrung des Gesichtes und mit einer normalen Okklusion bei guter Proklination der Schneidezähnen. Bei Rudolph II. besteht infolge des vorragenden Unterkiefers und einem pathologischen Prozeß am Oberkiefer eine Gesichtsverkürzung. Die anthropologischen Untersuchungen bei allen drei Generationen der Kaiser zeigten eine ansteigende Brachykranie, eine schmal gewelbte Stirn mit keiner tiefeinschneidenden Nasenwurzel mit schwach entwickelten superzyliaren Bogen, Anzeichnen frontaler Sutur und schwach

entwickelte sexuelle Zeichnen. Es kann vorausgestzt werden, daß bei Rudolph II. dazu führte, daß er schwer zu verstehen war. Bei Maxmilian II. 7 cm lange rechte Proc. styloideus konnte eine Neuralgie des Trigeminus und des Nervus glossopharyngeus hervorrufen.

Key words: Habsburg's progeny, 16th century, roentgencephalometric analysis, skeletal remains

In 1974, in conjunction with restoration work in St.Vitus Cathedral, the tombstone of the royal Colin mausoleum was restored. The contents of the mausoleum, the funerals of Ferdinand I, his wife Anna Jagellonska and Maxmilian II were investigated at that time. The investigation was conducted by the office of the President of the Republic in collaboration with the National Museum in Prague, represented by the first author of this paper, with the participation of an expert commission. In the following year, 1975, the remains of Rudolf II were investigated, which are in the sepulchre of Czech kings. In 1991 the remains of his sister Eleonore were also investigated (Vlček, 1979, 1992, 1993 a,b, 1994 a,b, 1995, 1996).

The treated remains were subjected to anthropological and medical investigation, i.e. not only to morphoscopic and morphometric inspection but also to X-ray examination and other clinical examinations. Therefore, we may contribute to the discussion of characteristics considered typical for the Habsburgs, such as progenia and hypercheilia. This research provides an opportunity to make certain comparisons between subjects of three generations connected by the closest possible familial links, which also allowes us to determine some genetic traits of the family.

1. Anthropological characteristics

From the craniometric and cranioscopic aspect, Maxmilian II holds the position between his father Ferdinand I and mother Anna Jagellonska (except for the orbital index which in Maxmilian has the most hypsiconchnic character of the three subjects). In Rudolf II, a representative of the third generation, there was a further shortening of the skull by six units of the cephalic index, as compared with his father, 12 units as compared with his grandfather and by 4 units, as compared with his grandmother. Thus we must assume marked brachycrania in Mary of Spain, mother of Rudolf II. Rudolf had a markedly reduced height of the whole face which differs by 11 index units from his father and by as much as 24 units from his mother. However, these features are more similar in his grandmother Anna. The striking reduction of the upper part of Rudolf II's face is influenced by the retarded development of the maxilla and an associated pathological process.

All three investigated generations share, from the morphoscopic aspect, a vaulted and narrow forehead with a non-indented nasion and a continuous transition of the outline of the forehead to the back of the nose, poorly developed supraciliary arches and persisting vestiges of the obliterated frontal suture. The occipital outline is in all representatives markedly curvooccipital with faint muscular insertions. Only the shape of the mastoid process and the shape of both jaws indicate the development of typical male sexual characteristics in the skulls of the investigated emperors. In Rudolf II's sister Eleonore the brachycrania increased by another two units, as compared with her brother, however, her facial skeleton proportions are more typical of a child.

Another common characteristic of the Prague Habsburgs is the small cranium with a small cranial capacity. The greatest volume was recorded in Ferdinand I, at 1397 ccm, the estimated volume of the brain being 1226 ccm. The corresponding figures for Maxmilian II are 1282 (1125) and for Rudolf II 1186 (1128) ccm. The figures for Anna Jagellonska are 1321 (1223) ccm and for Eleonore 1234 (1193) ccm.

To contribute to the discussion on the presence and development of characteristics considered typical for the Habsburgs, such as progenia, attention was paid to the shape of the maxillary and mandibular apparatus in all investigated subjects. From the most important data in the literature - Rubbrecht (1910), Strohmayer (1912) Haecker (1912), Wolf (1940), Bertram (1959), Stoltenberg-Leche (1961), Grabb et al. (1968), Jirava et al. (1969), Gajda (1970), Mezník (1974, 1975, 1976, 1977 a,b), Bílý and Pokorná (1979), Härle (1989), Vlček (1995) it can be assumed that Ferdinand I did not suffer from progenia. Deficiency of bony tissue in the maxilla above the upper second incisors and isolation of the intermaxilla with subsequent rotation of the second incisors could suggest retarded development of the maxilla as a result of an infectious agent. The lower jaw is of adequate length, high in the chin portion and before the branching noticeably reduced. Its outline with the developed bulge is regressing. The high palate is associated with adenoid vegetation and mouth breathing. The dental arches are narrow and the teeth are crammed.

In Anna Jagellonska there is protrusion of the frontal portions of both jaws without signs of mandibular progenia.

Maxmilian II had not a deficiency of bony tissue at the level of the second incisors of the upper jaw, obviously due to the genetic traits of his mother from the Jagellon family. His upper jaw is wider, and the same applies to the upper dental arch. The occlusion is normal with protrusion of

the lower front and supraocclusion. Moreover there is a marked artificial lingual abrasion of the upper and lower incisors caused by a hard object, perhaps a pipe, or some other bad habit.

In Rudolf II there is a combination of antagonistic characteristcs. The upper jaw is small, it has quite atrophic alveolar processes and the hard palate is therefore a smooth plate, with a single crooked tooth on the right, the canine tooth. The other teeth in the maxilla were lost during his life. The lower jaw has a healthy and complete dentition. Due to arrested growth of the maxilla and absolute prolongation of the mandible a disproportion developed between the upper and lower teeth and a 15 mm wide gap in the occlusion. The degree of abrasion of the posterior lateral quadrants indicates that the upper front of the originally fan-like incisors did not reach further than to the level of the canine teeth in the lower jaw. The lower incisors did not work throughout his life. This dysgnathia is exceptional and combines true and false progenia. The adverse position of the two dental arches was promoted by a destructive process of the gums in the upper jaw. The inadequate growth of the maxilla and prolongation of the mandible, may be, genetically linked to the maternal side - Mary Habsburg of Spain. In her portraits we can observe prolongation of the lower jaw and a poorly developed upper jaw. We tried to reconstruct the dentition of Rudolf II's upper jaw.

Research revealed that the proclaimed Habsburg progenia of the lower jaw can be found in the series of Czech Habsburgs only starting with Rudolf II. This means that in the Central European Habsburgs there was no typical progenia before Spanish blood, the emperess Mary of Spain, mother of emperor Rudolf II entered the family.

Convincing evidence for this fact is provided by the results of skeletal X-ray cephalometric analysis of the Habsburgs buried in Prague.

2. Skeletal roentgencephalometric analysis

2.1. Materials and method

The skulls of the Habsburgs were X-rayed under standard conditions at the Radiological Clinic of the University Hospital in Prague, Vinohrady, with the mandibles fixed in centric occlusion. The central ray was vertical in relation to the median plane of the skull. From comparison of selected dimensions of the skulls and roentgenograms a 5% enlargement was calculated.

The findings were compared with control teleroentgenographic films of 50 normal adult males and 36 females of Czech nationality, age 20-40 years (Šmahel, 1978, Šmahel et al., 1995).The subjects were selected at random among volun-

Tab. 1. X-ray cephalometric characteristics of members of the Habsburg dynasty buried in Prague (absolute values and differences from controls in SD).

variable	Ferdinand I.		Anna Jagellonska		Maxmilian II.		Rudolf II.	
	abs.	dif.SD	abs.	dif.SD	abs.	dif.SD	abs.	dif.SD
linear								
N-S	62.5	-2.0	58.2	-2.5	60.6	-2.5	55.4	-4.1
S-Ar	31.0	-1.4	37.7	1.6	38.2	1.0	33.9	-0.4
Sp-Pmp	44.9	-3.1	44.4	-2.2	42.0	-4.1	43.4	-3.6
Pgn-Go	75.3	0.4	68.9	-0.2	78.8	1.2	85.3	2.7
Ar-Go	42.0	-2.1	37.7	-1.8	41.1	-2.3	42.5	-2.0
N-Gn	134.7	2.6	112.7	0.4	123.7	0.7	110.8	-1.5
S-Go	71.6	-2.3	72.6	-0.6	75.4	-1.6	71.6	-2.3
N-Sp	53.8	0.3	46.7	-0.7	53.3	0.1	47.9	-1.5
Sp-Gn	82.6	2.6	67.6	0.9	70.3	0.4	63.2	-0.9
S-Go%N-Gn	53.0	-3.0	64.0	-1.0	60.9	-1.6	64.4	-1.0
Go-Gn%N-S	119.2	2.5	116.5	2.0	130.8	4.1	151.6	7.0
angular								
N-S-Ar	130.5	1.0	127.5	0.4	133.0	1.4	128.0	0.5
S-N-Ss	76.5	-1.1	79.5	-0.3	77.0	-1.0	79.0	-0.4
S-N-Sm	69.5	-2.5	74.0	-1.2	76.0	-0.6	90.0	3.2
Ss-N-Sm	7.0	2.1	5.0	1.3	1.0	-0.7	-11.0	-6.0
N-S-Pgn	83.5	4.0	75.0	1.8	75.5	2.0	62.5	-1.3
PL/NSL	16.0	2.6	14.0	2.1	17.5	3.1	8.5	0.3
OL/NSL	28.5	3.3	15.5	0.7	20.0	1.8	11.5	-0.3
ML/NSL	54.5	3.5	37.5	1.2	40.0	1.5	30.5	0.2
RL/NSL	106.0	3.6	96.0	1.7	97.0	1.7	87.0	-0.4
RL/ML	129.0	1.3	122.0	0.2	123.0	0.4	123.0	0.4
CL/ML	62.6	-1.4	74.4	0.5	71.5	0.1	63.0	-1.4
PL/ML	38.5	2.4	23.5	0.3	23.0	0.2	22.5	0.1
dental								
+1/NSL	84.5	-2.4	109.5	1.5	106.0	1.0	111.0*	1.7
+1/PL	100.5	-1.1	123.5	2.3	123.5	2.4	119.5*	1.8
-1/ML	80.5	-1.8	106.5	1.4	88.0	-0.8	97.5	0.3
+1/-1	140.5	0.6	106.0	-2.9	125.5	-1.0	121.0*	-1.4
Is-Ii	3.8	1.4	3.3	0.0	1.0	-1.2	-16.7*	-17.3

* caninus

teers hospitalized for minor injuries and among university students. The groups did not comprise subjects with markedly impaired occlusion, loss of teeth or facial disharmony. The X-rays were taken under standard conditions (distance of focus - object 370 cm, object - film 30 cm, enlargement 8%), with the subject´s head fixed in a cephalostat in centric occlusion.

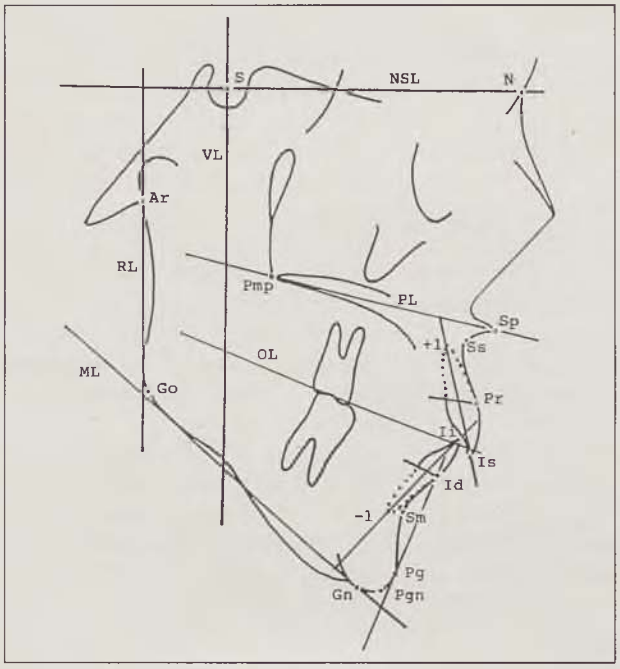


Fig. 1: Cephalometric points and reference lines used in the study.

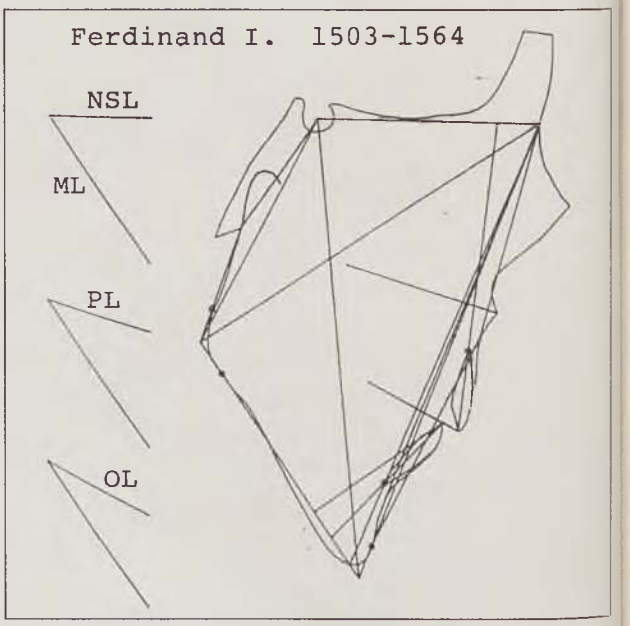
The X-rays were measured using a digitizer. Craniometric points and reference lines which are constructed automatically by the computer from the input points are illustrated in Fig.1. Important parameters are given in Table 1 and others can be found in the text. The angles are marked by a three-element abbreviation (e.g. the angle of the base N-S-Ar) or as a fraction of the reference lines formed by the given angle (e.g. gonial angle ML/RL). The slope of the axis of the upper incisors to the plane of the palate and the plane of the anterior base is marked as +1/PL and +1/NSL, the slope of the lower incisors to the mandibular line -1/ML, the interincisal angle as +1/-1. Maxillary overjet (Is-Ii) was measured between the edges of the upper and lower incisors parallel with the occlusal plane. The relative characteristics are described as Go-Gn%N-S (Go-Gn in percents of N-S). In case of double contours the point in the middle between the two sides is used.

The linear dimension of the skulls of the Habsburgs and controls were calculated to correspond to the actual size. The differences as compared with controls were expressed in all characteristics by the value of the standard deviation. Because the upper incisors are missing in Rudolf II, the given dental characteristics pertain to the canine which was preserved. The craniograms are the output of the plotter.

2.2. Craniometric findings in individual personalities

FERDINAND I (10.3.1503 - 25.7.1565), Fig. 2a, b.

Fig. 2a: Roentgenogram of the skull of emperor Ferdinand I.

