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Manifestations of heterotopic ossification in patients with radial head fractures combined with forearm dislocations

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Heterotopic ossifications (HO) is one from the negative consequences of the joint injuries, and they are especially significant for fractures and fracture-dislocations of the elbow, reaching 37 %. Objective. To study the frequency of occurrence and form of manifestation of HO in patients with fractures of the radial head (RH) in combination with dislocations of the forearm under the conditions of restoration of the head and the impossibility of its preservation. Methods. The study is based on a retrospective analysis of clinical observation material of 48 patients with dislocations of the forearm in combination with fractures of the RH, among which during surgical treatment in 39 patients the head of the radius was preserved (1st group), in 9 patients it was not possible to save the head (2nd group). Results. In 9 patients (23 %) of the 1st group and in 5 (56 %) of the 2nd group for an average period of 6 months, X-ray examination revealed manifestations of HO. Surgical interventions were performed later than 48 hours. It is noteworthy that among patients of the 1st group, HO, which caused limitation of the range of motion in the joint, occurred in 2 cases out of 9, that is, in 22 %, and among patients of the 2nd group, significantly more often — in 4 out of 5 patients, that is, in 80 % of cases. Differences between these indicators in groups are statistically significant ($p < 0.05$). The functional assessment of the elbow joints by the Mayo Clinic Score in groups was significantly higher in the patients of the 1st group — (87 ± 9) points compared to (49 ± 16) in the patients of the 2nd group ($p < 0.05$). Conclusions. In patients with fractures of the RH in combination with dislocations of the forearm in cases of impossibility of preserving the head, the formation of HO in the area of the elbow joint is observed more than twice as often compared to patients with preserved head (56 % vs. 23 %). HO of forms II and III are observed more than three times more often in patients with fractures of the RH in combination with dislocations of the forearm in cases of impossibility of preserving the head compared to cases of its restoration (80 % vs. 22 %). Given the high risk of HO in the elbow joint of patients with fractures of the RH in combination with dislocations of the forearm in case of impossibility of preserving the head, as well as in cases of postponement of the necessary surgical treatment for fractures in the elbow joint, it is necessary to take care of the available measures for the prevention of HO.

Одним із негативних наслідків травм ліктьового суглоба є гетеротопічна осифікація (ГО), що сягає 37 % . Мета. Вивчити частоту виникнення і форми прояву гетеротопічних осифікатів у пацієнтів і+з переломами головки променевої кістки в поєднанні з вивихами передпліччя за умов відновлення головки та неможливості її збереження. Методи. Дослідження базується на ретроспективному аналізі клінічного матеріалу спостереження 48 пацієнтів із вивихами передпліччя разом із переломами головки променевої кістки (ГПК), серед яких у процесі хірургічного лікування у 39 осіб вона була збережена (перша група), у 9 — ні (друга). Результати. У 9 випадках (23 %) першої групи та у 5 (56 %) другої на середній строк 6 міс. під час рентгенологічного обстеження виявлено прояви ГО. Хірургічні втручання їм виконано пізніше 48 годин. Зазначимо, що серед пацієнтів першої групи гетеротопічні осифікати, які обумовлювали обмеження обсягу рухів у суглобі, зафіксовано в 2 випадках із 9, тобто у 22 %, а серед осіб другої групи суттєво частіше — у 4 із 5 хворих, тобто в 80 % випадків. Різниця цих показників у групах статистично значуща ($p < 0,05$). Функціональна оцінка ліктьових суглобів у групах за бальною шкалою клініки Мауо виявилась суттєво вищою в пацієнтів першої групи — (87 ± 9) балів проти (49 ± 16) другої групи ($p < 0,05$). Висновки. У осіб із переломами ГПК у поєднанні з вивихами передпліччя в разі неможливості збереження головки формування гетеротопічних осифікатів у ділянці ліктьового суглоба діагностовано більш ніж у 2 рази частіше порівняно з хворими зі збереженою головкою (56 проти 23 %). Гетеротопічні осифікати II і III форм спостерігаються більш ніж у 3 рази частіше у пацієнтів із переломами ГПК разом із вивихами передпліччя у разі неможливості збереження головки як порівняти з випадками її відновлення (80 проти 22 %). Ураховуючи високий ризик виникнення гетеротопічних осифікатів у ділянці ліктьового суглоба хворих із переломами ГПК у поєднанні з вивихами передпліччя в разі неможливості збереження головки, а також у випадках відтермінування необхідного хірургічного лікування за умов переломовивиху в ліктьовому суглобі, потрібно потурбуватись про доступні заходи профілактики ГО. Ключові слова. Гетеротопічні осифікати, ліктьовий суглоб, переломовивих.

