

AVASCULAR NECROSIS FOLLOWING TRAUMATIC HIP DISLOCATION IN CHILDHOOD

Factors of Influence

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An evaluation was made of the factors possibly influencing the incidence of vascular necrosis in a collected series of 412 traumatic hip dislocations in children. This series consisted of 145 cases with necrosis, and 267 dislocations in which this complication had not developed after a follow-up period of 2 years or more. The age of the patient, the severity of the injury, the type of dislocation and the interval before reduction proved to be influencing factors. The reduction procedure appeared to play a similar role, but this could not be definitely assessed. The post-reduction immobilization and the interval before weight-bearing had no influence. Therapeutic principles are indicated.

Key words: avascular necrosis; children; hip; hip dislocation

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There is no general agreement in the literature as to the factors influencing development of avascular necrosis (AN) of the proximal extremity of the femur (PEF) after traumatic hip dislocation in childhood (THDC); the rarity of the injury and the number of variables per case play a role in this respect (Funk 1962, Klasen 1979).

Only two analyses of available data in series of cases developing AN after THDC have previously been performed in order to find common denominators (Haliburton et al. 1961, Pennsylvania Orthopaedic Society 1968).

In the present paper the factors theoretically influencing the development of AN are evaluated in a comparative investigation, considering cases of THDC developing AN, and those which after a sufficiently long observation period had not developed necrosis.

PATIENTS AND METHODS

A total of 1,117 cases of THDC were reviewed. The sources of this material were patients treated at Uruguayan hospitals, cases reported in the medical literature, and additional cases collected by personal communication.

Interference with the blood supply of the PEF in a child should result in AN, not only of the epiphyseal ossific nucleus, but also of the growth plate (Duriez 1977, Pous & Dimeglio 1977, Bucholz & Ogden 1978). On this basis, the observations to be included under the term AN should be those with radiologic signs of necrosis of the ossific nucleus, or with changes indicating necrosis of the growth plate, or both. Including the five cases reported by us, the number of observations of AN after THDC collected totals 145 (Barquet 1982). A correlative evaluation of the theoretically influencing factors was made in a control series of cases of THDC not developing AN. As AN may be diagnosed up to 24 months following the dislocation (Barquet 1982), only those THDC with a clinical and radiological follow-up of 2 years or more were included in the control series. Among the 1,117 cases reviewed, 267 hips fulfilled these conditions (Table 1).

Table 1. *A total of 267 cases of traumatic hip dislocation in children, not complicated with avascular necrosis, and observed for 2 years or more

Author	Year	Cases	Author	Year	Cases
Mauck et al.	1935	1	Liuboshits et al.	1964	1**
Cuche	1937	1	Dialer	1965	1
Rocher et al.	1937	1	Perry	1966	1
Funsten et al.	1938	1	Wilson	1966	2
Pfab	1938	3	Byram et al.	1967	3
Caamaño	1941	1	Chavatte	1968	6
Quist-Hanssen	1945	3	Rigault et al.	1968	4
Paus	1951	1	Spissak et al.	1969	2
Trillat et al.	1951	1	Fregnani et al.	1970	3
Blount	1955	1	Nelson	1970	1
Loray	1955	1	Pizio	1971	2
Perruelo	1955	1	Gula	1972	1
Fineschi	1956	4	Gaul	1973	1
Gui	1957	2	Laskowski et al.	1973	8***
Economu et al.	1958	1	Pearson et al.	1973	6
Jonasch	1958	1	Proctor	1973	8
Judet	1958	1	Schlonsky et al.	1973	14
Litton et al.	1958	1	Bijlsma	1974	1
Tailhefer	1958	1	Brug et al.	1974	2
Lievre	1959	1	Rowe	1974	1
Morton	1959	3	M'Bamali	1975	1
Carpi	1960	1	Hammelbo	1976	3
Davalli	1961	1	Obel et al.	1976	7
Freeman	1961	3	Kanan et al.	1978	22
Glass et al.	1961	14	Soares	1978	8
Gouin	1961	1	Barquet	1979	11
Piggot	1961	7	Cataldi et al.	1979	1
Funk	1962	15	Ciliani	1979	5
Oprandi et al.	1962	1	Jansen et al.	1979	2
Ulloa	1962	5	Klasen	1979	8
Duyfjes	1963	1	Lavianos	1979	7
Koszla	1963	5	Weigand et al.	1979	1
Ricci et al.	1963	2	Epstein	1980	12
Aufranc et al.	1964	1	Fernández	1980	4
Hohmann	1964	1	Hidalgos	1980	10

* A full list of references to Table 1 is available from the author on request.

** Bilateral.

*** One bilateral case.

For a significant number of cases in both series, the data provided was accurate and thus useful for statistical evaluation.

The incidence of AN was analyzed in relation to the following: 1) age of patient, 2) severity of injury, 3) type of dislocation, 4) interval before reduction, 5) reduction procedure, 6) post-reduction immobilization, and 7) interval before weight-bearing.

Before a probability of determination can be made in a statistical analysis, each category to be investigated should consist of comparable data; therefore a correlation of the incidence of AN with two or more variables

was made simultaneously thus constituting comparable groups of observations.