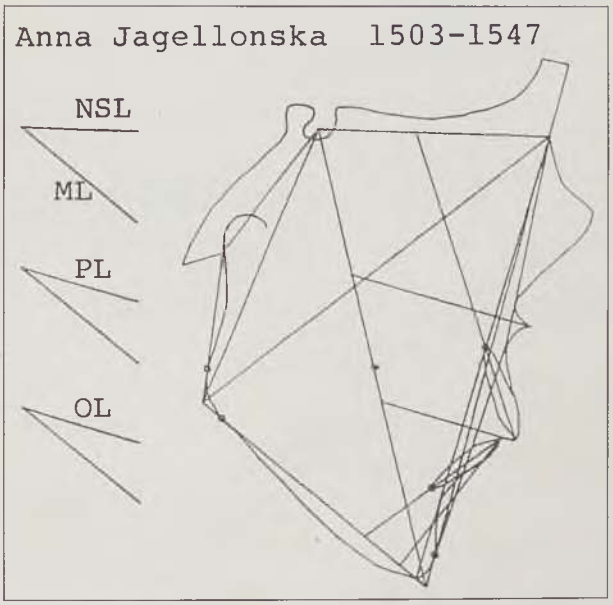


2b: Facial morphogram of Ferdinand I.

The base of the skull is, compared to present norms, shorter in the presellar portion (N-S, -2 SD). The so-called sellar angle (N-S-Ar) which

provides information on the curvature of the base is not changed. The face is long in the anterior height (N-Gn, +2.6 SD) due to the high jaws portion (Sp-Gn, +2.6 SD). Its increased height is due in particular to the dentoalveolar component of the maxilla (Sp-Is, +2 SD). In the posterior height (S-Go) the face is reduced (-2.3 SD) and the ratio to the anterior height (S-Go%N-Gn, 53%) indicates a marked posterior rotation of the face. This is confirmed by the steep slope of the mandibular body (ML/NSL, +3.5 SD) and the large angle N-S-Pgn (+4 SD). The mandible is in posterior rotation as a whole with a strong retroinclination of the ramus (RL/NSL, -3.6 SD) without marked flattening of the gonial angle (ML/RL). Consistent with the posterior rotation is the steeper occlusal plane (OL/ML, +3.3 SD). The vertical jaw relations (PL/ML) are impaired in terms of hyperdivergence (+2.4 SD). The depth of the maxilla (Sp-Pmp) is reduced slightly more than the anterior base (N-S) and the maxilla is therefore slightly retrusive (S-N-Ss, -1.1 SD). The length of the mandibular body (Pgn-Go) is consistent with our norms but with regard to the shortening of the anterior cranial base and depth of the maxilla it is excessive (Go-Gn%N-S, +2.5 SD). This disproportion is compensated by the mentioned posterior rotation which pushes back the lower jaw (S-N-Sm -2.5 SD). Because the protrusion of the upper jaw is only slightly reduced, the sagittal jaw relations (Ss-N-Sm) reach an angle of 7° (+2.1 SD) and include subject into the second skeletal class (with posterior position of the mandible). The maxilla is also posteriorly rotated, as apparent from the steeper slope of the palatal plane (PL/NSL, +2.6 SD). Dental analysis revealed a steep slope of the upper incisors toward the cranial base (84.5° ie. -2.5 SD) and of the lower incisors to the mandibular base (80.5° , i.e. -1.8 SD). However, the latter is the result of compensation of the steepness of the mandibular body. The interincisal angle is at the borderline of the clinical norm (140°). The slightly increased maxillary overjet (4 mm) is usually an associated sign of the second skeletal class.

Fig. 3a: Roentgenogram of the skull of emperess Anna Jagellonska.



3b: Facial morphogram of Anna Jagellonska.

ANNA JAGELLONSKA (23.7.1503 - 27.1.1547), Fig. 3a, b.

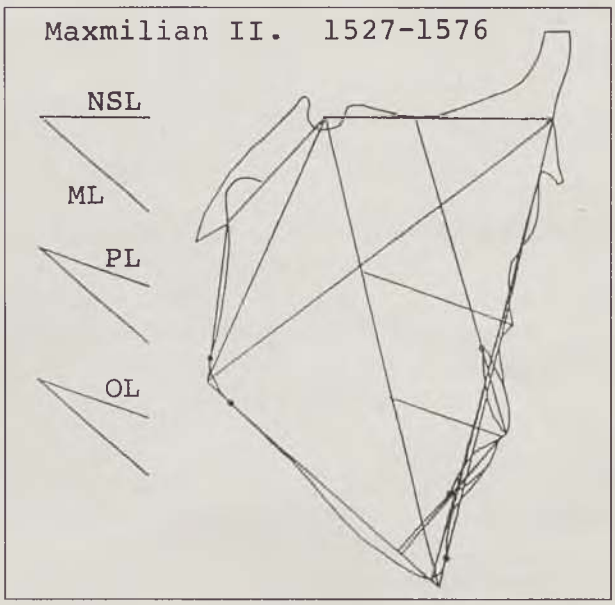
The presellar part of the cranial base is reduced (N-S), the postsellar length (S-Ar) and curvature of the base (N-S-Ar) are not altered. The anterior height of the face (N-Gn) is similar to controls, and the posterior height (S-Go) is slightly reduced. The ratio of the two heights indicates slight posterior rotation (S-Go%N-Gn, -1 SD) with a steeper body (ML/NSL) and ramus (RL/NSL) of the mandible causing slight backward displacement of the lower jaw (S-N-Sm, N-S-Pgn). It compensates the normal, but in relation to the anterior base excessively long body of the mandible (Go-Gn%N-S, +2 SD). The depth of the maxilla (Sp-Pmp) is reduced adequately to the length of the anterior base and protrusion of the upper jaw (S-N-Ss) thus corresponds to the norm. As the mandible is displaced backward the protrusion of the lower jaw (S-N-Sm) and the sagittal relationship of the two jaws (Ss-N-Sm) is within the normal range. The shape of the lower jaw i.e. the gonial angle (ML/RL) and the chin angle (CL/ML) are not altered. Thus there are no serious disproportions in the basic shape of the facial bony framefork. Dental analysis revealed anterior proclination of the upper and lower incisors (+1.5 SD), causing marked reduction of the interincisal angle (-3 SD). It is characteristic for bialveolar (so-called bimaxillary) protrusion. The maxillary overjet is adequate.

MAXMILIAN II (1.8.1527 - 12.10.1576), Fig. 4a, b.

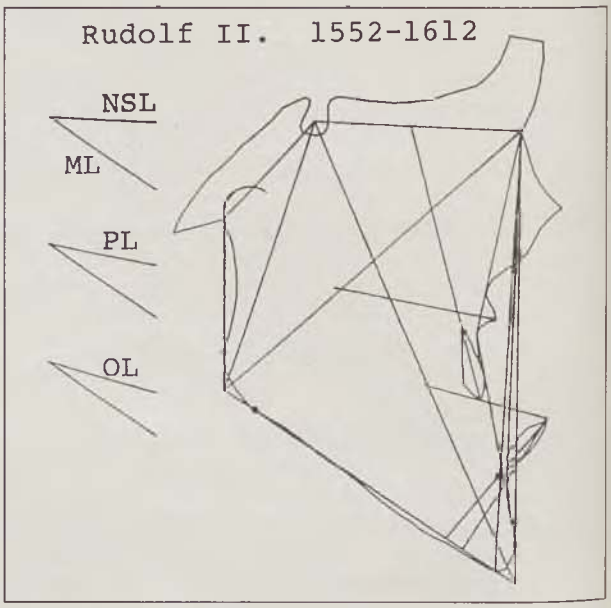
Similar to both parents, the presellar part of the skull base (N-S) is shortened, the postsellar part (S-Ar) is not altered, and the angle of the sella (N-S-Ar) is slightly flattened. The anterior height of the face is within the normal range (N-Gn), and the posterior height is reduced (S-Go, -1.6 SD). The ratio of heights, the greater steepness of the mandibular body (ML/NSL) and ramus (RL/NSL), the angle of the direction of growth of the mandible (N-S-Pgn) and the inclination of the occlusal plane (OL/NSL) indicate a slight posterior rotation of the face. The vertical proportionality of the face is not altered (N-Sp and Sp-Gn are within the normal range). The body of the mandible is slightly prolonged (Pgn-Go, +1.2 SD) but with regard to the shorter anterior cranial base the disproportion is 4.1 SD (Go-Gn%N-S). It is fully compensated by the mentioned posterior rotation of the mandible (Ss-N-Sm). The depth of the upper jaw (Sp-Pmp) is somewhat more reduced than the anterior base (N-S) but the maxillary retrusion is minimal. The protrusion of the lower jaw (S-N-Sm) and sagittal jaw relations (Ss-N-Sm) are similar to the controls. The gonial angle (ML/RL) and chin angle (CL/ML) are not altered. Dental analysis did not reveal striking deviations in the inclination of the incisors; the interincisal angle is at the lower borderline of the clinical norm (125°). On the whole the face can be considered balanced.

Fig. 4a: Roentgenogram of the skull of emperor Maxmilian II.

Fig. 5a: Roentgenogram of the skull of emperor Rudolf II.



4b: Facial morphogram of Maxmilian II.



5b: Facial morphogram of Rudolf II.

RUDOLF II (18.9.1552 - 20.1.1612), Fig. 5a, b.

The presellar part of the cranial base (N-S) is even more shortened (-4.1 SD) than in the predecessors, the curvature of the base (N-S-Ar) is not changed. The anterior and posterior heights of the face are reduced, their ratio is similar to controls (S-Go%N-Gn). The steepness of the mandibular body (ML/NSL) and ramus (RL/NSL) are consistent with the norm, as are other parameters of facial rotation (N-S-Pgn). The mandibular body is markedly prolonged (Pgn-Go, +2.7 SD) the disproportion to the reduced anterior base length is 7 SD (Go-Gn%N-S). The lower jaw is therefore markedly pushed forward (S-N-Sm, +3.2 SD). The depth of the maxilla is similarly reduced as the length of the anterior base, the protrusion of the upper jaw (S-N-Ss) is therefore adequate. The disproportion in the anteroposterior position of both jaws is thus -11° (Ss-N-Sm, -6 SD) and is characteristic for the severe third skeletal class. The vertical proportionality of the face is not altered; the heights of the upper (N-Sp) and lower (Sp-Gn) face are proportionately reduced (-1.5 and -0.9 SD). The gonial angle (ML/RL) is not changed, and the sharper chin angle (CL/ML) is associated with progenia. The inclination of the lower incisors is normal (-1/ML), the upper incisors are missing but the marked proclination of the only preserved canine (111°) may suggest a similar inclination of the incisors. The reversed occlusion was extreme (the gap in relation to the canine tooth is 17.5 mm).

2.3. Comparison of findings in family members

From the comparison of the craniometric findings in members of the Habsburg family and Anna Jagellonska it is obvious (with regard to our present norm) that there is a marked reduction of the length of the anterior cranial base which is also consistent with a reduction of the depth of the maxilla and the mandibular ramus. This may be associated with the smaller size of the cranium (see above) and specific characteristics of the face of the mentioned subjects. The position of the upper jaw in the anteroposterior direction, specifically its protrusion, in all examined subjects, is consistent with normal values. The length of the mandibular body, on the other hand, is not reduced which causes a disproportion in relation to the length of the anterior base and maxilla. Moreover, in Maxmilian II the body is slightly (+1.2 SD) and in Rudolf II already markedly (+2.7 SD) prolonged which makes the disproportion in consecutive generations more prominent (from 2.5 SD in Ferdinand to 4.1 SD in Maxmilian to 7 SD in Rudolf). In Ferdinand I the disproportion is fully compensated by a marked posterior rotation of the mandible accentuated by a high maxilla (and its dentoalveolar component, Fig. 2b, 6). The sagittal jaw relations clearly show a second skeletal class (Ss-N-Sm, 7°). Therefore despite the steep position of the incisors a normal (slightly increased) positive overjet is achieved. In Maxmilian II the posterior rotation of the lower jaw is much slighter (Fig. 6), and probably as a trait of the maternal side the height of the maxilla is not increased as in the father, and the upper incisors procline adequately. The slight posterior rotation is sufficient to compensate the relatively long mandibular body, and sagittal intermaxillary relations (Ss-N-Sm, 1°) are within the normal range (0-5°). Despite the slightly in-

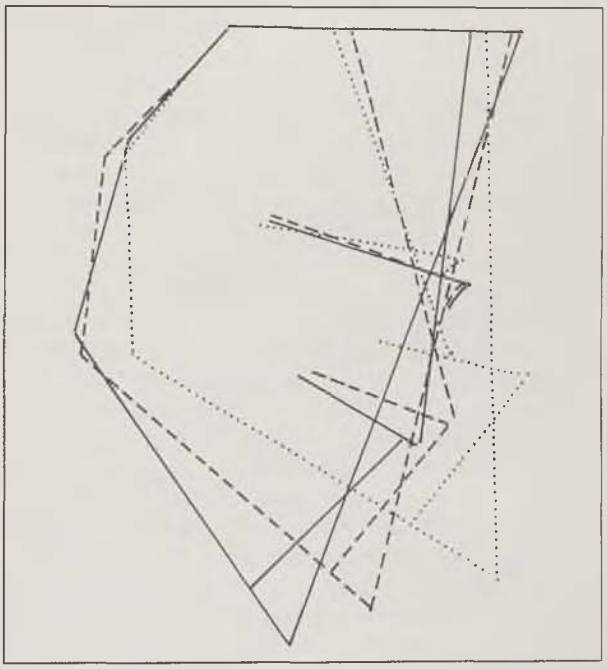


Fig. 6: Facial morphograms of Ferdinand I. (full line), his son Maxmilian II. (dashed line) and his grandson Rudolf II. (dotted line).

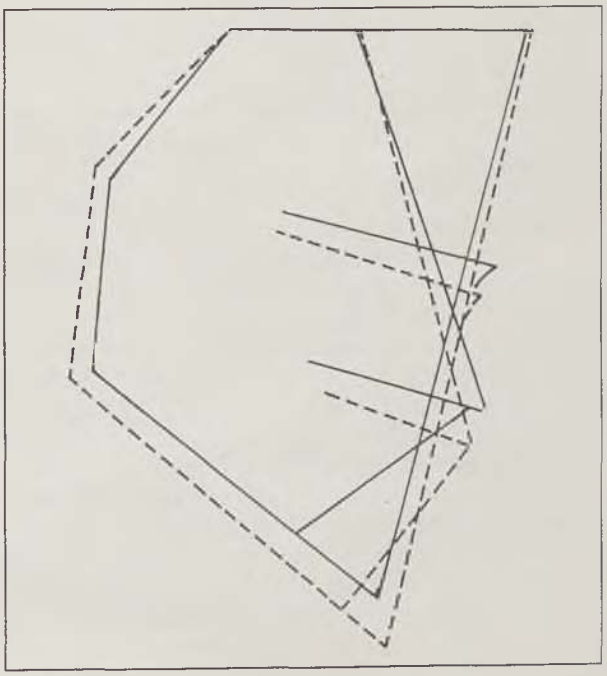


Fig. 7: Facial morphograms of Anna Jagellonska (full line) and her son Maxmilian II. (dashed line).

creased proclination of the upper incisors there is only a slight maxillary overjet (1 mm). In Rudolf II the lower jaw is elongated to such an extent, in particular in relation to the reduced anterior base and the depth of the maxilla, that it lost the intercuspidation with the upper jaw and slipped forward (Fig. 6). This is a severe third skeletal class. Because protrusion of the upper jaw is normal we can speak of true progenia. The described deviations are not associated with the curvature of the cranial base which is in all members of the imperial family within the normal range.

