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INDICATIONS AND METHODS FOR RADIOTHERAPY OF CAVERNOUS HAEMANGIOMAS

A study of 1191 haemangiomas following radiotherapy

by

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The role of radiation therapy in the treatment of haemangiomas is a subject of keen discussion. Radiotherapy has been used very sparingly in England for example (LISTER 1938, WALTER 1953), because it has been felt that haemangiomas have a natural tendency to spontaneous healing. In Germany, on the other hand, the opinion has been held that the risk of complications such as haemorrhage and infection is so great that a more active attitude is justified (MIESCHER 1944, WEISHAAR & KOSLOWSKI 1959). The Swedish author, NOTTER (1956), recommended radiotherapy for haemangiomas in areas where there is an enhanced risk of these complications.

The authors in the present communication examine:

1. The results one year following the radiation treatment of haemangiomas and the extent to which these results were affected by such factors as the size of the growths, the quality of radiation used and the dose administered.

2. The effect these same original factors had on the appearances of the skin 5 to 15 years following therapy, and whether radiotherapy can be shown to have had any injurious effects.

Submitted for publication 11 October 1962.

Table 1

Distribution in per cent in the different age group (all patients)

Year of treatment	Number of patients	Age in years 0—½	½—1	1—2	2—10
1945	130	46	33	16	5
1950	274	47	31	20	2
1955	426	64	26	8	2
Total	830	56	29	13	2

Haemangiomas are usually classified in the medical literature according to their histologic appearances into the following categories: haemangioma capillare, haemangioma simplex, haemangioma cavernosum and haemangioma racemosum. This classification, however, is unsuitable for clinical use and at Jubileumskliniken in Lund haemangioma simplex and haemangioma cavernosum are classified on a clinical basis into surface (cutaneous) and deep (subcutaneous) types, two types that commonly occur simultaneously in one haemangioma. The present writers will not discuss haemangioma racemosum and those types of haemangioma capillare known as haemangioma vinosum and angioma stellatum.

Material

This investigation, which was carried out in 1961, includes all haemangiomas in children under 10 years of age who were given radiotherapy in the years 1945, 1950 and 1955. The number of patients in those years was 130, 274 and 426, respectively, and the number of haemangiomas 169, 402 and 620 respectively, a total of 830 patients with 1 191 haemangiomas; of these haemangiomas 868 (72 %) had only superficial components, 311 (27 %) both superficial and deep elements and 12 (1 %) only deep components.

The size of the haemangiomas showed wide variations. Haemangiomas having a maximum measurement of 15 mm in any direction are called minor; there are 756 minor and 435 major haemangiomas in this investigation. The haemangioma was single in 598 patients, and 232 patients had multiple haemangiomas. The number of haemangiomas per patient in this latter group varied from 2 to 50, the usual number being 2 to 4. The distribution between the sexes is the same as that given in the literature, namely one male to two females.

Table 1 gives the age at the time of the first treatment. The aim has been to treat haemangiomas as early as possible, preferably during the first year of life. The table also shows that the number of patients over the age of one year has diminished with the passage of time, falling from 22 % to 10 % of the total number between 1950 and 1955.

Investigation and percentage of answers

All patients who were not re-examined in 1961, were asked to fill in a questionnaire giving:

1. Details of the present appearances of the skin, any changes in the skin in the form of atrophy, pigmentation, de-pigmentation, telangiectases, or other abnormality.
2. To state in brief whether or not the result was cosmetically satisfactory.
3. To state whether they were healthy and normally developed.

Certain special problems, however, e. g. indications and counter-indications for radium therapy and the possible occurrence of disturbances in growth due to irradiation of epiphyses, made it necessary for a number of patients to come to the clinic for re-examination. This examination comprised inspection and palpation with assessment of any permanent changes in the skin and any deformity or hypoplasia in the surrounding tissue. Most of the patients also had routine haematologic studies including haemoglobin and red, white and differential blood counts. The blood tests were all within normal limits. Further investigations such as roentgenography or ophthalmoscopy were carried out where there was reason to suspect that the dose to any one organ was excessive.