Keywords. Heterotopic ossifications, elbow joint, fracture dislocation

Introduction

Fractures of the radial head (RH) account for about 30 % of injuries in the elbow joint [1]. RH serves as one of the primary stabilizers of the elbow joint [2]. Additionally, approximately 60 % of the axial load transmitted through the elbow is borne by the humeral-radial articulation [1]. RH plays an essential role in the normal functioning of the joint. Unfortunately, it is not always possible to restore the damaged head in the case of its multi-fragment fracture, although this possibility has increased after the creation of new low-profile plates that are more adapted to the size of the fragments [3, 4]. In cases of RH type II and even type III fractures (according to the Mason classification in the Broberg-Morrey modification [5]), its removal has almost no effect on the functioning of the joint [6, 7], however, in the case of impossibility of performing osteosynthesis of multi-fragmentary head fractures, the use of its endoprostheses is increasingly widespread [7, 8]. In the case of a type IV head fracture, i.e. in combination with a forearm dislocation, the consequences of its removal are manifested both by functional limitations and daily pain in the joint [9]. One of the manifestations of the negative consequences of elbow joint injuries is heterotopic ossification (HO) [10]. In type III and IV RH fractures, the development of HO according to C. S. Fischer et al. reaches 52.1 % [11].

Purpose: to study the frequency of development and forms of manifestation of heterotopic ossification in patients with radial head fractures in combination with forearm dislocations under conditions of head repair or impossibility of its preservation.

Material and Methods

Clinical observation materials of 48 patients with type IV RH fractures without fractures of other bones of the elbow joint, who were treated at the State Institution Professor M. I. Sytenko ISJP of the NAMS of Ukraine in the period 2009–2024. The materials of the study were considered and approved at the meeting of the Committee on Bioethics and Deontology at the State Institution Professor M. I. Sytenko ISJP of the NAMS of Ukraine (protocol No. 250 dated 10.03.2025). All patients signed an informed consent.

The average age of the patients was (41 ± 2) years, 18 men and 30 women. Two groups were distinguished according to the preservation of the RH or the removal of its fragments. The first group consisted of 39 patients (16 men and 23 women), average age (45 ± 2) years (from 18 to 70), who underwent surgical intervention to eliminate the dislocation and restore the RH. The second group consisted of 9 subjects (2 men and 7 women), mean age (40 ± 3) years (from 27 to 52), in whom osteosynthesis of the radial head was not possible, i.e. the head was not preserved. In 14 patients out of 48, manifestations of HO were detected during X-ray examination. The presence and intensity of pain were assessed, focusing on the indicators according to the Mayo Elbow Performance Index (MEPI) [5]: absence (0), slight (1), moderate (2) and severe (3) pain. The presence and degree of manifestation of instability of the elbow joint was also studied according to the following criteria: the presence of excessive amplitude of valgus/varus movements (with the forearm extended) up to 10° was characterized as instability of the 1st degree; > 10° as the 2nd degree. The HO was assessed taking into account radiological characteristics of ossification and reduction in the range of motion in the elbow joint proposed by several authors [12, 13], according to which three forms were distinguished:

I (mild) — limitation of the amplitude of movements < 30°;

II (moderate) — ≥ 30° (II A — flexion-extension, II B — rotation, II C — both options);

III (severe) — presence of bone ankylosis (III A — shoulder-elbow joint, III B — proximal radioulnar joint, III C — both joints).

The volume of movements in the joint was also recorded and an integral assessment of the limb function was determined using the MEPI system. Tables 1 and 2 show data on gender, age, presence of HO and its form, presence and degree of joint instability, amplitude of movements in it, assessment of its function according to MEPI, as well as the period of testing the condition of the joint from the moment of injury in these 14 patients according to their group category.

To determine the statistical significance of the differences in frequency values, the analysis employed both the comparison of two proportions and the Mann-Whitney U test for independent samples using Statistica software.

Results and Discussion

X-ray and functional study of the condition of the elbow joints of patients was carried out in the period from 5 to 9 months (after (6.5 ± 0.4) months in the first group and after (6.2 ± 0.4) in the second). Among 48 individuals, HO was detected in 14 (29 %): 9 cases out of 39 in representatives of the first group, i.e. with preserved RH, which amounted to 23 %, 5 out of 9, i. e. 56 % of the second group, where the head could not be preserved. The difference in the indicators of the relative frequency of HO observation in the groups is statistically significant ($p < 0.05$).

O. A. Ilahi et al. [14] found that HO limiting joint motion occurred in 33 % of elbow injury patients who had

surgery more than 48 hours after injury but was not observed in those treated earlier. In our study, 14 subjects with HO underwent interventions later than 48 hours due to various circumstances. Among these cases, HO II and III were observed in 6 patients (42.8 %). In the first group, 2 out of 9 patients (22 %) presented with these forms, whereas in the second group, HO II and III occurred significantly more frequently — in 4 out of 5 patients (80 %). The difference in these indicators of the frequency of more severe forms of OA in the groups is statistically significant ($p < 0.05$).