The morphogram of Maxmilian II's face differs markedly from the finding in his father but resembles closely that of his mother (Fig. 7). In particular, the equal anterior height of the face must be emphasized which in the father was greater, while in the son, in conjunction with the reversed occlusion, it was reduced. Therefore, the rotation of the mandible is also similar. The difference is only in the bialveolar protrusion in Anna Jagellonska. Without examining the remains of his mother it cannot be determined whether the marked deterioration of the jaws of Rudolf II. where the disproportion in the size of the two jaws could not be compensated in the natural intracranial way, was promoted also by the traits of the craniofacial morphology of the mother. It would not necessarily involve only a larger mandible but also an anterior growth rotation pattern of the lower jaw. The portraits of the mentioned emperess from the branch of the Spanish Habsburgs provide evidence of the protruding lower jaw (see above). The parameters of the lower jaw of father Maxmilian II and grandfather Ferdinand I, however, do not rule out a certain predisposition for an enlarged mandible in the Central European Habsburgs. It may be that it was fully expressed after the merging of the two Habsburg branches.

3. Contribution to the phoniatric and otorhinolaryngological findings in the Habsburgs

Cephalometric examination of the skulls of emperors and kings from the Habsburg dynasty who reigned on the Bohemian throne in the 16th and the beginning of the 17th century revealed remarkable findings in regards to the cephalometry of their neurocranium and splanchnocranium, as well as orthodontics and also provided some unorthodox findings.

From the shape of the jaws and the strongly vaulted skeleton of the trunk it may be assumed that Ferdinand I spoke rapidly with a low nasal resonance, and that he had a pectoral voice of higher pitch and impaired pronounciation of addental hissing sounds. The speech of Maxmilian and Anna Jagellonska was normal. The speech of Rudolf II was, according to analyses made by Prof. K. Sedláček, M. D., poorly comprehensible.

The poor mobility of the tongue of Maxmilian II recorded in history can be explained by the

Fig. 8: Skull of emperor Rudolf II. after removal from coffin. In the maxilla signs of fixation of a prosthesis in the form of a loop.

Fig. 9: Parts of prosthetic fixation on the maxilla of Rudolf II.

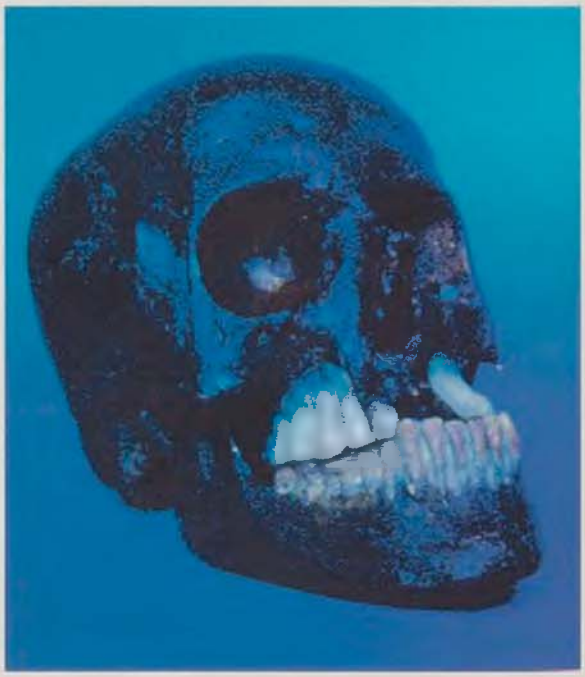


Fig. 10: The skull of Rudolf II. with a reconstructed prosthesis of the upper jaw.

finding of a 7 cm long processus styloideus elongatus on the right. This abnormally long process could produce clinical manifestations of styloid or stylocarotid syndrome with neuralgias of the trigeminal and glossopharyngeal nerve.

The great shortcoming of emperor Rudolf II - destruction of the maxilla and thus poorly comprehensible speech - later notably affected the emperor's contact with the public. He avoided official speeches and conversations. In addition to his psychopathic mental conditions this shortcoming may have also influenced his attitude to marriage with prominent brides. Was this the reason why he did not marry? His sexual demands were rather high but he met them by temporary mistresses.

Rudolf II did not have legitimate offspring but he was not childless. He lived with Catherina da Strada in Prague and Brandýs on the Elbe. He was the father of three sons and three daughters. Thus in addition to Rudolf II's exceptionally gloomy nature, the state of his speech organs also played an important role in his communication with the outside world. Various prosthetic devices did not help (Vlček, 1995; Figs. 8-10).

REFERENCES

Bertram, G.: The Course of Class III in the Habsburg. European Orthodontic Society, 1959.

Bílý, B., Pokorná, M.: Stomatologické nálezy u Ferdinanda I., jeho ženy Anny Jagellonské, Maxmiliana II. a Rudolfa II. Zpráva o výzkumu 1979, Manuscript pp. 1-26, Archiv Pražského hradu.

Gajda, Z.: Dziedziczenie progenii u Habsburgów i Jagiellonow. Crasopisma Stomatoloquiczne, 22:569-577, 1970.

Grabb, W. C. et al.: The Habsburg Jaw. Plast. Reconstr. Surg., 42:442-445, 1968.

Haecker, V.: Der Familientypus der Habsburger. Z. Induktive Abstammung- und Vererbungslehre VI:61-89, 1912.

Härle, F.: The Mandibular Prognathism of the Spanish Habsburgs. Bull. of the History of Dentisty 37:87-95, 1989.

Jirava, E., Pěgřim, R., Jelínek, R., Eber, M.: K diagnostice a léčbě prodlouženého bodcovitého výběžku. Čs. Stomat., 67:430-436, 1967.

Matiegka, J.: Tělesné pozůstatky českých králů, Čs. akad. věd a umění, Praha 1932.

Mezník, J.: „Habsburský ret" a „Habsburská čelist". Drobná plastika, 11:65-73, 1974.

Mezník, J.: Dědičné znaky habsburské v rodové linii. Drobná plastika, 12:33-46, 1975.

Mezník, J.: O vzniku dědičných znaků habsburských. Drobná plastika, 13:33-40, 1976.

Mezník, J.: Dědičné znaky habsburské ve španělské linii rodu. Drobná plastika, 14:12-19, 1977.

Mezník, J.: Závěrečná studie o děděných znacích habsburských. Drobná plastika, 14:33-46, 1977.

Rubbrecht, O.: L'origine du type familial de la Maison de Habsbourg. Bruxelles, 1910.

Šmahel, Z.: Kraniofaciální morfologie u jednostranné formy aplasie boltce a rozštěpu rtu a patra. Thesis. Chair of Anthropology, Charles University, Prague 1978.

Šmahel, Z., Tomanová, M., Müllerová, Ž., Škvařilová, B.: České normy pro Jarabakovu analýzu dálkových snímků. Čes. Stomat., 95:97-104, 1995.

Stoltenberg-Leche, J.: Die Progenie der Habsburger. Inaugural Disertation, Hamburg 1961.

Strohmayer, W.: Die Vererbung des Habsburger Familien typus. Archiv f. Rassen- und Gesellschaftsbiologie, Bd. 9, Hf. 2, 1912.

Vlček, E.: Král Kaše. Habsburkové pohřbení v Praze, 1. část. Vesmír, 72:689-690, 680-681, 1993.

Vlček, E.: Čeští Habsburkové očima antropologa. 2. část. Vesmír, 73:95-102, 1994.

Vlček, E.: Rudolf II. a jeho sestra Eleonora. 3. část. Vesmír, 73:258-265, 242, 1994.

Vlček, E.: Zpráva o antropologicko-lékařském vyšetření pozůstatků českých králů z rodu Habsburků, Manuscript 1979. Archiv Kanceláře prezidenta republiky.

Vlček, E.: Zpráva o antropologicko lékařském průzkumu pozůstatků českého krále Rudolfa II. a arcikněžny Eleonory, dcery Maxmiliána II. Manuscript 1992. Archiv Kanceláře prezidenta republiky.

Vlček, E.: Čeští králové habsburského rodu pohřbení v Praze. Proceedings of the 19 Congress of the Czech and Slovak Anthrop. Praha 1993, pp. 223-225.

Vlček, E.: Habsburský předkus a habsburský ret. Stomatologické zprávy, 36:124-226, 1995.

Vlček, E.: Srdce Habsburků. Vesmír, 75:621-624, 1996.

Wolf, J.: Blut und Rasse des Hauses Habsburg-Lothringen. (Probleme der Physiognomiengeschichte und Vererbungslehre), Zürich-Leipzig-Wien, Amalthea-Ver. 1940.

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EXPERIENCE WITH THE TREATMENT OF FACIAL GUNSHOT INJURIES

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SUMMARY

Treatment of facial gunshot injuries and their reconstruction is still one of the most serious problems of reconstructive surgery. Our experience comprises treatment of 23 patients with this type of injury. Five patients had primary treatment. In these patients, attention was focused on maintaining the patency of the airways, fixation of bone fragments and soft tissue reconstruction. In secondary reconstructions, principles of craniofacial surgery and microsurgery were applied. The majority of patients needed osteoplasties using classical or vascularized bone grafts. In injuries of the middle part of the face, the orbit, radix nasi and forehead, principles of craniofacial surgery were applied. The greatest problem is deformities after shotgun wound, where reconstructions call for repeated reconstruction procedures.

ZUSAMMENFASSUNG

Unsere Erfahrungen mit der Behandlung der Gesichtsschußverletzungen

J. Kozák, P. Voska

Die Behandlung der Gesichtsschußverletzungen und ihre Rekonstruktion gehört immer noch zu den schwierigsten Problemen der rekonstruktiven Chirurgie. Unsere Erfahrungen schließen die Behandlung von 23 Patienten mit dieser Verletzung ein. 5 Patienten wurden primär behandelt. Die Aufmerksamkeit konzentrierte sich bei ihnen aut die Erhaltung der durchgängigen Atemwege, auf die Fixation der Knochensplitter und auf die Rekonstruktion der weichen Gewebe. Bei den sekundären Rekonstruktionen wurden die Prinzipien der kraniofaziallen Chirurgie und der Mikrochirurgie angewandt. Bei den meisten Patienten war auch notwendig die Osteoplastik mit Hilfe der klassischen und vaskulierenden Knochenstücken. Bei den Verletzungen im Gebiet der Mittelgesichtes, des Orbites, der Nasenwurzel und der Stirn wurde das in der kraniofaziallen Chirurgie übliche Verfahren angewandt. Als größtes Problem bleibt die Deformation nach der Schußverletzungen, die durch die Schrotbüchse verursacht wurden. Hier muß das Rekonstruktionsverfahren mehrmals wiederholt werden.

Key words: gunshot injury, reconstruction, microsurgery, craniofacial surgery

Facial gunshot wounds are among the most serious injuries encountered. They can be classified according to various criteria: e.g., according to the severity, the type of weapon which caused the injury, the etiology of the injury (suicidal, criminal, war, hunting), etc.

Another criterion is the most severely affected anatomical area: injury of the mandible, the middle portion of the face or a craniofacial injury where the injury affects one or both orbits and the anterior cranial fossa.

War is a major cause of such injuries. During the Vietnam war facial injuries accounted for 10-15% of all injuries, i.e. cca 38 000. But even in peacetime these injuries are frequent. In the USA there are some 28 000 fatal injuries per year and the number of injured are obviously much higher (1). In the Czech Republic the number of patients with gunshot wounds of the face and adjacent structures increases every year.

In gunshot injuries the kinetic energy (KE = MV^2:2; M - mass of projectile, V - velocity of bullet) is an important factor. Therefore modern firearms with high-velocity bullets cause major injuries and loss of tissues. After the primary impact of projectile, bone fragments and teeth often act as secondary projectiles. Treatment of these patients is difficult because gunshot injuries may cause avulsion of soft and hard tissues, reduced vascularity of these tissues and major bacterial contamination (2).

Specialists should face a patient immediately after the injury but in the majority of cases, as we do not have specialized centres for the treatment of these patients, we meet them at a later stage when the reconstruction is performed.

MATERIAL AND METHODS

In our departments we had the opportunity to treat 23 facial gunshot wounds in 1985-1995. The group was comprised of 22 men and one woman, 17 to 63 years in age. Eight patients were victims of violent criminal action, seven were treated for sequelae of war injuries. Four patients had attempted suicide and in four the injuries occured by accident (handling weapons).

From this group five patients were treated immediately after the injury and the remaining 18 were referred for reconstruction after primary treatment in another department. The data on the type of weapon used are given in Table 1.

Tab. 1. Causes of injuries in our series.

Gunshot injuries caused by the weapons with low kinetic energy (pistol)	9
Gunshot wounds caused by arms with high kinetic energy (army rifles)	6
Injuries caused by shot-guns	6
Injuries caused by shells	2

In primary treatment, attention was focused firstly on maintaining the patency of the airways. The mouth was cleaned, blood was sponged and the patients were intubated. In two of five patients tracheotomy was performed. Haemorraging was gradually arrested without major problems. None of the patients needed ligature of the external carotid artery. All patients had been subjected to X-ray examination and all necessary examinations by consultants. This was followed by surgical revision, essential debridement, reposition of dislocated facial bones, their inner fixation and suture and reconstruction of soft tissues. Primary osteoplasty was not used for any of the patients.

In secondary reconstructions bone grafts had to be used to overcome defects: in three instances from the calva, 15 from the illium, including 10 vascularized grafts. In four patients a vascularized free musculo-cutaneous and fascio-cutaneous flap was used for reconstruction of soft tissues. In two patients a muscular flap from the m. temporalis, in one a deltopectoral cutaneous flap, and in one instance a musculo-cutaneous flap from the m. pectoralis major. In addition we used other local flaps such as Abbee Estandler's (2x), nasolabial (1x), cervical flap and, skin flaps of the forehead in Conver's modification for the reconstruction of the nose (2x).

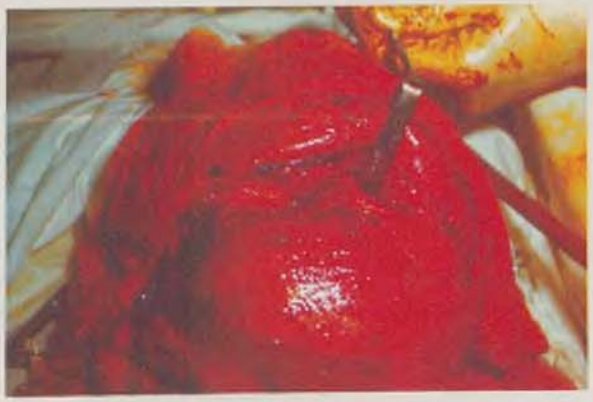
For fixation of bone grafts osteosutures were used in 10 instances: miniplates were also used in 10 instances.

Case reports

Case No 1 (Fig. 1): 63 - year old man who while handling a shotgun accidentaly shot himself in the face. After primary treatment at another department he was reffered in our hospital. We carried out debridement, fixation of the facial skeleton with miniplates and reconstruction of the soft tissue with rotation cervical flap. The cranial part of the flap necrotised and we had to provide secondary reconstruction with pectoralis major - musculocutaneous flap.

Fig. 1: Patient after admission with temporary sutures and traumating tatooing after shotgun injury.

Fig. 2a: Patient after selfinflicted shotgun injury.



2b: Surgical revision and reconstruction of the skull base.

2c: X-ray after fixation of the facial skeleton.

2d: The patient before final adjustment of the soft tissue.

Case No 2 (Fig. 2a-d): 21 - year old man who shot himself in suicidal intention. After primary treatment at anoter hospital we reconstructed cranial skull bone from bicoronary approach and fixated facial bones. Secondary we adjusted the soft tissue of the face.

Case No 3 (Fig. 3a-e): 40 - year old man with intention shot himself in the face with a shotgun. He received primary treatment at another de-

Fig. 3a: Patient after shotgun injury and posttraumatic osteomyelitis.