One hundred and thirty-five patients with 178 haemangiomas were requested to come to the clinic, and 695 patients with 1 013 haemangiomas were invited to fill in a questionnaire; some of this latter group elected to come to the clinic for re-examination instead. Thus a total of 267 patients with 354 haemangiomas (30 % of the total number) were re-examined at the clinic and 492 patients with 733 haemangiomas (62 %) filled in the questionnaire. This provided data on long-term results for 759 patients with 1 087 haemangiomas (92 %). Similar data are not available for 71 patients with 104 haemangiomas (8 %). Some of these latter patients had died but the majority had moved to other districts and could not be traced even by consulting parish registries. For 64 of these patients with 96 haemangiomas only a one year control examination is recorded, but not even this is available for 7 patients with 8 haemangiomas.

Principles of treatment

Haemangiomas were treated at Jubileumskliniken during the period covered by the investigation with radium, radium combined with contact roentgen therapy, or by contact roentgen therapy alone. A few patients received roentgen therapy, generally tangentially.

The principle followed was that haemangiomas in especially radiosensitive areas, e. g. epiphyses and undeveloped breasts, were given contact roentgen therapy. The method of treatment was otherwise determined by the depth of the haemangioma and by its spread at the surface. Minor superficial haemangiomas received contact roentgen therapy (50 kV, 0.5 mm Al additional

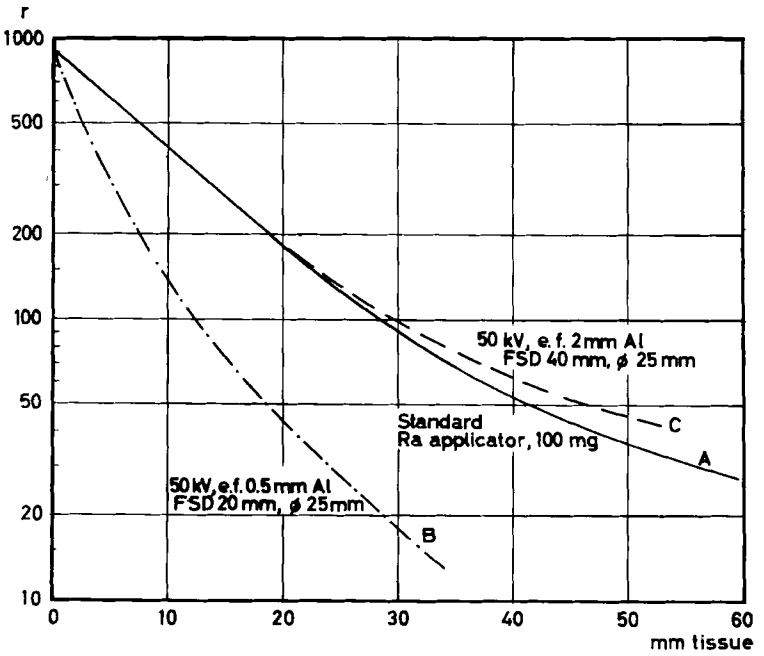


Fig. 1. Central axis depth dose distribution for radium and roentgen contact therapy. Surface dose 900 r.

filter, 20 mm FSD, corresponding to a HVL of 3 mm soft tissue). Contact roentgen therapy was also often given to major haemangiomas including some where the changes extended down beneath the superficial layers of the skin. The haemangiomas were then compressed during treatment and in some cases the quality of the rays was modified (50 kV, 0.5 to 1 mm Al additional filter, 40 mm FSD, corresponding to a HVL of about 4 to 6 mm soft tissue). Many haemangiomas with relatively thick superficial components were given radium therapy. Haemangiomas with subcutaneous components were mostly treated with radium or, in isolated instances, with tangential roentgen therapy. Those haemangiomas that showed substantial regression after radium treatment but still had a minor superficial residue were usually given final treatment with contact roentgen therapy. Isolated cases were recommended for surgical therapy if any disfiguring haemangioma residue following radiotherapy existed.