RESULTS

Table 2 shows the relationship between the incidence of AN, the age of the patient, the severity of the injury, and the interval before reduction. There was a correlation between age of patient

Table 2. Incidence of avascular necrosis related to age, severity of injury and interval before reduction

#		× Within 24 hours				Later than 24 hours			
		No AN	AN	Total	% AN	No AN	AN	Total	% AN
0-5 yr	Slight	6	0	6	0	1	0	1	0
	Moderate	23	0	23	0	3	4	7	57.14
	Severe	17	1	18	5.55	2	5	7	71.42
6-10 yr	Slight	2	0	2	0	1	4	5	80
	Moderate	23	4	27	14.81	0	14	14	100
	Severe	28	7	35	20	2	14	16	87.50
11-15 yr	Slight	0	0	0	-	0	0	0	-
	Moderate	12	2	14	14.28	1	5	6	83.33
	Severe	24	10	34	29.41	2	11	13	84.61

* Age (years).

Severity of injury.

× Interval before reduction (hours).

and incidence of AN, and it would appear that there exists a protection against AN in children under 6 years. Injuries were grouped into slight, such as falls from the same level; moderate, such as athletic traumas; and severe. The severity of injury strongly influenced the result; in severe accidents the incidence of AN was greater. In regard to the influence of the interval before re-

duction, the incidence of AN in cases reduced within the first 24 hours was much lower than in those treated after that interval.

In Table 3 the incidence of AN is correlated with the type of dislocation, the interval before reduction, and the reduction procedure. For the purpose of this study, dislocations were classified into: *Type 1*, posterior dislocations without frac-

Table 3. Incidence of avascular necrosis related to type of dislocation, interval before reduction and reduction procedure

	Type	× Within 24 hours				Later than 24 hours			
		No AN	AN	Total	% AN	No AN	AN	Total	% AN
Closed	1	146	19	165	11.51	16	32	48	66.66
	2	5	2	7	28.57	-	-	-	-
	3	0	2	2	100	0	1	1	100
	4	13	2	15	13.33	1	6	7	85.71
Open	1	3	1	4	25	1	14	15	93.33
	2	2	2	4	50	0	1	1	100
	3	0	2	2	100	0	13	13	100
	4	1	0	1	-	-	-	-	-

× Interval before reduction.

* Reduction procedure.

Note: In an isolated analysis of factors it was found that in dislocations with associated separation of the capital epiphysis AN occurred in 100 percent of cases. Therefore, in Table 3, these Type 3 dislocations were not included.

ture; *Type 2*, posterior dislocations with fracture of the acetabulum; *Type 3*, posterior dislocations with traumatic separation of the capital epiphysis; and *Type 4*, anterior dislocations without fracture. No significant difference concerning the incidence of AN in posterior and anterior dislocations could be found. Although the number of fracture dislocations was relatively small, the incidence of AN proved to be much higher in these lesions than in simple dislocations. The incidence of AN was much more frequent in cases reduced later than 24 hours after the injury. Nevertheless, early reduction did not mean absence of AN; even in those cases reduced within 24 hours, necrosis occurred in 11.5 percent. The influence of the reduction procedure could not be definitely assessed, as the number of cases undergoing open reduction within the first 24 hours was too small. Although it might appear that open reduction would increase the incidence of AN, it should be noted that early surgical reduction was not always followed by this complication.

In order to equalize the number of patients in each group, the interval before reduction was di-

Table 4. Incidence of avascular necrosis related to interval before reduction in posterior dislocations without fracture, reduced by closed procedures

Interval before reduction	No AN	AN	Total	% AN
0- 4 hours	45	3	48	6.25
5-12 hours	34	5	39	12.82
13-24 hours	32	5	37	13.51
Later than 24 hours	16	32	48	66.66

Table 5. Incidence of avascular necrosis related to post-reduction immobilization in posterior dislocations without fracture, reduced by closed procedures within 24 hours

Immobilization	No AN	AN	Total	% AN
No immobilization	19	3	22	13.63
Up to 3 wk	34	5	39	12.82
More than 3-6 wk	27	5	32	15.62
More than 6 wk	38	6	44	13.63

Table 6. Incidence of avascular necrosis related to interval before weight-bearing in posterior dislocations without fracture, reduced by closed procedures within the first 24 hours

Interval before weight-bearing	No AN	AN	Total	% AN
Up to 4 wk	45	6	51	11.76
More than 4-8 wk	38	4	42	9.52
More than 8-12 wk	22	2	24	8.33
More than 12 wk	15	3	18	16.66

vided into 0-4 hours, 5-12 hours, 13-24 hours and over 24 hours. Table 4 shows the incidence of AN in each of these periods in regard to *Type 1* dislocations treated by closed procedures. In this analysis the importance of this factor is even more clearly demonstrated: a very low incidence of necrosis occurred in dislocations reduced within 4 hours, a higher but still low incidence was found in cases treated between 5 and 24 hours, and there was a high incidence in those reduced later than 24 hours after the injury.

A further investigation concerned the influence of post-reduction immobilization in *Type 1* dislocations treated by closed procedures within 24 hours. Table 5 indicates that post-reduction immobilization did not influence the incidence of AN.

In Table 6 the incidence of AN is correlated with the interval before weight-bearing in patients with *Type 1* dislocations reduced by closed procedures within 24 hours. The evaluation shows that the interval before weight-bearing was not an influencing factor.

DISCUSSION

Certain conclusions may be drawn from this investigation. The age of the patient, the severity of the causative trauma, the type of dislocation, and the interval before reduction, appear to be factors favoring the incidence of AN after THDC. The reduction procedure might play a similar role. The fate of the PEF seems to be determined at the time of dislocation and reduction. Therefore the only variable to be modified is the interval

before reduction. Consequently, therapeutic measures should be carried out as an emergency in an attempt to diminish the risk of AN, which nevertheless cannot be completely eliminated. As post-reduction immobilization and the interval before weight-bearing do not appear as influencing factors, the guidelines for post-reduction management should be determined on the basis of current concepts of treatment of dislocation of any other joint.

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