3b: Defect of the mandible on an X-ray film.

3c: X-ray after reconstruction of the mandible with free vascularized bone graft from the illium.

3d: Arteriography before reconstruction (left), after transfer of the vascularized bone graft from the illium (center) and after transfer of a free scapular flap (right).

3e: Patient after transfer of a free scapular flap.

Fig. 4a: Patient after war injury caused by shell.

4b: After reconstruction of the nasal skeleton with L - calvarial bone graft.

4c: Patient after reconstruction of the soft tissue and reconstruction of the nose with Conver's frontal flap.

partment and with osteomyelitis, soft tissue defect of the face and palate he was referred to our department. We closed palatal defect from local resources, reconstructed the mandible by a vascularized bone graft from the illium and the cheek by a free scapular flap.

Case No 4 (Fig. 4a-c): 42 - year old man after war injury caused by shell. We reconstructed the soft tissue of the face, nasal skeleton by calvarial bone graft and fixated the medical palpebral ligamentum.

RESULTS

One patient developed a pseudoarthrosis after primary treatment following osteomyelitis and was treated secondarily by osteoplasty. All bone grafts were incorporated without any problems. During soft tissue reconstructions one free flap from the forearm was lost and a partial loss was suffered in a rotated cervical flap which was used immediately for reconstruction after a shotgun injury.

DISCUSSION

For the primary treatment of these patients the etiology of their injury is extremely important. After injuries caused by projectiles with low kinetic energy a conservative procedure may be used, i.e. minimal or no debridement, fixation of bone fragments and suturing of the wounds. This experience was confirmed during the civil war in Northern Ireland and we used similar procedures for this type of injury with no resulting complications (10). In primary treatment of injury caused by projectiles with high kinetic energy and shotguns, we made, consistent with others (3, 5, 6), the essential debridement, fixed the facial skeleton using osteosutures and miniplates and covered the bony skeleton with soft tissues. In one patient injured by a shotgun we started immediate reconstruction using a rotated cervical flap. The cranial portion of the flap, however, necrotized completely (Fig. 1). There is probably some association with zones which develop close to the missile pathway. The remote zone of molecular damage is very questionable, as its bounderies are not accurately defined. This zone is characterized by the development of complicated haemodynamic and metabolic processes which may lead to extensive cutaneous ischaemia, as in the described patient (7). In complicated cases it is sometimes necessary to repeat debridement (3). A frequently discussed problem is the suitable time for bone reconstruction. In the Vietnam war, bone reconstruction of the mandible was done eight months after the injury and was needed in 38% of the wounded. Of this number 16% failed. Attempts of immediate osseous reconstruction of the mandible usually failed (7).

Final bone reconstruction was delayed after comprehensive reconstruction of soft tissues. This multi-stage treatment has, however, many shortcomings because it is associated frequently with extensive scarring, and contraction of soft tissues in particular in the middle portion of the face (3).

Therefore, recently new therapeutic patterns were elaborated where the authors recommend, if the patient's general condition permits, immediate bone reconstruction of the middle portion of the face to create adequate support for the soft facial tissues, and in cases with major losses of soft tissues, to cover these grafts by the vascular-

ized omentum (4). None of the authors recommends immediate reconstruction of the mandible as the majority of these attempts fails (3, 4, 7, 11). For bone reconstruction of the middle portion of the face bone grafts from the calva and ribs are used (5). In group destribed herein none of the patients was thus treated as they did not suffer from such severe injuries calling for this method of treatment. The question remains whether the patient is able to undergo in the acute stage, a reconstruction operation which lasts many hours. It is, however, beyond any doubt that perfect primary treatment gives the best functional and cosmetic results (3, 5, 6).

If the patient s general condition does not permit primary reconstruction, it should be implemented within the shortest possible time, i.e. 7-10 days. In late reconstructions when the patients are referred for various reasons after long intervals, progressive methods of craniofacial surgery and microsurgery are used, as well as CT imaging methods and fixation of the facial skeleton by means of miniplates (3, 4, 8).

Before the planned reconstruction the following factors must be carefully considered:

1. age, sex, physical and psychological characteristics of the patient,
2. time interval after injury,
3. nature, extent of injury and defect.

The face is a complicated set of functional and aesthetic units. When planning reconstructions certain principles must be respected. Soft tissue defects should be covered in the first place by rotation and transposition flaps with regard to the skin colour and satisfactory final aesthetic effect. If the defect is large, muscular, musculo-cutaneous or free flaps can be used. Bone defects up to 3-4 cm are usually treated by the use of conventional bone grafts from the illium. In larger mandibular defects it is convenient to use free vascularized bone grafts from the illium, fibula or scapula (5, 11).

In reconstructions, principles of craniofacial surgery were frequently used. One of them is also the use of bone grafts from the calva which we also used successfully in reconstructions of the maxilla and mandible, as well as in reconstructions of the nose. We used full thickness bone grafts as well as grafts of the cortical layer only (8).

The authors also made use of the advantages of a bicoronary approach to gain better access to cranial portions of the facial skeleton when treating frontobasal injuries. They found the advantages offered by muscular flaps from the m.temporalis for closing palatal defects very useful as well (8).

The greatest problem of reconstruction are patients injured by shotguns, usually attempted suicide. The injury affects in particular the area of the mandibular symphysis and the middle portion of the face and is sometimes associated with severe injuries of the cranial nerves and in particular uni-or bilateral amaurosis has a great impact on the patient. Reconstructions are in these patients a long-term problem and various reconstruction principles must be used (4). The condition frequently calls for repeated transfer of one or several vascularized flaps and despite this the results are sometimes problematic.

CONCLUSION

Treatment of these patients remains, despite advances of modern surgical methods, a serious problem which must be resolved not only in the surgical but also the psychological aspect. Patients with facial deformities are, on contrary to patients with congenital defects, much more sensitive and untolerable of the altered appearance and subjective complaints. New surgical procedures should not only improve the standard of treatment but also shorten it.

REFERENCES

1. Baker, S. P.: 28 000 gun deaths a year. What is our role? Trauma J., 16:510, 1975.
2. Banks, P.: Gunshot wounds. In: Rowe, N. T., Williams, J. L., (eds.), Maxillofacial Injuries. Churchill-Livingstone, London 1985:561-694.
3. Clark, N., Birely, B., Manson, P. N., Slezak, S., Kolk, C. V., Robertson, B., Crawley, W.: High-energy ballistic and avulsive facial injuries: Classification, patterns and an algorithm for primary reconstruction. Plast. Reconstr. Surg., 98:583-601, 1996.
4. Denny, A. D., Sanger, J. R., Matloub, H. S., Yousif, N. J.: Self-inflicted midline facial gunshot wounds: The case for a combined craniofacial and microvascular team approach. Ann. Plast. Surg., 29:564-570, 1992.
5. Gruss, J. S., Antonyshyn, O., Phillips, J. H.: Early definitive bone and soft-tissue reconstruction of major gunshot wounds of the face. Plast. Reconstr. Surg., 87:436-450, 1991.
6. Gruss, J. S., Van Wyck, L., Phillips, J. H., Antonyshyn, O.: The importance of the zygomatic arch in complex midfacial fracture repair and the correction of posttraumatic orbitozygomatic deformities. Plast. Reconstr. Surg., 85:878-890, 1990.
7. Kelly, J. F.: Management of war injuries to the jaws and related structures. Documents U.S. government printing office, 1977, 33-53.
8. Kozák, J., Voska, P.: Our experiences with the reconstruction of war and shot injuries. Abstracts of the first congress of surgery of Bosnia and Herzegovina, Sarajevo, 1996, 145.
9. Nemeth, T., Kozák, J., Voska, P.: Úrazy obličeje. Avicenum, Praha 1991, 138-146.
10. Whitlock, R.: Urban guerilla warfare. In: Rowe, N. T., Williams, J. L., (eds.), Maxillofacial Injuries, Vol 2. Churchill-Livingstone, Edinburgh 1985, 664.
11. Williams, C. N., Cohen, M., Schultz, R. C.: Immediate and long-term management of gunshot wounds to the lower face. Plast. Reconstr. Surg., 82:433-439, 1988.

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CALCIUM ALGINATE DRESSINGS PROMOTE HEALING OF SPLIT SKIN GRAFT DONOR SITES

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SUMMARY

A prospective controlled trial was carried out to assess the healing efficacy of calcium alginate and paraffin gauze on split skin graft donor sites. Thirty patients were randomised to the calcium alginate group and 21 to the paraffin gauze group. The donor sites were assessed at 10 days post harvesting to determine if they were completely healed (100%) or not. Twenty one of the 30 patients dressed with calcium alginate were completely healed at day 10, while only 7/21 in the paraffin gauze group were healed ($p < 0.05$). There were two infections in the study, both occurring in the alginate group while there was no difference in dressing slippage between the two groups. Calcium alginate dressings provide a significant improvement in healing split skin graft donor sites.

ZUSAMMENFASSUNG

Die Behandlung der Wunde mit kalzio-alginatem Verband unterstützt die Heilung des zerspalteten Hautlappens der Entnahmestelle

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Prospektive kontrolle Studie wurde durchgeführt. Sie befaßte sich mit der Bestimmung der Heilkrafte vom kalzio-alginaten Verband und der paraffinierten Gaze aut den zerspalteten Hautlappen der Entnahmestelle. 30 Patienten wurden zufällig in die kalzio-alginate Gruppe eingereiht und 21 Patienten kamen in die andere Gruppe, wo die paraffinierte Gaze angewandt wurde. Die Entnahmestelle wurde nach 10 tagen seit der Lappenentnahme beurteilt mit der Bestimmung, ob diese Stelle komplet verheilt (100%) ist oder nicht. 21 von 30 Patienten aus der kalzio-alginaten Gruppe waren am 10 Tag komplet verheilt, wobei nur 7 von 21 Patienten aus der anderen Gruppe auch verheilt ($p < 0.05$) waren. In der Studie wurden 2 Infektionen festgestellt, beide in der kalzio-alginaten Gruppe, obwohl es zu keinem Unterschied in der Verbandtechnik zwischen den beiden Gruppen kam. Der kalzio-alginate Verband verbessert signifikant die Heilung des zerspalteten Hautlappens der Entnahmestelle.

Key words: split skin graft, donor site, calcium alginate

Split skin graft donor sites have traditionally been dressed with paraffin gauze and absorbent padding. However, problems with this dressing include wound adherence, which can result in pain during removal and damage to healing epithelium when it is stripped off. The tendency therefore has been to leave these dressings undisturbed for up to two weeks. In addition, these dressings tend to be bulky and consequently limit mobility. In an attempt to overcome these problems many dressing types have been used on donor sites. These include polyurethane films (1), hydrocolloids (2) and silver impregnated porcine xenografts (3). However polyurethane films and porcine xenografts have failed to demonstrate improved healing (1, 2). Although hydrocolloids have been shown in some series to improve healing (4), leakage of wound exudate from beneath the dressing tends to be high. Conversely polyurethanes trap wound exudate and haematomata. Alginates, derived from brown seaweeds (*Laminaria hyperborea*) were used for medicinal purposes in Scotland and Ireland as far back as the early eighteenth century (5). More recently, calcium alginate dressings (Kaltostat® - Britcair) have been shown to possess haemostatic properties (6). The aim of this trial was to compare the healing efficacy of tulle gras (Jelonet® - Smith and Nephew) to calcium alginate (Kaltostat®) on split skin graft donor sites.

MATERIALS AND METHODS

Fifty one patients requiring split skin grafts for small full thickness burns were prospectively randomised into two groups. Exclusion criteria were applied i.e. patients on long term steroid medication, diabetics, patients with autoimmune collagen vascular diseases and patients with general debility including those with nutritional defi-

ciencies were excluded from the study. This was necessary in order to reduce as much as possible the number of variables that can potentially influence wound healing. Patients randomised to group A had their donor sites dressed with a single layer of paraffin gauze (Jelonet®), which was covered with three layers of cotton gauze, cotton wool padding and secured with a bandage. Group B patients had their donor sites dressed with Kaltostat® impregnated with 0.25% plain bupivacaine in order to minimise postoperative pain. This was overlaid with Jelonet®, cotton gauze, cotton wool and a bandage. All grafts were harvested from the lateral aspect of the thigh using a Padgett® electric dermatome at a setting of 0.01 inches. This ensured as much as possible, uniform thickness of the grafts harvested. An adrenalin soaked gauze was placed temporarily on each donor site for ten minutes prior to applying the dressing. The dressings were removed on day ten after surgery by the first author (JOD) and the donor site was assessed. A donor site was classified as 100% healed if the wound had a dry re-epithelialised surface. Less than 50% healing of the donor site was also recorded. The presence of infection was assessed by culturing wound swabs from donor sites that were unhealed at day 10. Wound contact dressing slippage was also noted following removal of the outer dressings.

RESULTS

Thirty of the 51 patients had their donor sites dressed with Kaltostat® while 21 were dressed with Jelonet®. There were no significant differences in the gender distribution or age ranges between the two groups of patients (Tab. 1). There were two non resistant *Staph. aureus* infections in the study. Both occurred in the Kaltostat® group. Eight Kaltostat® dressings slipped as compared to four Jelonet® dressings. This difference was not statistically significant (Tab. 2). Twenty one of the 30 patients in the Kaltostat® group were completely healed at day ten, while only seven patients in the Jelonet® group were healed. This was statistically significant at the 5% level on chi square analysis; p = 0.021 (Tab. 3). However at less than 50% surface area healing, there was no statistical difference between the two groups; p = 0.181. Nevertheless only two patients in the Kaltostat® group fell into this category as opposed to five in the Jelonet® group (Tab. 3). Both of these Kaltostat® dressed patients had *Staph. aureus* wound infections sensitive to flucloxacillin, whereas none of the five Jelonet® treated patients who failed to heal were infected.

Tab. 1. Age and gender "distributions" in the study.

	MALES	FEMALES
KALTOSTAT® JELONET®	19 10	11 11
	$X^2 = 0.685$ $p > 0.10$ (NS)	
	AGE RANGE	MEAN AGE
KALTOSTAT® JELONET®	5-63 YRS 5-74 YRS	38 YRS 46 YRS

Tab. 2. Dressing slippage.

	SLIPPAGE	NO SLIPPAGE
KALTOSTAT® JELONET®	8 4	22 17
	$X^2 = 0.087$ $p > 0.50$ (NS)	

Tab. 3. Donor site healing at day ten.

	100% HEALED	< 100% HEALED
KALTOSTAT® JELONET®	21 7	9 14
	$X^2 = 5.308$ $p < 0.05$	
	< 50% HEALED	> 50% HEALED
KALTOSTAT® JELONET®	2 5	28 16
	$X^2 = 1.878$ $p > 0.05$ (NS)	

Yates' correction for continuity used in all chi-square analyses.

DISCUSSION

The ideal dressing for split skin graft donor areas should fulfil the following criteria (7):

1. Promote rapid pain-free healing.
2. Maintain a moist sterile environment, while removing excess exudate.
3. Be removable without causing trauma to the re-epithelialised surface.
4. Be actively haemostatic, while allowing gaseous exchange.
5. Be impermeable to bacteria.
6. Be free from toxic wound contaminants.
7. Not result in hypertrophic scarring.