The first radium treatment consisted of a dose of 700 to 800 r at a depth of about 3 mm corresponding to 900 to 1 000 r on the skin surface following the method described by STRANDQUIST (1939) (Fig. 1). The radium dose for each additional application for those haemangiomas that received several treatments was usually 500 to 700 r at a depth of 3 mm. The surface dose in

Table 2a

Results of treatment in per cent for all re-examined haemangiomas

Total number	After one year			After 5—15 years	
	Disappeared	Almost disappeared	Regression	Disappeared	To surgical therapy
1 087	44	35	21	99	1

Table 2b

Result of treatment in per cent for all re-examined haemangiomas, comparison between haemangiomas without and with deep components, major and minor haemangiomas and haemangiomas in males and females

	Number of haemangiomas	Skin after 5 to 15 years		
		No changes	Minor changes	Major changes
All haemangiomas	1 087	47	48	5
Haemangiomas with only surface components	794	47	49	4
Haemangiomas with deep components	293	42	51	7
Size of haemangiomas $\leq$ 15 mm	685	54	43	3
$>$ 15 mm	402	37	53	10
Males	357	49	46	5
Females	730	47	48	5

contact roentgen therapy was usually 1 000 r for the first treatment and 600 to 800 r for subsequent treatments.

The majority of haemangiomas were treated by one of three methods (routine radiation treatment):

1. Radium treatment alone (one or two applications);
2. One radium application followed by one contact roentgen therapy treatment;
3. Contact roentgen therapy alone (one or two treatments).

A minority of growths were treated by other methods (non-routine treatment). Some of these were given radium treatment or contact roentgen therapy three times. A number received one or more radium applications combined with one or more contact roentgen therapy treatments, the first treatment consisting alternately of radium and contact roentgen therapy. A few haemangiomas received roentgen therapy, generally tangential. The interval between the treatments was generally about 180 days, occasionally about 120 days, and rarely more than 200 days.

An examination of the percentage distribution between the different types of treatment described above reveals that 53 % of the haemangiomas received some kind of radium treatment on at least one occasion, whereas 45 % were

Table 3

Result of treatment in per cent for different age groups (routinely treated haemangiomas)

Age in years	Number of haemangiomas	Haemangioma after one year			Skin after 5 to 15 years		
		Disappeared	Almost disappeared	Regression	No changes	Minor changes	Major changes
0—1/2	530	49	38	13	45	51	4
1/2—1	273	47	39	14	51	47	2
1—2	128	56	30	14	47	49	4
2—10	21	31	49	20	62	26	12
Total	952	50	36	14	50	47	3

given contact roentgen therapy only, and 2 % received roentgen treatment. The number of patients receiving radium therapy has gradually declined during the latter part of the 1950's (NORDBERG 1961), and the number treated with contact roentgen therapy has increased. Treatment to-day is mostly by contact roentgen therapy.

Since many patients had more than one haemangioma, and since the therapeutic technique and the results obtained vary for different haemangiomas on the same patient, the percentage figures cited above, and the figures in all the following tables, refer to the number of haemangiomas and not to the number of patients.

Results

One-year results. All the haemangiomas that were re-examined have been assigned to one of three groups with the assistance of the case notes (Table 2a). The first group ('disappeared') consists of haemangiomas that had completely disappeared; the second ('almost disappeared') contains those in which only minor haemangioma residues were discernible; the third group ('regression') contains those that had receded to a greater or lesser degree but not completely. This last group also includes the 12 cases (1 % of the material) that were later referred for surgical therapy. The percentage distribution within the three groups specified in the 96 haemangiomas in which only the one-year results are known is 41, 30 and 29 % respectively.

Long-term results. As there is no haemangioma residue remaining after 5 to 15 years, the long term assessment applies to the appearance of the skin, i. e. the long-term results from the cosmetic point of view. The first group ('no changes') contains those cases in which the skin was completely normal; the second ('minor changes') contains those in which the skin showed isolated telangiectases, slight pigmentation or de-pigmentation. The cosmetic results in both these groups were satisfactory. There were more obvious changes in the skin in the third group ('major changes').