The limitation of movements in the joint cannot be unambiguously associated only with the presence of HO, without taking into account other factors (fibrosis of the capsule and ligaments, the condition of the muscles associated with the functioning of the joint, etc.). Figure 1 presents radiographic images of the elbow joint from a patient in the first group (case No. 9). These images indicate that the size, location, and positional changes of the ossifications relative to variations in the angle between the shoulder and forearm do not provide sufficient evidence to conclude that they are the primary cause of the observed movement limitation. Consequently, it is appropriate to categorize these ossifications as representing the mild form (I).

Fig. 2 presents radiographic images of the elbow joint from a patient in the first group (case No. 4) taken seven months after injury, following head consolidation. The images indicate a compact ossification of notable size situated in the area of the coronoid process of the ulna. It has no obvious relation to the proximal radioulnar joint. Such a radiological picture is the basis for believing that this heterotopic formation is indeed the main cause of the limitation of flexion-extension movements, that is, it refers to HO form II A.

In patients of the second group, HO form II was radiographically distinguished by a significantly greater prevalence compared to ossifications in patients of the first group.

Figure 3 presents radiographic images of the elbow joint from a patient in the second group (case No. 4), obtained seven months following reduction of the forearm dislocation and excision of radial head fragments due to the inability to perform osteosynthesis.

Radiographic images demonstrate the following HO II C presentation: dense, significant ossification occupies the space necessary for the movements

Table 1

Data of patients in the first group with the presence of HO

No.	Gender	Age (years)	Pain	Instability	HO (form)	Range of motion (degrees)		Joint function assessment (score)	Time since injury (months)
						extension/flexion	supination/pronation		
1	f	70	1	—	I	0/20/120 (100)	55/0/60 (115)	85	6
2	f	55	1	—	I	0/5//125 (120)	65/0/65 (130)	85	6
3	f	50	—	—	I	0/5/120 (115)	65/0/75 (140)	100	6
4	m	45	—	—	IIA	0/20/115 (95)	75/0/75 (150)	95	7
5	f	48	1	—	I	0/45/110 (65)	5/0/5 (10)	80	5
6	m	20	—	—	IIIB	0/50/95 (45)	0/5/5 (0)	75	7
7	m	50	—	—	I	0/10/125 (115)	75/0/75 (150)	100	7
8	f	49	1	—	I	0/5/120 (115)	65/0/65 (130)	85	6
9	m	37	1	—	I	0/50/125 (75)	75/0/70 (145)	80	9
Total		48 ± 7	—	—	—	94 ± 9	108 ± 20	87 ± 3	6.5 ± 0.4

Table 2

Data of patients in the second group with the presence of HO

No.	Gender	Age (years)	Pain	Instability	HO (form)	Range of motion (degrees)		Joint function assessment (score)	Time since injury (months)
						extension/flexion	supination/pronation		
1	f	50	1	1	I	0/25/120 (95)	55/0/45 (100)	75	6
2	f	46	1	1	IIA	0/45//95 (50)	45/0/45 (90)	45	7
3	f	43	1	1	IIA	0/40/105 (65)	65/0/60 (125)	45	5
4	f	45	1	—	IIC	0/38/58 (20)	5/0/5 (10)	30	7
5	m	52	—	—	IIIC	0/55/55 (0)	0/10/10 (0)	50	6
Total		47 ± 2	—	—	—	46 ± 17	65 ± 25	49 ± 7	6.2 ± 0.4

Fig. 1. Radiographic images of the elbow joint of the patient of the first group in the lateral projection in the position of maximum flexion (a) and extension (b), mild HO (I)

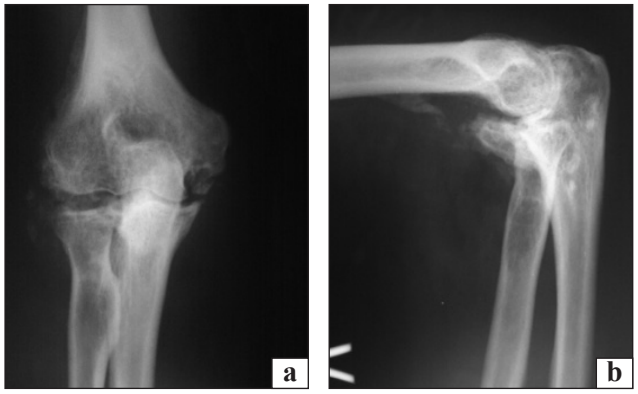

Fig. 2. Radiographic images of the elbow joint of the patient of the first group in the direct (a) and lateral (b) projections after removal of the fixators from the proximal part of the radius, HO II A