Calcium alginate dressing on split skin graft donor sites has been shown in this study to be superior to traditional dressings of paraffin gauze in terms of percentage surface area healed at ten days post harvesting. Similar results have been demonstrated by Attwood (8) and more recently Basse (9). Attwood demonstrated that complete healing had occurred by 7 ± 0.71 days with a Kaltostat® dressing compared to 10.75 ± 1.6 days with paraffin gauze, while Basse demonstrated healing at 8.3 days versus 10.2 days in favour of the Kaltostat® group. In this study, we did not examine the time taken to complete healing, but rather the percentage area healed on the first dressing change at day ten. Day ten was chosen, as this was the the day we traditionally inspected donor sites in our unit when they were dressed with Jelonet®.

In this study, we impregnated the Kaltostat® with 0.25% plain bupivacaine. This has been shown in a previous study to significantly reduce postoperative donor site pain (10). Although the

effects of bupivicaine on wound healing are unknown, it has been clearly shown that the use of bupivicaine on alginates does not interfere with the healing of split skin graft donor sites (10). The effects of bupivicaine on the gelling properties of alginates are also unknown. Nevertheless it is obvious that bupivacaine moistens the dressing. This may help accelerate the formation of a hydrophilic gel at the wound interface. Hydrophilic gel formation results from the ion exchange reaction between the calcium of the alginate filaments and the sodium in the blood and exudate. Release of soluble calcium ions provides one of the essential factors of the clotting cascade (Factor IV) (11). Attwood (8) makes the point that gel formation produces a wet "sloughy" dressing which will fall off painlessly at the first dressing change. We did not find this to be the case in this study. Invariably the Kaltostat® was dry and required soaking to be removed. This can result in pain during removal and damage to healing epithelium with consequent bleeding. Some completely healed patients may then have been classified as unhealed. Attwood commenced inspecting wounds as early as day one and finally standardised his assessments at seven days after the first ten patients. We chose day 10 for inspection as this was the day traditionally used in our unit for inspecting donor sites. The Kaltostat® was overlaid with Jelonet® in an attempt to prevent the Kaltostat® from becoming dry. However even Jelonet® "dries" out if left on a wound too long. Since this trial, we have commenced another trial comparing Kaltostat® with newer synthetic dressings. We have begun our inspections on day 7 in this trial and have found that the Kaltostat® dressing is invariably moist and falls off painlessly. Therefore, it would appear that leaving Kaltostat® dressings in situ for ten days or longer will result in drying out and consequently prove difficult and painful to remove.

In this study, both the Kaltostat® and Jelonet® dressings were applied without overlap, and this probably contributed to the relatively high slippage rate in both groups. Contact layer slippage allows the outer dressing to adhere to the wound surface. This results in pain on removal and damage to the healing epithelium. We would therefore recommend that a generous overlap (of at least 2 cm) be used when applying the contract layer of Kaltostat®.

Attwood (8) found a lower rate of infection in the alginate treated group but this was not statistically significant. We on the other hand had a higher rate of infection in the Kaltostat® group. However, the number of patients is too small to make any meaningful conclusions from this.

The bulkiness of the dressings was the same in both groups. We were of the impression that covering Kaltostat® with Jelonet® would help keep the Kaltostat moist during the first ten days, while still allowing exudate to pass into the overlying padding. This does not appear to be the case, while Attwood (8) states that it is not necessary to provide thick bandaging provided there is sufficient alginate to absorb the initial bleeding.

Finally, in those who require multiple grafting procedures for large burns, improved donor site healing would allow donor sites to be recropped earlier, thus facilitating earlier healing of the large burn wound.

CONCLUSIONS

In conclusion, calcium alginate dressings promote healing of split skin graft donor sites. We would recommend their routine use and would suggest that Kaltostat® be impregnated with 0.25% bupivacaine during application. A generous overlap onto normal skin should be used so as to prevent dressing slippage, while we would also recommend that the first dressing change should be done on day seven. The advantages accrued from the routine use of calcium alginate would include a substantial cost saving due to more rapid and effective healing.

REFERENCES

1. Jonkman, M. F.: Poly (ether urethane) wound covering with high water vapour permeability compared with conventional tulle gras on split-skin graft donor sites. PhD Thesis, University of Groningen, 1989.
2. Tan, S. T., Roberts, R. H., Sinclair, S. W.: A comparison of Zenoderm® with DuoDERM® in the treatment of split skin graft donor sites. Br. J. Plast. Surg., 46:82-84, 1993.
3. Vanstraelen, P.: Comparison of calcium sodium alginate (KALTOSTAT®) and porcine xenograft (E-Z DERM®) in the healing of split-thickness skin donor sites. Burns, 18:145-148, 1992.
4. Tan, S. T., Roberts, R. H., Blake, G. B.: Comparing DuoDERM E with scarlet red in the treatment of split skin graft donor sites. Br. J. Plast. Surg., 46:78-81, 1993.
5. Martin, M.: A description of the Western Islands of Scotland. 1716.
6. Groves, A. R., Lawrence, J. C.: Alginate dressing as a donor site haemostat. Annals of the Royal College of Surgeons of England, 68:27-28, 1986.
7. Turner, T. D.: The functional development of wound management products. Proceedings of medical applications of textiles. Leeds University, July 1981.
8. Attwood, A. I.: Calcium alginate dressing accelerates split skin graft donor site healing. Br. J. Plast. Surg., 43:373-379, 1989.
9. Basse, P., Siim, E., Lohmann, M.: Treatment of donor sites - calcium alginate versus paraffin gauze. Acta Chir. Plast., 34:92-98, 1992.
10. Butler, P. E. M., Eadie, P. A., Lawlor, D., Edwards, G., McHugh, M.: Bupivacaine and Kaltostat reduces post-operative donor site pain. Br. J. Plast. Surg., 46:523-524, 1993.
11. Jarvis, P. M., Galvin, D. A. J., Blair, S. D., McCollum, C. N.: How does calcium alginate achieve haemostasis in surgery? XIth International Congress of Thrombosis and Haemostasis. Brussels, 8-10 July 1987.

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COMBINED TECHNIQUE OF ANESTHESIA IN EARLY AND LATE NECK RECONSTRUCTION

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SUMMARY

Once the notion of the „quality of life" has been used in deliberations about straight-forward cases, it may be given wider application. It may be invoked in intensive care, in care of the handicaped and in any of medicine's specialist areas.

In severe burns to keep the patient alive occurs at the cost of a degree of discomfort and disability caused by scar formation and following deformities.

Severe anterior neck burn scar contracture issues in serious functional embarrassement, requiring early neck reconstruction based on three principles: releasing shrinked area, restoring contour of the mento-collical angle and preventing recurrence.

Performing the surgical procedure demands endotracheal intubation which is impossible to accomplish because of chin adherent to jugulum. Combined technique of anesthesia using intravenous introduction (Ketalar) with or without local infiltration of the anterior neck scarring and immediate cutting through to the healthy muscle layer is necessary. Then follows insertion of endotracheal tube. The interval between incision and insertion may be rather crucial, as will be demonstrated in one of the cases treated in the Prague Burn Center during the last two decades.

ZUSAMMENFASSUNG

Die Technik einer kombinierten Anästhesie bei frühen oder späten Halsrekonstruktionen

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Wenn sich einmal über die Lebensqualität bei den klaren, offensichtlichen Fällen nachzudenken begann, dann ist möglich diesen Begriff in den breiteren Aplikationen zu verwenden und zwar in der Intensivpflege, in der Pflege über die Behinderten und in irgendeinem medizinischen Bereich. Bei den schweren Verbrennungen gelingt es das Leben des Patienten zu retten für den Preis der Unbequemlichkeit und Beschränkung der Arbeitsfähigkeit, was durch die Narbenbildung und der folgenden Verunstaltung verursacht ist.

Die gefährliche Narbenkontraktur, die durch eine Verbrennung im anteriorem Halsbereich verursacht wurde, führt zu den schweren funktionellen Beschwerden und verlangt deswegen die frühzeitige Halsrekonstruktion. Diese Halsrekonstruktion beruht auf drei Prinzipien: der geschrumfte Bereich wird gelockert, die Kontur des mento-collicalen Winkels erneuert und das Rezidiv verhindert.

Der chirurgische Eingriff verlangt die endotrachealle Intubation, die nicht durchführbar ist, denn das Kinn zum Jugulum zugezogen ist. Es ist notwendig die kombinierte Technik der Anästhesie zu verwenden, die auf der intravenosen Einführung (Ketalar) beruht, mit oder ohne lokaler Infiltration der anterioren Halsnarbe und schließlich kommt der Schnitt durch die nicht beschädigte Muskelschicht. Dann folgt die Einlegung des endotrachealen Tubuses. Das Intervall zwischen der Inzision und Insertion kann kritisch sein, was an einem Fall, der im Prager Verbrennungszentrum während der letzten zwei Dekaden behandelt wurde, demonstriert wird.

Key words: anesthesia in burns, anesthesia and neck reconstruction, neck postburn contracture

The priorities of reconstructive surgery are so variable according to circumstances and differ from patient to patient. Reconstructive surgery has been rendered immeasurably safer by the skilled anesthetic techniques being developed, notably endotracheal intubation (1).

The aim of burn care is to ensure survival, but survival is not a subtle enough indicator of the pathophysiological processes or a measure of our success or failure. We must step back to the scar result, where the most important factor is the site of scarring. Severe anterior neck burn scar contracture issues in serious functional embarrassement, requiring neck reconstruction based on three principles: releasing shrinked area, restoring contour of the angle below mandible and preventing recurrence (Tab. 1).

Tab. 1.

NECK RECONSTRUCTION REQUIRES:
- RELEASING SCAR CONTRACTURE - RESTORING CONTOUR OF THE ANGLE BELOW MANDIBLE - PREVENTING RECURRENCE

Performing the surgery demands endotracheal intubation which is impossible to accomplish because of a rigid scar shield restricting mobility of the mandible. In extensive burns most of the parenchymatous organs suffer overload or damage during the long-lasting treatment, and therefore, the choice of a suitable anesthetic drug for delivery of general anesthesia is rather limited. The inhalation technique for induction by means of volatile anesthetics (Halothan) - as mentioned in Burns 1996 - has to be dismissed in extensive burns, though this technique is relatively safe in patients with mechanical obstruction of the upper airways of different origin (2).

The anesthetists in the Prague Burn Center have been using for induction of general anesthesia in the neck postburn contractures Ketamine intravenously, demand dose ranged from 1 to 2 mg per kilogram of body weight. This induction has been combined with local anesthesia using Mesocain, infiltrated in and under the scarred area (3). The local anesthesia has been used by Burian's school since the First World War. It is convenient for the surgeon, because the scarring involves usually deep structures and thus the infiltration protects large vessels and trachea, which might be distorted and endangered by cutting the hard scar layers of cartilagenous character. Ketamin provides a satisfactory analgesia without respiratory depression and enables the surgeon to penetrate through this rigid area and to extend the incision until cervical hyperextension is possible. This enables the anesthetist to insert the endotracheal tube using the relaxation technique, discerning between the depolarizing and not depolarizing drugs for myorelaxation. After the airways have been secured there are usually no other problems to be solved regarding the GA (Tab. 2).

Tab. 2.

DEPOLARIZING DRUG:	
SUCCINYLCHOLINJODID 0,75 mg - 1 mg/1 kg	
- NOT DEPOLARIZING DRUGS:	
ALLOFERIN (toxiferin)	1 mg/5 kg
ARDUAN (pipecuronium)	1 mg/10 kg
NORCURON (vecuronium)	1 mg/10 kg

To secure successful result it is preferential to keep the patient mechanically ventilated in the intensive care ward for several hours or till the next day. The postoperative care is just important as the surgical procedure. Extubation follows, like in other cases, when the patient is awake, spontaneous ventilation is satisfactory and his airways and oral cavity are clear.

One atypical case should be demonstrated, in whom the interval between release incision and insertion of ET tube raised a critical situation. A 27-year-old woman fell on gas cooker in an epileptic paroxysm. She sustained flame burns full-thickness to 24 per cent of TBSA, the site of burn was her face, neck, anterior thorax and upper extremities, together with inhalation injury. She had been suffering from epilepsia since her childhood and this accident happened though she had been on antiepileptic therapy all the time.

On admission she was intubated and the inhalation injury required the artificial ventilation for 10 days. In the course of treatment she had repeated EP paroxysms in spite of the altered therapy (Timonil, Orfiril). This underlying disease excluded use of Ketamin and the general anesthesia was delivered either by repeated intermittent bolus or by slow continuous intravenous infusion of Fentanyl and Diprivan (2,5 mg/kg) (Table 3).

Tab. 3.

DIPRIVAN (propofol)
dose: 2,5 mg/1 kg slow i. v. infusion: 40 mg/10 sec.

For necrectomies and grafting she was intubated. Despite of the inhalation injury no problems were encountered until the 8th week after accident when the final grafting of her chest was planned. ET anesthesias which preceded (7 days and then, 3 days before) were without complications. However, the 56th day during the i.v. induction there occured unpredicted difficulty in intubation, that had been successful everytime before. This time the surgical neck release had to be performed promptly as an emergency - without local infiltration. After this urgent release the insertion of ET tube was managed smoothly and autografting easily accomplished.

The period between the initial burn injury and the neck release ranged from 8 weeks to 8 months.

A 7-year-old boy was involved in an explosion when throwing acetone on fire-place. He suffered flame burn to 72 per cent of TBSA (deep dermal burn 28%, full thickness 44%). Apart from the other areas his neck was excised on day 10 after accident and grafted with meshgraft (1 : 1,5). 15 days after accident he was extubated (Fig. 1). Due to his critical condition and extreme obesity any positioning or splinting was very difficult to perform. He developed severe anterior neck contracture, microstomia and eversion of lower lip (Fig. 2, 3). Combined technique of anesthesia for neck release was used and **full-thickness skin graft** for his chin and lower lip and **thick dermoepidermal graft** to his neck were applied (Fig. 4, 5, 6).

Fig. 1: 7-year-old boy after necrectomy and grafting of his neck 10days after accident.

Fig. 2.

Fig. 3.

Fig. 2, 3: Severe anterior neck contracture, microstomia, eversion of his lower lip 8 months after accident.

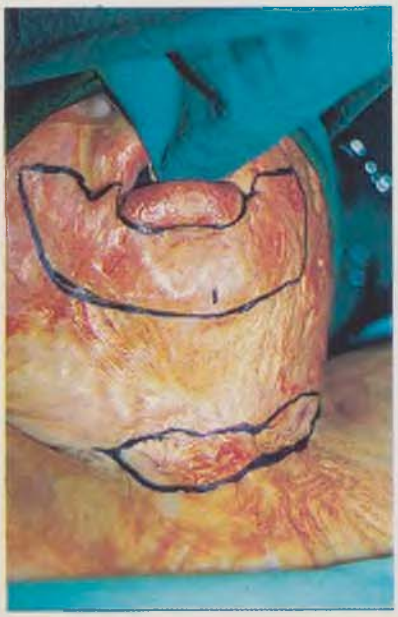

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 4, 5, 6: Neck release under combined technique of anesthesia.

A 13-year-old boy who was involved in an electrical injury and suffered also flame burn to 70 per cent of TBSA, in Croatia. All the treatment was carried out in Zagreb except grafting of his back and left upper extremity. He was transported to the Prague Burn Center 8 month after the accident (Fig. 7). The fifth day after admission here the neck contracture was restored (Fig. 8, 9, 10) and all the other necessary surgical procedures were accomplished (Fig. 11, 12).

In conclusion there should be pointed out the indispensability of the interdisciplinary team work throughout the long-lasting burn care, as in burn patients any emergency may befall at any time and under any circumstances.