Data on the long-term results for 1 087 haemangiomas, 952 of which re-

Table 4

Result of treatment in per cent after different treatments and different doses (routinely treated haemangiomas)

Table 4a — one treatment

Treatment	Surface dose in r	Number of haemangiomas	Haemangioma after one year: Disappeared	Almost disappeared	Regression	Skin after 5 to 15 years: No changes	Minor changes	Major changes
Radium	≤ 900	56	47	41	12	57	38	5
	> 900	99	61	30	9	66	31	3
Roentgen contact therapy	≤ 900	46	68	24	8	74	24	2
	> 900	262	74	24	2	51	47	2

Table 4b — two treatments

Treatment	Surface dose in r at the 1st treatment	Number of haemangiomas	Haemangioma after one year: Disappeared	Almost disappeared	Regression	Skin after 5 to 15 years: No changes	Minor changes	Major changes
Radium	≤ 900	66	32	31	37	41	55	4
	> 900	97	36	40	24	49	46	5
Roentgen contact therapy	≤ 900	34	40	43	17	59	38	3
	> 900	147	31	50	19	35	62	3
Radium + roentgen contact therapy	≤ 900	87	30	53	17	40	57	3
	> 900	58	37	52	11	55	43	2

ceived routine radiation treatment are available. A survey of the long-term results for all the radiotherapeutically treated haemangiomas that were re-examined, irrespective of the type of treatment they had received, is given in Table 2b. Haemangiomas with subcutaneous components are also placed in this table in juxtaposition to those without such components for comparison. Both the one-year results and the long-term results are considerably worse for the subcutaneous category. There is also, as can be seen from Table 2b, a marked difference between major and minor haemangiomas both in the one-year and long-term results. There is no difference between the results for males and those for females.

The results for haemangiomas that received routine radiation treatment are better than those for the total number of haemangiomas, irrespective of the type of treatment. This may be explained by two factors.

1. The majority of the haemangiomas receiving non-routine treatment were given three or four treatments and thus received larger skin doses than

Table 5

Result of treatment in per cent after different treatments and different sizes of haemangiomas (routinely treated haemangiomas)

Table 5a — one treatment

Treatment	Size of haemangiomas in mm	Number of haemangiomas	Haemangioma after one year: Disappeared	Almost disappeared	Regression	Skin after 5 to 15 years: No changes	Minor changes	Major changes
Radium	≤ 15	102	63	31	6	70	28	2
	> 15	53	44	39	17	47	45	8
Roentgen contact therapy	≤ 15	252	74	23	3	56	42	2
	> 15	56	68	30	2	47	50	3

Table 5b — two treatments

Treatment	Size of haemangiomas in mm	Number of haemangiomas	Haemangioma after one year: Disappeared	Almost disappeared	Regression	Skin after 5 to 15 years: No changes	Minor changes	Major changes
Radium	≤ 15	84	50	33	17	50	47	3
	> 15	79	18	39	43	42	52	6
Roentgen contact therapy	≤ 15	116	40	43	17	43	55	2
	> 15	65	22	56	22	34	62	4
Radium + roentgen contact therapy	≤ 15	80	38	53	9	54	45	1
	> 15	65	27	52	21	37	58	5

those treated in the normal manner. A greater number of skin changes due to radiation may therefore be expected in this group.

2. When haemangiomas that had received non-routine treatment, i. e. 12 % of the total material, are excluded the cutaneous group diminishes by 9 % and the subcutaneous group by 22 %, minor haemangiomas by 7 % and major ones by 21 %. It is therefore evident that major haemangiomas and haemangiomas with subcutaneous components are over-represented in the non-routine groups. These types of haemangiomas give a less satisfactory cosmetic result than minor haemangiomas and haemangiomas with only cutaneous components.