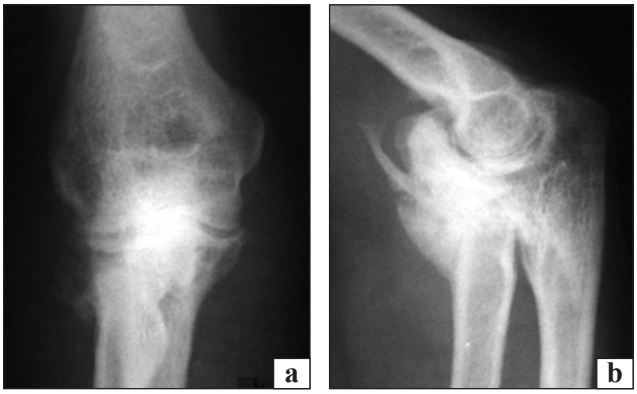

Fig. 3. Radiographic images of the elbow joint of the patient of the second group in the direct (a) and lateral (b) projections, HO II C

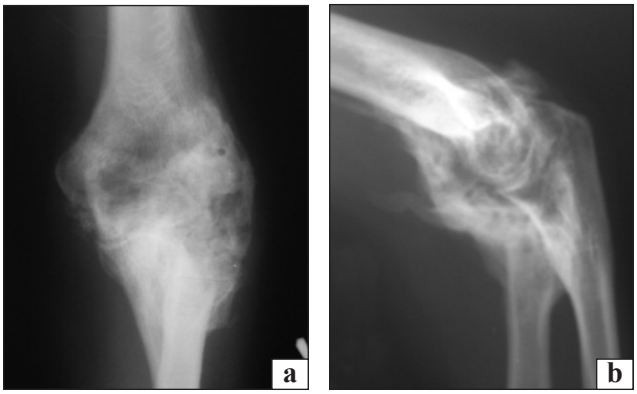

Fig. 4. Radiographic images of the elbow joint of the patient of the second group in the direct (a) and lateral (b) projections, HO III C

of bone articular formations and therefore is an obvious cause of limitation of flexion-extension and rotational movements of the forearm.

The most severe form of HO (III) was observed in both groups. Fig. 4 shows radiographic images of the elbow joint (case No. 5) 6 months after removal of the forearm dislocation and removal of fragments of the RH due to the impossibility to perform osteosynthesis. Ossification of a mature structure forms a bone bridge between the bone formations of the joint, which completely blocks flexion-extension and rotational movements of the forearm.

In 3 cases among patients of the second group, a mild degree of instability of the elbow joints in the frontal plane was observed, and in the presence of HO form II A in 2 individuals. Minor intermittent pain in this area at the time of assessment of the immediate results was noted by 55 % of patients in the first group and 60 % of patients in the second. As evidenced by the data of O. O. Korzh [15], the dependence of the development of HO on the age or sex of patients has not been established. Taking into account the similarity of patients in the groups by the nature of the injuries, it can be assumed that the difference in the preservation and absence of the RH is the main reason for the discrepancy in the frequency of HO formation and the degree of its manifestation, which was also reflected in the results of assessing the functional capabilities of the elbow joints in the groups according to the Mayo Clinic scoring scale. These indicators were significantly higher in the first group, (87 ± 9) versus (49 ± 16) in patients in the second group ($p < 0.05$).

Thus, the absence of RH along with significant damage to the soft tissue structures of the elbow joint, which occurs during forearm dislocation, suggests a decrease in the degree of its stability, which probably affects the frequency and nature of the formation of HO in this area.

The combination of several negative factors, including delayed surgical intervention (more than 48 hours after injury) and a decrease in the degree of stability of the damaged joint, leads to a more pronounced and severe form of HO.

Conclusions

In patients with fractures of the radial head in combination with forearm dislocations in cases where it is impossible to preserve the head, the formation of heterotopic ossifications in the elbow joint is observed more than twice as often as in patients with a preserved head (56 versus 23 %).

Heterotopic ossifications of forms II and III are diagnosed more than three times more often in patients with fractures of the radial head in combination with dislocations of the forearm in case of impossibility of preserving the head as compared to cases of its restoration (80 vs. 22 %).

Considering the high risk of heterotopic ossifications in the elbow joint of patients with fractures of the radial head in combination with dislocations of the forearm in case of impossibility of preserving the head, as well as in cases of postponing the necessary surgical treatment in case of fracture-dislocations in the elbow joint, it is necessary to take care of available measures for the prevention of HO.

Conflict of interest. The author declares that there is no conflict of interest.

Prospects for further research. The data presented can be used by traumatologists-orthopedicians to reduce the number of such complications and reduce the degree of their manifestation.

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MANIFESTATIONS OF HETEROTOPIC OSSIFICATION IN PATIENTS WITH RADIAL HEAD FRACTURES COMBINED WITH FOREARM DISLOCATIONS

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