Fig. 7: 13-year-old boy after 8 months' treatment in Zagreb who was involved in an electrical injury and suffered also flame burn to 70 per cent of TBSA.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 8, 9, 10: Neck release under combined technique of anesthesia.

Fig. 11.

Fig. 12.

Fig. 11, 12: Physiotherapy including neck and axilla splints.

REFERENCES

1. Thompson, R. V. S.: Kay-Kilner Prize Essay. Brit. J. Plast. Surg., 48:410-418, 1995.

2. Kreulen, M., Mackie, D. P., Kreis, R. W., Groenevelt, F.: Surgical release for intubation purposes in post-burn contractures of the neck. BURNS, 22, 4:310-312, 1996.

3. Jíchová, E., Königová, R.: Specific features of anesthesia in the reconstruction period in severe burns. Acta Chir. Plast., 22:177-181, 1980.

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LIPOFUSCIN PRODUCT ACCUMULATION, INSUFICIENT ANTIOXIDANT DEFENCE IN ERYTHROCYTES AND PLASMA AND ENHANCED SUSCEPTIBILITY TO OXIDATIVE HAEMOLYSIS AFTER THERMAL TRAUMA

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SUMMARY

The mechanism of increased susceptibility of red blood cells to oxidative haemolysis in the early post-burn period remains unclear. In this study it was revealed that the accumulation of lipofuscin products in red blood cells was accompanied by the elevation of oxidative haemolysis on the 24th hour after thermal trauma of rats (full thickness skin, on 20% of TBSA). Enhanced thiobarbituric acid reactive substrates (TBARS) and lowered levels of antioxidants such as α-tocopherol, ceruloplasmin and albumin were found in plasma. The activity of superoxide dismutase (SOD) and the concentration of α-tocopherol and reduced glutathione (GSH) in erythrocytes were also diminished. The results from this study suggest that plasma and intracellular antioxidant deficiency can potentiate oxidative membrane damage. There was a possitive correlation (r = 0.72) between increased levels of lipofuscin products and oxidative haemolysis of red blood cells. The enhanced susceptibility of erythrocytes to oxidative haemolysis may be considered as an indirect but sensitive indicator of the impaired antioxidant defence of these blood cells following thermal skin injury. The decreased resistance of red blood cell to oxidative haemolysis under the conditions of reduced antioxidant defence of erythrocytes and blood plasma suggests that adequate antioxidant therapy could prevent all these complications after thermal skin injury.

ZUSAMMENFASSUNG

Die Akumulation der Lipofuszinprodukte, der inzuffiziente Antioxidanzschutz in den Erytrozyten und im Plasma und die erhöhte Neigung zur oxidativen Hemolyse nach einem termalen Trauma

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Der Mechanismus der erhöhten Aufnahmefähigkeit der roten Blutzellen zur oxidativen Hemolyse bleibt in der frühen Periode nach der Verbrennung unsicher. In dieser Studie wurde bei Ratten festgestellt, daß nach dem termalen Trauma (die völlige Hautdicke aut 20% TBSA) die Ansammlung der Lipofuszinprodukte in den roten Blutzellen von der erhöhten oxidativen Hemolyse in 24 Stunden begleitet wurde. Im Blutplasma kam es zur Erhöhung des reaktiven Substrates der thiobarbiturischen Säure (TBARS) und zur Herabsetzung des Antioxidanzspiegels, wie Alpha-Tocopherol, Ceruplasmin und Albumin. In den Erytrozyten wurde auch die Aktivität des Superoxides dismutasa (SOD) und die Konzentration des Alpha-Tocopherol und des reduzierten Glutathions herabgesetzt. Die Ergebnisse dieser Studie setzen voraus, daß das Plasma und der Mangel an die intrazellularen Antioxidanten die oxidative Membranbeschädigung verstärken können. Es wurde gefunden die positive Korelation (R = 0,72) zwischen dem erhöhten Spiegel der Lipofuszinprodukte und der oxidativen Hemolyse der roten Blutzellen. Die erhöhte Aufnahmefähigkeit der Erytrozyten zur oxidativen Hemolyse kann für den undirekten, aber sensitiven Indikator der beschädigten antioxidativen Abwehr dieser Blutzellen infolge der termalen Hautverletzung gehalten werden. Diese herabgesetzte Resistenz der roten Blutzellen zur oxidativen Hemolyse unter Bedingungen der reduzierten antioxidativen Abwehr bei den Erytrozyten und beim Blutplasma setzt voraus, daß die entsprechende antioxidative Therapie an allendiesen Komplikationen nach der termalen Hautbeschädigung verhindern kann.

Key words: thermal skin injury, erythrocytes, oxidative haemolysis, lipofuscin products, α-tocopherol, SOD, GSH, Plasma-TBARS, ceruloplasmin, albumin

Severe thermal injury is known to result in early postburn loss of erythrocyte mass and increased number of morphologically abnormal erythrocytes (echinocytes, hexagonal cells and spherical cells) showing a decreased resistance to oxidizing agents (1, 2). The mechanisms of erythrocyte disorders, however, are complex and still unclear. It has been reported that membrane protein alterations of red blood cells cause to increased oxidative haemolysis after burn injury

(1). The activation of lipid peroxidation and the accumulation of malonyl dialdehyde (MDA) lead to shortened life span of red blood cells in circulation (3). MDA cross links the aminogroups of membrane proteins and phospholipids to form fluorescent products called aging pigment or *lipofuscin* products (4). It has been demonstrated that the accumulation of these lipid fluorescent products in old animals, aging erythrocytes and erythrocytes exposed to oxidant agents that initiate membrane lipid peroxidation (5, 6). It is unknown, however, whether the formation of postburn fluorescent products in red blood cells is linked to the resistence of these cells to oxidative haemolysis. Vitamin E (α-tocopherol) deficiency in erythrocytes may increase their susceptibility to oxidative stress (7). The data about plasma antioxidants and erythrocyte antioxidative enzymes protecting red blood cells against oxidative alteration in the early postburn period are scarce and contradictive (8, 9).

The aim of the present study was to examine oxidative haemolysis, lipid peroxidation products and antioxidant defence in plasma and erythrocytes in the early postburn period.

MATERIAL AND METHODS

Male Wistar rats weighing 230 ± 21 g (mean ± SD) were distributed randomly into two groups: (1) control (not-burnt) group (n = 8) and (2) burnt group of (n = 8). Under thiopental (30 mg/kg) anesthesia the shaved dorsal skin over the lumbosacral area of rats was exposed to about 20% total body surface full thickness burn by immersion in 90 °C water for 10 seconds.

Venous blood was obtained from the tail vein under light narcosis on the 24^{th} hour after the injury. Blood was collected in tubes containing 3,8% sodium citrate. The samples were immediately centrifuged at 2000 g for 10 minutes at room temperature. The supernatant was separated from the pellet and used for the assay of TBARS, α-tocopherol, ceruloplasmin and albumin concentrations. The pellet, which consisted mainly of erythrocytes was used for determination of the resistance of red blood cells to oxidative hemolysis, free radical mediated injury of red blood cells and antioxidant defence of these cells.

TBARS and fluorescent lipid products were used as markers for lipid peroxidation in plasma and erythrocytes. TBARS was assayed by the method of Porter et al (10) and was presented in nmol/ml plasma. Fluorescent products of lipid peroxidation (*lipofuscin products*) were measured by the method of Dillard and Tappel (11), using LS Perkin Elmer luminescent spectrophotometer. Values were expressed in μmol/ml red blood cell mass.

The content of α-tocopherol in plasma and erythrocytes was measured by the method of Taylor et al. (12), using Luminiscent Spectrofotometer LS-5. Plasma α-tocopherol values were expressed in μmol/l and erythrocyte concentration - in μmol/l RBC. The content of glutathione in the reduced (GSH) and in the oxidized (GSSG) form in RBC was determined by the Hissin and Hill method (13). SOD activity in erythrocytes was determined by the Misra, Fridovich method (14) and presented as U/ml RBC. Plasma ceruloplasmin was assayed by the Ravin method (15) and presented as mg/l. Plasma albumin levels were measured by paper electrophoresis.

Oxidative haemolysis of erythrocytes was determined by the method of Farell et al. (16). Haemolysis (per cent) was expressed as a ratio of the haemoglobin in PBS supernatant to that in distilled water supernatant after preliminary exposure of erythrocytes in H_2O_2 (in vitro).

Data were presented as the mean ± SEM and the statistical significance between the control and burnt groups were established by means of the Student's *t*-test.

RESULTS AND DISCUSSION

In the previous studies it has been shown that the activation of free radical mediated processes leads to changes in the osmotic fragility, deformability and survival of red blood cells in the early postburn phase (17-20). The results from the present study demonstrates an increased susceptibility of erythrocytes to oxidative haemolysis. Oxidative haemolysis of thermally affected red cells was elevated by 190% ($p < 0.001$) compared to that of the control group. (Fig. 1) This is in agreement with the data reported (1, 2). Plasma levels of TBARS were also markedly elevated (by 189%, $p < 0.05$, Fig. 2) suggesting increased free radical production following thermal injury (21, 22).

Several sources may be responsible for free radical production in the early postburn period. The complement-activated polymorphonuclear neutrophil leukocytes released in large amounts of oxygen free radicals such as superoxide radicals (O_2), hydrogen peroxide (H_2O_2), hydroxyl radicals (OH) and hypochlorous acid (HOCl) in extracellular medium in the early postburn period (23, 24). Hypoxanthine-xantine oxidase system can generate oxygen radicals after burn injury (25). It has been reported that superoxide radicals promote liberation of free ferrous ions from ferritin, which are important catalysts of hydroxyl radical production from hydrogen peroxide via Haber-Weiss reaction (26). Circulating TBARS may be presented as oxidized lipids of the lipoproteins and the blood cell membranes.

Red blood cells are subjected to the attacks of oxygen radicals, generating extracellulary in large amounts in the early postburn period. Increasing evidence suggest that neutrophil oxygen radical burst after burn injury cause oxidative alteration of red blood cells and intravascular haemolysis (23). It has been reported that increased intravascular haemolysis correlates with

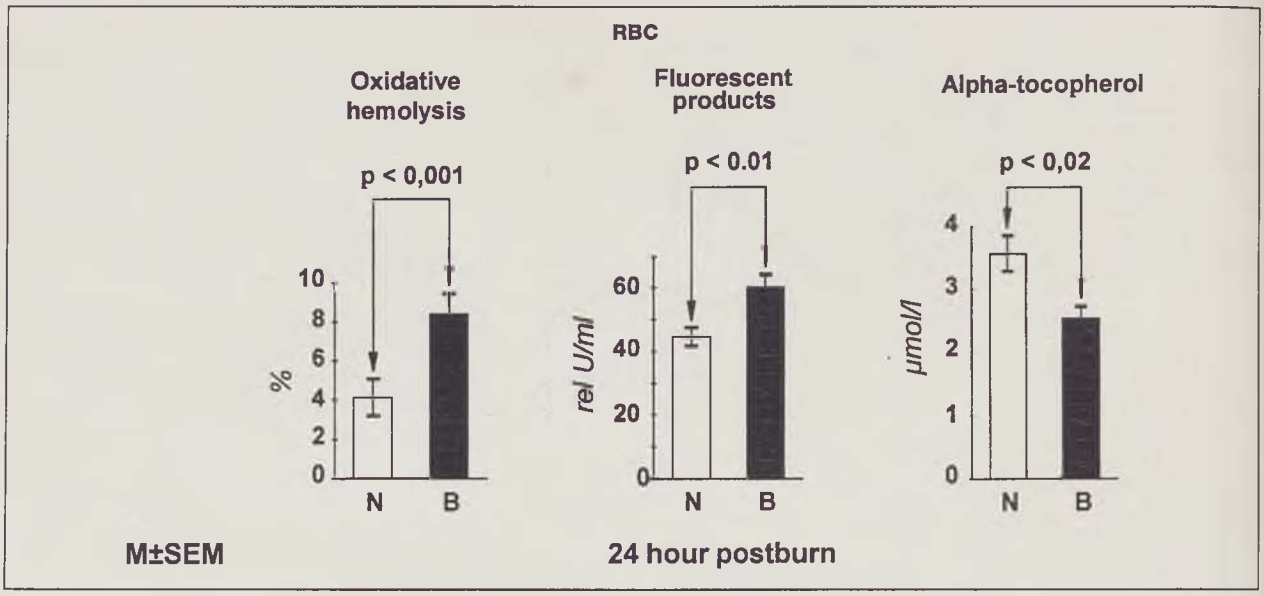

Fig. 1: Erythrocyte fluorescent lipid product and α-tocopherol concentration and oxidative haemolysis twenty four hours after thermal skin injury in rats.

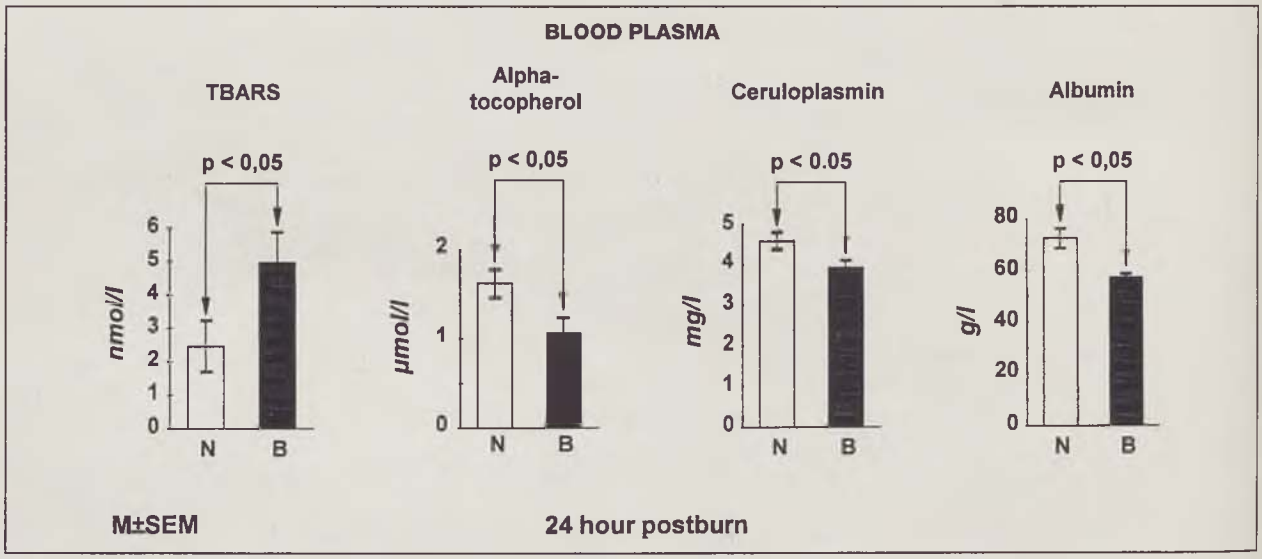

Fig. 2: Plasma TBARS, α-tocopherol, ceruloplasmin and albumin levels twenty four hours after thermal skin injury in rats.

enhanced plasma xantine oxidase activity in the early postburn period (25). Oxygen radicals can attack directly membrane lipids and activate lipid peroxidation in the process of which is generated MDA. This substance readily reacts with red cell membrane proteins and phospholipids to yield lipofuscin products. The results of this study reveal that thermal skin injury causes significant increase of lipofuscin product levels in erythrocytes by 37% ($p < 0.01$, Fig. 1). The accumulation of fluorescent products causes alterations in membrane lipid bilayers, conformational changes in cytoskeletal proteins and subsequent disorders in the interaction between membrane lipids and proteins, all implicating peroxidative damage (3). There is positive correlation between the accumulation of fluorescent damaged products and oxidative haemolysis ($r = 0.72$). It could be presumed that free radical mediated membrane damage of red blood cells can worsen their barrier functions and can increase their susceptibility to oxidative agents such as hydrogen peroxide.