The non-routine treated haemangiomas form a non-homogenous group as far as the therapeutic technique is concerned. There are also relatively few of them compared with those that had routine radiation treatment. With due consideration to these factors it was therefore thought correct to omit non-

Table 6

Comparison between the one-year result and the long-term result in per cent for different sizes of haemangiomas (routinely treated haemangiomas)

Number of haemangiomas	Size of haemangiomas in mm	Haemangioma		Skin after 5 to 15 years		
		After one year	After 5 to 15 years	No changes	Minor changes	Major changes
323	≤ 15	Disappeared	Disappeared	57	41	2
153	> 15	»	»	31	67	2
206	≤ 15	Almost dis-	»	62	37	1
146	> 15	appeared	»	37	60	3
54	≤ 15	Regression	»	52	39	9
70	> 15	»	»	36	44	20

routine treated haemangiomas in further tables. Tables 3, 4, 5 and 6 thus contain only those haemangiomas that received routine radiation treatment.

The results for different age groups may be seen in Table 3. The number of haemangiomas in the 2 to 10 age group is so small that the less satisfactory results in this group are not necessarily significant. There is otherwise no marked difference between the different age groups.

Tables 4a and 4b show the extent to which the results of the treatment are influenced by the size of the dose. Cases that received two treatments (Table 4b) are grouped according to the size of the first surface dose. The boundary between a low and a high dose has been fixed at 900 r. Corresponding depth doses for a normal radium application (A) and contact roentgen irradiation of normal quality (B) are shown in Fig. 1.

Despite the fact that the number of haemangiomas in some groups is rather small, the tables show that for radium-treated haemangiomas both the one-year results and the long-term results are better when the higher dose was given. For haemangiomas that received contact roentgen therapy the long-term results are better for those given the lower dose.

The haemangiomas are divided according to size in Tables 5a and 5b, the boundary between the major and minor haemangiomas being fixed at 15 mm, as described above. The results of the different types of treatment when given once (Table 5a) or twice (Table 5b) are compared within these two main groups. The results for the major haemangiomas are less satisfactory; those for the different kinds of treatment are basically the same as those shown in Tables 4a and 4b.

The possible variation in the results with the site of the haemangioma was also investigated. Haemangiomas were divided into three main groups: those situated on the head, the trunk and the extremities. The one-year results are about the same in all three groups and are similar to the results for all routine

Table 7

Supplementary examinations — Doses and fractionation-time for irradiation of the skeleton, lens and thyroid gland

Table 7a — irradiation of the skeleton

Patient's No.	Area examined	Dose in rad at the examined part of the skeleton at treatment 1	2	3	Interval in months between treatments 1—2	2—3	Total dose in rad	Total fractionation-time in months
44 18 24	Thoracic vertebras	600	500	400	6	8	1 500	14
44 10 13	Cervical vertebras	900					900	
45 01 18	Wrist	600	600		5		1 200	5
	Skull	600					600	
55 05 03	Femur	70	90		6		160	6
50 06 20	Skull	700	700	400	8	9	1 800	17
49 10 05	Shank	130	90		8		220	8
49 02 06	Thoracic vertebras	600					600	
49 06 27	Shoulder	200					200	
49 08 23	»	70	70	70	4	6	210	10
50 06 19	Skull	800	500		4		1 300	4
49 10 22	»	800	600		4		1 400	4

Table 7b — irradiation of the lens

Patient's No.	Dose in rad at treatment 1	2	Total dose in rad	Total fractionation-time in months
50 06 19	90	60	150	4
49 10 22	140	110	250	4
49 12 18	120	100	220	4
49 03 21	100	100	200	4

Table 7c — irradiation of the thyroid gland

Patient's No.	Dose in rad at treatment 1	2	Total dose in rad	Total fractionation-time in months
45 04 27	90	60	150	5
49 09 23	140	100	240	4
55 09 03	300	75	375	10

radiation treated haemangiomas shown in Table 3. The long-term results are better for haemangiomas situated on the head. Of these latter 68 % showed no skin changes after 5 to 15 years and 29 % showed only minor changes. The corresponding figures for the other two groups are 40 % and 42 % respectively without changes and 56 % and 54 % respectively with minor changes. A