Normal red blood cells have potent free radical scavenging properties explaining their high resistance to the exposure of hydrogen peroxide. Burnt animal's erythrocytes showed increased susceptibility to oxidative hemolysis, which may be a result of the disbalance between the impaired antioxidant defence of red blood cells and free radical overgeneration in erythrocytes and its surrounding.

Liposoluble α-tocopherol plays an important role at „the front line" of antioxidant defence and acts as important chain-breaking antioxidant in

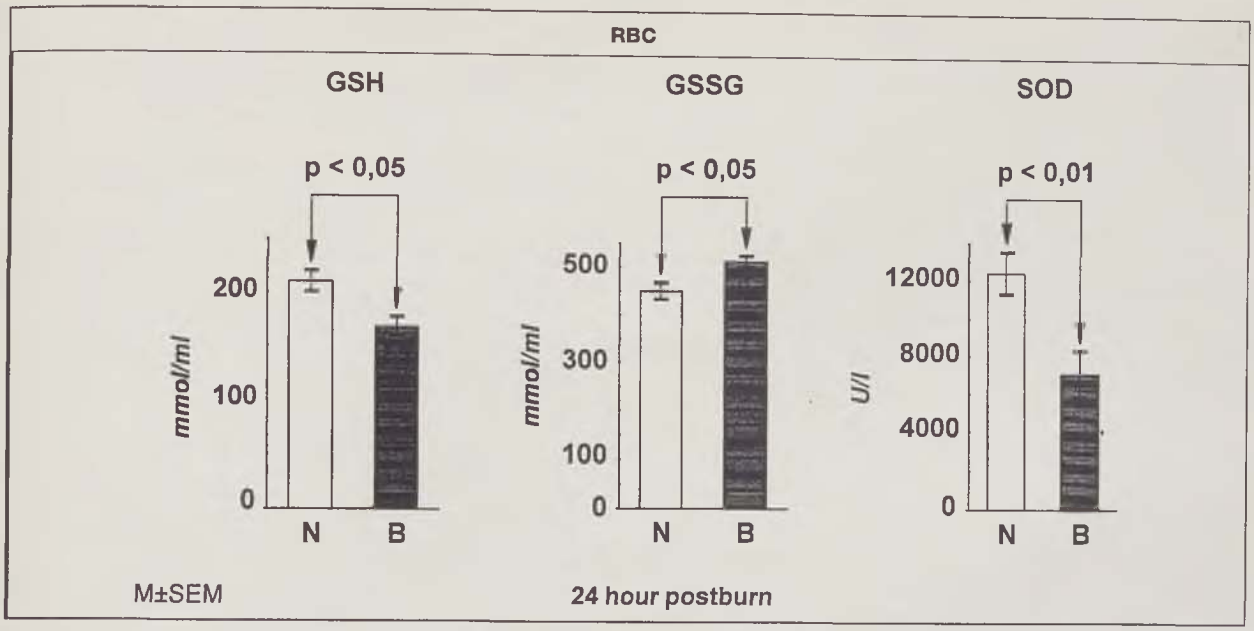

Fig. 3: Erythrocyte glutathione (GSH and GSSG) levels and SOD activity twenty four hours after thermal skin injury in rats.

plasma and red cell membranes (27). Vitamin E is carried by plasma lipoprotein fractions to the target organs, including erythrocytes and acts as a membrane stabilizing factor (28). Both plasma and erythrocyte α-tocopherol contents decreased significantly by 37% and 35% ($p < 0.05$), respectively, in comparision with that of the control animals (Fig. 1, 2). There are some evidence that vitamin E is consumed more intensively under conditions of activated lipid peroxidation and lower antioxidant enzyme defence. The decrease of plasma α-tocopherol levels could be due to enhanced oxidative damage of lipoproteins (HDL) which carry α-tocopherol into erythrocytes (29). The aggravated transport of vitamin E through erythrocyte membrane could also contribute to the decrease of its concentration in these blood cells.

GSH as water-soluble antioxidant plays an important role in the regulation of erythrocyte functions. It protects the SH groups of membrane proteins and haemoglobin and detoxifies free radicals produced by erythrocyte membrane lipid peroxidation throuth glutathione peroxidase (30). In comparison with the control values erythrocyte GSH content decreased significantly (by 22%) in burnt group while GSSG levels were enhanced (by 18%, $p < 0.05$, Fig. 3). The decrease of GSH concentration may be explained not only with its increased oxidation to GSSG but also with the decreased GSH recycling on account of low activity of GSH relating enzymes in the early postburn period (31). Peroxidase activity in red blood cells decreased in the early post burn period (our unpublished data).

SOD as O_2 scavenger is an important component of erythrocyte antioxidant defence. Twenty four hours after thermal skin injury the activity of SOD in erythrocytes was deminished by 44% ($p < 0.01$, Fig. 2) compared to that of the control one. SOD-activity may be directly inactivated by hydrogen peroxide.

Ceruloplasmin and albumin are important components of plasma antioxidant defence system. Ceruloplasmin by removing of Fe^{2+} to Fe^{3+} via its ferrooxidase activity inhibits iron ion dependent lipid peroxidation and hydroxyl radical formation from hydrogen peroxide (33). Albumin is a powerful scavenger of HOCI in plasma from activated neutrophils (34). Plasma concentration of ceruloplasmin and albumin were decreased significantly by 26% and 21% (Fig. 1) respectively, in burned animal as compared to the controls. Deficient of plasma ceruloplasmin and albumin content could be due to the enhanced protein catabolism which is closely linked with the elevated free radical production in the early postburn period (35). Negative changes in plasma antioxidant capacity facilitates the free radical mediated damage of red blood cells. Peroxidative membrane alteration of red blood cells increases their susceptibility to the oxidizing effect of hydrogen peroxide. Oxidatively damaged red blood cells can stimulate phagocytic cells to produce an oxygen radical burst (21). Plasma and erythrocyte antioxidant deficiency may diminished the resistance of erythrocytes to oxygen radicals and hydrogen peroxide, generated permanently from the activated leukocytes, which may lead to persistent oxidative haemolysis in the early postburn period.

The results from this study suggest that a certain relationship exists between elevated oxidative haemolysis and free radical mediated alteration of red blood cells which is probably due

to the disbalance between free radical overproduction and decreased antioxidant defence in erythrocytes and blood plasma. The increased susceptibility of erythrocytes to oxidative hemolysis could represent an indirect but sensitive indicator of the impaired antioxidant defence of these blood cells following thermal skin injury. The decreased resistance of red blood cell against oxidative hemolysis unter conditions of reduced antioxidant capacity of erythrocytes and blood plasma suggests that adequate antioxidant therapy could prevent all these complications following thermal skin injury.

REFERENCES

1. Yuan, Y., Zhiyang, F.: Change in the rate of hemolysis during the early stage after burns in the rabbit. Burns, 14:365-368, 1988.
2. Zaets, T. L., Lavrov, V. A., Marchuk, A. L., Nosova, I. M.: Changes of several characteristics of the erythrocyte membrane and erythrocyte structure in severe burns in animal experiments. Bull. Experim. Biol. Med., 109:27-30, 1990.
3. Jain, S. K., Mohandas, N., Clark, M. R., Shohet, S. B.: Effect of malondialdehyde on erythrocyte deformability, dehydration and 51 Cr -survival of erythrocytes. Brit. J. Hematol., 53:247-255, 1983.
4. Tappel, A. L.: Lipid peroxidation damage to cell components. Fed. Proc., 32:1870-74, 1973.
5. Jain, S. K.: Evidence for membrane lipid peroxidation during the in vivo aging of human erythrocytes. Biochim. Biophys. Acta, 937:205-210, 1988.
6. Chiu, D., Kuypers, F., Lubin, B.: Lipid peroxidation in human red cells. Semin. Hematol., 26:257-276, 1989.
7. Tamai, H., Miki, M., Mino, M.: Hemolysis and membrane lipid changes induced by xanthine oxidase in vitamin E deficient red cells. J. Free Radic. Biol. Med., 2:49-56, 1986.
8. Sasaki, J., Cottam, G. L., Baxter, C. R.: Lipid peroxidation following thermal injury. J. Burn Care Rehabil., 3/4:251-254, 1983.
9. Meng, X. M.: Mechanism of damage of erythrocytes after burn injury in rat changes in lipid peroxidation, antioxidant function and sulhydril groups. Chin. J. Plast. Surg. Burns, 7:205-207, 1991.
10. Porter, N., Norton, Y., Ramdas, I.: Cyclic peroxidase and the thiobarbituric assay Biochim. Biophys. Acta, 441:596-599, 1976.
11. Dillard, C., Tappel, A. L.: Fluorescence of lipid peroxidation damage products. In: L. Parker (Ed), Methods in Enzymology, 105, Oxygen Radicals in Biological Systems, Acad. Press. New York, pp. 337-341, 1984.
12. Taylor, S. L., Lamden, M. P., Tappel, A. L.: Sensitive fluorimetric method for tissue tocopherol analysis. Lipids, 11:530-538, 1976.
13. Hissin, P. J., Hilf, R. A.: A fluorimetric method for determination of oxidized and reduced glutathione in tissue. Anal Biochem., 74:214-226, 1976.
14. Misra, H. P., Fridovich, T. P.: The role of superoxide anion in the antioxidant of epinephrine and simple assay for superoxide dismutase. J. Biol. Chem., 247:3170-3175, 1972.
15. Ravin, H. A.: Standard methods in the clinical chemistry. J. Lab. Clin. Med., 58:161-164, 1961.
16. Farell, P. M., Bieri, G., Fratantoni, J. E.: The occurrence of effects of human vitamin E deficiency - a study in patients with cyctic fibrosis. J. Clin. Invest., 60:133-137, 1977.
17. Bekyarova, G., Yankova, T., Yankov, D., Kozarev, I.: Erythrocyte rheology and lipid peroxidation in burns. Biomed. Biophys. Acta, 50:71-76, 1991.
18. Saitoh, D., Okada, Y., Takahara, T., et al.: The effect of an SOD derivated (SM-SOD) administration in the burned rat model. Tohoku J. Exp. Med., 174:31-40, 1994.
19. Hatherill, J. R., Till, G. O., Bruner, L. H., et al.: Thermal injury, intravascular hemolysis and toxic oxygen products. J. Clin. Invest., 78:629-636, 1986.
20. Bekyarova, G., Kozarev, I., Yankova, T.: Dependence between the free radical peroxidation, the activity of superoxide dismutase, glucose-6-phosphate dehydrogenase and erythrocyte hemolysis after thermal trauma and tocopherol treatment. Acta Physiol. Pharmacol. Bulg., 15:268-273, 1989.
21. Saez, J. C., Ward, P. H., Gunther, B., Vivaldi, E.: Superoxide radicals involvment in the pathogenesis of burn shock. Circ. Shock, 12:229-239, 1984.
22. Nguen, T. T., Cox, C. S., Traber, B. L., et al.: The radical activity and loss of plasma antioxidant vitamin E and sulfhydrill groups in patients with burns: The 1993 Moyer Award. J. Burn Care Rehabil., 14:602-, 1993.
23. Ward, P. A., Till, G. O.: Pathophysiologic events related to thermal injury of skin. J. Trauma, 30:S76-79, 1990.
24. Oldham, K. T., Guice, K. S., Till, G. O., et al.: Activation of complement by hydroxyl radical in thermal injury. Surgery, 104:272-279, 1988.
25. Burton, L. K., Velasco, S. E., Patt, A., Terada, L. S., Repine, J. E.: Xanthine oxidase contributes to lung leak in rats subjected to skin burn. Inflamation, 19:31-38, 1995.
26. Tomas, C. E., Morehouse, L. A., Aust, S. D.: Ferritin and superoxide dependent lipid peroxidation. J. Biol. Chem., 260:3275-3280, 1984.
27. Burton, G. W., Joyce, A., Ingold, K. V.: Is vitamin E the only lipid soluble, chain-breaking antioxidant in human plasma and erythrocyte membranes. Arch. Biochem. Biophys., 221:281-290, 1983.
28. Chow, C. K.: Vitamin E and antioxidative stress. Free Radic. Biol. Med., 11:215-232, 1991.
29. Kagan, V. E., Serbinova, E. A., Forte, T., Scita, G., Parker, L.: Recicling of vitamin E in human low density lipoprotein. J. Lipid Res., 33:385-397, 1992.
30. Denek, M. S., Farburg, L. B.: Regulation of cellular glutathione. Am. J. Physiol., 257:L163-173, 1989.
31. Baar, S.: Anaemia of burns. Burns, 6:1-8, 1979.
32. Halliwell, B. H., Guteridge, J. M. C.: The antioxidants of human extracellular fluids. Arch. Biochem. Biophys., 280:1-8, 1990.
33. Halliwell, B. H., Guteridge, J. M. C.: Oxygen radicals, transition methals and disease. Biochem. J., 219:1-14, 1984.
34. Vasil, M., Halliwel, B., Hutchison, D. C. S., Baun, H.: The antioxidant action of extracellular fluids. Biochem. J., 243:219-223, 1987.
35. Shao, H.: Effect of lipoperoxide on catabolism of protein in burns in rats. Chin. J. Surg. & Burns, 29:581-583, 1991.

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ACTA CHIRURGIAE PLASTICAE 39, 2, 1997, p. 65 - 67

SURGICAL APPROACH TO THE RABBIT SCIATIC NERVE
Technical note

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SUMMARY

A description with anatomical pictures of a simple and gentle dorsolateral approach to the rabbit sciatic nerve are presented. Blunt separation of the septum between the semitendinosus muscle and the caput pelvinum bicipitis femoris muscle, allows for excellent access to the nerve along a considerable length. The dorsolateral subfascial vein of the thigh is an easily identifiable landmark of this septum. This gentle approach ensures very smooth healing.

ZUSAMMENFASSUNG

Die chirurgische Freilegung des Nervus Ischiadicus bei einem Kaninchen - technische Bemerkung

M. Sameš, V. Beneš, Jr.

Die Autoren beschreiben und an den anatomischen Präparaten demonstrieren die einfache und schonende dorsolaterale Freilegung des Nervus Ischiadicus bei einem Kaninchen. Das Verfahren besteht aus einer stumpfen Separation des Septum zwischen dem Musculus Semitendinosus und der Caput Pelvinum Musculi Bicipitis Femoris, die sorgt für die schnelle und einfache Freilegung des gesamten Nervus Ischiadicus. Der Verlauf des Septum an der dorsolateralen Seite des Schenkels kann anhand des Verlaufes der dorsolateral- subfascialen Vene genau bestimmt werden. Diese Freilegung führt nicht zu einer Verletzung des Schenkelmusculatur und resultiert in eine frühe und komplikationslose Heilung.

Key words: rabbit, sciatic nerve, surgical approach

The rodent sciatic nerve and various types of injury to this nerve is the most frequently used model in peripheral nerve regeneration research. Rats are used in the majority of experiments while rabbits are used in very few protocols (1 - 10, 12). Very little information with few details has been published concerning the surgical approach to the rabbit sciatic nerve.

We used rabbits for over 3 years of research on sciatic nerve regeneration (11) utilizing two approaches to access the sciatic nerve. We abandoned the medial approach very early, and have recently only used the dorsolateral approach. The surgical technique of this approach is described in detail below.

MATERIAL AND METHODS

Anesthesia

All surgeries (50) were performed under general anesthesia with pentobarbitalum natricum 30 mg/kg i.m., ketamine 30 mg/kg i.m. and atropine sulfate 0,1 mg/kg s.c. All surgeries are performed in a semisterile enviroment using sterile surgical instruments. Local anesthetics are injected into all the wound layers before the cut. At the conclusion of the surgery wide-spectrum antibiotics are given intramuscularly and continued until the wound is healed.

The animals are individualy cared for in separate, heated cages in accordance with the European Communities Council Directive of 24 November 1986 (86/609/EEC).

SURGERY

The rabbit is in a prone position with the posterior limb mildly externally rotated and with semiflexion of the knee. As soon as the surgical field is prepared with iodine, the incision extends longitudinaly from as high as the sacrum down to the knee. The skin incision is mildly lateral to the most posterior part of the thigh. The incision of the superficial fascia has to be lateral to the dorsal vein (Fig. 1). The septum between the semitendinosus muscle and the caput pelvinum bicipitis femoris muscle is identified and followed (Fig. 2). Blunt dissection between these two mus-

cles leads directly to the sciatic nerve (Fig. 3). Only one automatic retractor is needed to expose the sciatic nerve for a sufficient length (Fig. 4). If the most proximal portion of the nerve needs to be approached, section of the caput vertebrae of the bicipitis femoris muscle becomes the only option. At the conclusion of the surgery only the skin is closed.

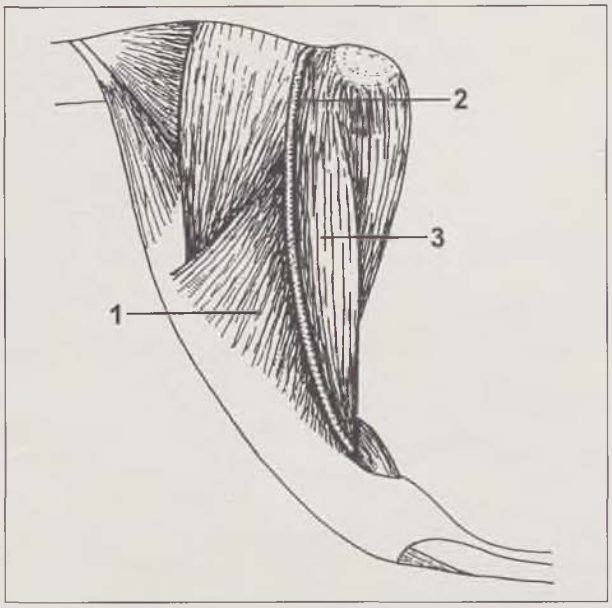

Fig. 1: Schematic representation of the dorsolateral face of the left thigh of the rabbit. 1-biceps femoris muscle, 2-vein, 3-semitendinosus muscle.

Fig. 2: The incision of the superficial fascia is lateral to the dorsal vein (anatomical preparation).

Fig. 3: Blunt division of the septum between the biceps femoris muscle and the semitendinosus muscle.

Fig. 4: Exposure of the sciatic nerve.

DISCUSSION

The prone position of the rabbit is very advantageous for the anesthesia and for the stability of the experimental animal during surgery. The dor-

sal subfascial vein serves as a very easily identifiable landmark to expose the semitendinosus and biceps femoris muscles. Blunt separation of these two muscles is very simple minimizing damage to the tissues and allows for excellent access to the nerve along a considerable length. This very gentle and fast approach ensures very smooth wound healing. Scarring in the vicinity of the sciatic nerve and throughout the depths of the wound is minimal and the approach is easily repeated.

In our series we have not had any complications related to the surgical approach or to the positioning of the animal. We have found this approach to be superior to the medial one, where section of the superficial layer of the muscles is necessary.

Acknowledgment

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REFERENCES

1. Feldman, M. D., Sataloff, R. T., Epstein, G., Ballas, S. K.: Autologous fibrin tissue adhesive for peripheral nerve anastomosis. Arch. Otolaryngol. Head Neck Surg., 113:963-967, 1987.
2. Gordon, T., Gillepsie, J., Orotco, R., Davis, L.: Axotomy-induced changes in rabbit hindlimb nerves and the effects of chronic electrical stimulation. J. Neurosci., 11:2157-2169, 1991.
3. Grace, P. A., Augustine, S., Lynch, G.: Immediate return of nerve function following microsurgical repair. Br. J. Plast. Surg., 42:212-215, 1989.
4. Hunt, D. M., McCarthy, R., Green, C. J.: The effect of freezing on peripheral nerve repair. Hand, 15:317-324, 1983.
5. Lynch, G., Quinlan, D.: Jump function following nerve division. Br. J. Plast. Surg., 39:364-366, 1986.
6. Mani, G. V., Shurey, C., Green, C. J.: Is early vascularization of nerve grafts necessary? J. Hand. Surg. (Br), 17:536-543, 1992.
7. de Medinaceli, L., Freed, W. J.: Peripheral nerve reconnection: immediate histologic consequences of distributed mechanical suport. Exp. Neurol., 81:459-468, 1983.
8. Radek, A. J.: Blood supply of transected rabbit peripheral nerve after end-to-end suture or autogenous grafting. A microangiographic study. Scand. J. Plast. Reconstr. Surg., 20:273-277, 1986.
9. Restrepo, Y., Merle, M., Michon, J., Folliguet, B., Barrat, E.: Free vascularized nerve grafts: an experimental study in the rabbit. Microsurgery, 6:78-84, 1985.
10. Rigoni, G., Smahel, J., Chiu, D. T., Meyer, V. E.: Veneninterponat als Leitbahn für die Regeneration peripherer Nerven. Handchir. Mikrochir. Plast. Chir., 15:227-231, 1983.
11. Sameš, M., Beneš, V. Jr: Direct current stimulation of the transected rabbit sciatic nerve. The Meeting of European Neuroscience, Amsterdam, p. 188. September 3-7, 1995.
12. Sparman, M.: Stellenwert verschiedenen Nahtmaterialen bei der Defektuberbruckung peripherer Nerven. Handchir. Mikrochir. Plast. Chir., 27:322-328, 1995.

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SOUHRNY - ACTA CHIRURGIAE PLASTICAE 39, 2, 1997, p. 67 - 68

K PŮVODU PROGENIE U STŘEDOEVROPSKÝCH HABSBURKŮ: RENTGENKRANIOMETRICKÁ ANALÝZA HABSBURKŮ POHŘBENÝCH V PRAZE

E. Vlček, Z. Šmahel

Rentgenkraniometrické nálezy u prvních tří generací Habsburků na českém trůnu (1526-1612) ukazují u všech zkrácení délky přední lební báze, se kterým se shoduje předozadní zkrácení maxily. Nálezy odpovídají malé mozkovně a lební kapacitě těchto Habsburků. Maxila proto není retrusivní, a to ani u Rudolfa II., kde je postižena patologickým procesem. Tělo mandibuly není u žádného člena dynastie zkráceno, což způsobuje disproporci vzhledem ke krátké přední bázi a maxile. Disproporce je u Ferdinanda I. a Maxmiliána II. kompenzována posteriorotací mandibuly. U Rudolfa II. je tělo mandibuly výrazně prodlouženo, dolní čelist je předsunuta a nález můžeme charakterizovat jako pravou progenii. Je zvýrazněna kratší přední bází a maxilou císaře. Progenie je tak u středoevropských Habsburků prokazatelná až u Rudolfa II., pravděpodobně jako vklad ze strany matky z větve španělských Habsburků. Parametry dolní čelisti otce Maxmiliána II. a děda Ferdinanda I. však jistou predispozici v rodě středoevropských Habsburků nevylučují.

Kranium prvého Habsburka na českém trůnu Ferdinanda I. je typické vysokou čelistní etáží obličeje s výrazně posteriorotovanou mandibulou a strmým postavením horních i dolních řezáků. Kranium manželky Ferdinanda I. Anny Jagellonské je naopak charakteristické bimaxilární protrusí. U syna Maxmiliána II., jako vklad ze strany matky, není obličej prodloužen a řezáky dobře proklinují s normálním skusem. U Rudolfa II. je obličej v souvislosti s vysunutou mandibulou a patologickým procesem na maxile snížen. Antropologické vyšetření u všech tří generací císařů ukázalo vzrůstající brachykranii, úzké klenuté čelo s nezařízlým kořenem nosu, málo vyvinuté nadočnicové oblouky, stopy po obliterovaném čelním švu a slabě vytvořené sexuální znaky. U Rudolfa II. lze předpokládat nesrozumitelnou řeč, u Maxmiliána II. 7 cm dlouhý proc. styloideus vpravo mohl vyvolávat neuralgie trojklanného a jazykohltanového nervu.

NAŠE ZKUŠENOSTI S LÉČENÍM STŘELNÝCH PORANĚNÍ OBLIČEJE

J. Kozák, P. Voska

Ošetřování střelných poranění obličeje a jejich rekonstrukce stále patří k nejzávažnějším problémům rekonstrukční chirurgie. Naše zkušenosti zahrnují léčení 23 pacientů s tímto druhem poranění. Pět pacientů bylo ošetřeno primárně. Pozornost byla u nich zaměřena na udržení průchodnosti dýchacích cest, fixaci kostních úlomků a rekonstrukci měkkých tkání. U sekundárních rekonstrukcí byly využity principy kraniofaciální chirurgie a mikrochirurgie. Většina pacientů

vyžadovala provedení osteoplastiky pomocí kostních štěpů klasických i vaskularizovaných. U poraněných v oblasti střední obličejové etáže, orbit, kořene nosu a čela byly použity principy kraniofaciální chirurgie. Největším problémem zůstávají deformace po střelných poranění z brokovnice, kdy rekonstrukce vyžadují opakované rekonstrukční postupy.

KALCIUM ALGINÁTOVÝ OBVAZ PODPORUJE HOJENÍ V MÍSTĚ ODBĚRU ROZŠTĚPENÉHO KOŽNÍHO ŠTĚPU

J. M. O'Donoghue, S. T. O'Sullivan, E. S. Beausang, J. I. Panchal, M. O'Shaughnessy, T. P. F. O'Connor

Byla provedena prospektivní kontrolní studie hojivé účinnosti kalcium alginátového obvazu a obvazu z parafinové gázy na rozštěpený kožní štěp dárcovské strany. Do kalcium alginátové skupiny bylo náhodně zařazeno 30 pacientů a do skupiny léčených parafinovou gázou 21 pacientů. Místo odběru bylo posouzeno 10 dní po odnětí štěpu se zjištěním, je-li kompletně zhojeno (100%), nebo ne.

21 z 30 pacientů ošetřených kalcium alginátem bylo 10. dne kompletně zhojeno, zatímco pouze 7/21 bylo takto zhojeno po použití parafinové gázy ($p < 0,05$).

Ve studii se vyskytly dvě infekce, obě v alginátové skupině, přičemž nebyl rozdíl v obvazové technice mezi oběma skupinami. Obvaz kalcium alginátu signifikantně zlepšuje hojení rozštěpeného kožního štěpu dárcovské strany.

KOMBINOVANÁ TECHNIKA ANESTEZIE U ČASNÝCH A POZDNÍCH REKONSTRUKCÍ KONTRAKTUR KRKU

J. Jandová, R. Königová, Z. Kapounková, L. Brož

Jakmile se jednou začalo uvažovat o kvalitě života u jasných, zřejmých případů, pak je možné použít tento pojem v širších aplikacích, a to v intenzivní péči o hendikepované a v jakémkoliv medicínském oboru. U těžkých popálenin se daří zachránit život pacienta za cenu nepohodlí a zneschopnění, jež je způsobeno tvorbou jizev a následným znetvořením.

Závažná jizevnatá kontraktura po popálení přední plochy krku je příčinou závažných funkčních potíží a vyžaduje včasnou rekonstrukci krku založenou na třech principech: uvolnit smrštěnou oblast, obnovit konturu mento-kolického úhlu a zabránit recidivě.

Chirurgický zákrok vyžaduje endotracheální intubaci, kterou není možné provést, neboť brada je přitažena k jugulu. Je nezbytné použít kombinovanou techniku anestezie, používající intravenózní úvod (Ketalar) s, nebo bez lokální infiltrace jizvy přední plochy krku, jež je okamžitě profata až k nepostižené svalové vrstvě. Potom následuje zavedení endotracheální rourky. Interval mezi incizí a inzercí ET rourky může být kritický, jak je demonstrováno na jednom případu léčeném v pražském popáleninovém centru v průběhu posledních dvou dekád.

SHROMAŽĎOVÁNÍ LIPOFUSCINOVÝCH PRODUKTŮ, NEDOSTATEČNÁ ANTIOXIDAČNÍ OBRANA V ERYTROCYTECH A PLASMĚ A ZVÝŠENÁ NÁCHYLNOST K OXIDATIVNÍ HEMOLÝZE PO TEPELNÉM TRAUMATU

G. Bekyarova, T. Jankova, M. Marinov

Mechanismus zvýšené vnímavosti červených krevních buněk k oxidativní hemolýze zůstává nejistý v časném období po popálení. V této studii bylo zjištěno u krys, že po tepelném traumatu (plná tloušťka kůže na 20% TBSA) bylo shromažďování lipofuscinových produktů v červených krevních buňkách doprovázené zvýšenou oxidativní hemolýzou za 24 hodin. V plazmě bylo nalezeno zvýšení reaktivního substrátu thiobarbiturové kyseliny (TBARS) a snížení hladiny antioxidantů, jako je alfa-tokoferol, ceruplasmin a albumin. V erytrocytech byla také snížena aktivita superoxidu dismutázy (SOD) a snížená koncentrace alfa-tokoferolu a redukovaného glutathionu (GSH). Výsledky této studie předpokládají, že plasma a nedostatek intracelulárních antioxidantů může zesílit oxidativní poškození membrány. Byla nalezena pozitivní korelace ($R = 0,72$) mezi zvýšenou hladinou lipofuscinových produktů a oxidativní hemolýzou červených krevních buněk. Zvýšená vnímavost erytrocytů k oxidativní hemolýze může být považována jako nepřímý, ale sensitivní indikátor porušené antioxidační obrany těchto krevních buněk v důsledku tepelného poranění kůže. Tato snížená resistence červených krevních buněk k oxidativní hemolýze za podmínek redukované antioxidační obrany erytrocytu a krevní plazmy předpokládá, že odpovídající antioxidační terapie může zabránit všem těmto komplikacím po tepelném poškození kůže.

CHIRURGICKÝ PŘÍSTUP K N. ISCHIADICUS U KRÁLÍKA

M. Sameš, V. Beneš, Jr.

Autoři popisují a na anatomických preparátech demonstrují jednoduchý a šetrný dorsolaterální přístup k nervus ischiadicus u králíka. Podstatou přístupu je tupá separace septa mezi musculus semitendinosus a caput pelvinum musculi bicipitis femoris; ta zajišťuje snadný a rychlý přístup k nervu v celém rozsahu. Průběh septa z dorsolaterální strany stehna lze spolehlivě identifikovat dle dorsolaterální subfasciální vény. Tento přístup nezpůsobuje poranění svalů stehna a je zárukou hladkého a rychlého hojení.

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