Table 8

Three cases with multiple haemangiomas, doses and fractionation-periods

Patient's No.	Number of haeman-giomas	Interval between treatments	Dose in rad on Active bone marrow	Thyroid gland	Gonads	Lens
55 03 18	5		9	20	5	70
		3 months	1	0	0	0
	Total	3 months	10	20	5	70
50 04 14	15		20		25	
		8 days	20		25	
		4 months	15		40	
		4 months	15		25	
	Total	8 months	70	< 20	115	< 10
50 02 13	18		20	80	3	60
		1 day	10	80	9	20
		4 months	10	20	12	20
		4 months	1	10	0	20
	Total	8 months	41	190	24	120

relatively larger number of the haemangiomas located about the head were minor ones. This may be one explanation of the fact that the long-term results are better for this group than for the other two groups. Another explanation is that the vascularization and thus also the nutrition of the skin is better in the head than in the rest of the body. There is consequently better healing of the skin changes in this region brought about mechanically by haemangiomas and those caused by radiation.

The material was still further divided by specifying the sites even more closely, e. g. upper and lower halves of the face and scalp or chest, back and abdomen. The results are essentially the same as that noted for the principal groups within these subdivisions. Such deviations as could be noted are explained by the fact that the number of haemangiomas is small for certain groups.

The relationship between the one-year results and the long-term results are illustrated in Table 6. No single case with a haemangioma residue was found at control examination after 5 to 15 years (Table 2a), although other skin changes that were to a greater or lesser degree disfiguring were often evident. The haemangiomas are divided in the table according to size and one-year results. The results after 5 to 15 years are given for each group, and are similar for all haemangiomas except for the group containing those large haeman-

giomas that after a year showed only regression. The long-term results in this group were often unsatisfactory but for the other haemangiomas the long-term results did not differ considerably from the average result. As less satisfactory long-term results may be expected for those major haemangiomas that show only regression after one year there is good reason to refer these patients while still in childhood for plastic surgery in order that supplementary non-radiotherapeutic treatment may be given at a suitable opportunity.

Supplementary investigations where complications due to radiation are probable. There are numerous accounts in the literature of injuries arising from radiotherapy applied to haemangiomas. These injuries usually occur in patients who have been given doses far above those regarded as permissible at our clinic.

Table 7 deals with a number of patients in whom supplementary investigations in connection with their re-examination were performed. The table shows the dose at each treatment, the interval between the treatments and the total dose. The doses are given in rads to make it possible to add doses of differing quality.

The radio-sensitivity of epiphyses, i. e. the lowest dose at which the risk of growth disturbances or other damage to epiphyses arises, has often been discussed (MAU 1953, FISCHER 1955, WEISHAAR & KOSLOWSKI 1959, BONSE & GRAF 1960). It is generally stated, without any precise information on the quality of the radiation being given, that the risk of any permanent growth disturbances is slight after a maximum tissue dose of 300 r during one treatment. WEISHAAR & KOSLOWSKI stated that tolerance increases with fractionation and diminishes with harder radiation. These two writers believed that the tolerance limit stated is also applicable to contact roentgen therapy. A tissue dose of > 400 r produces a risk of the development of deformities.

Twelve patients among those who came to the clinic for re-examination, and in whom the tissue dose in some part of the skeleton was high, were subjected to roentgen examination for the detection of possible skeletal changes caused by radiation. It was not possible to demonstrate any deformities or damage to the skeleton even though the dose at a single treatment was as high as 900 rad and the total dose reached 1 800 rad over a 17 month period (Table 7a).

The danger of causing a *radiation cataract* when treating haemangiomas near the eye was discussed by e. g. MERRIAM & FOCHT (1957), QUIST & ZACHAU-CHRISTIANSEN (1959) and BEK & ZAHN (1960). A single dose of about 200 rad gamma radiation to the lens is considered to be dangerous. The longer the fractionation period the greater the tolerance, and thus the limit of tolerance is considered to be 550 rad fractionated over a period of three months. Four patients were examined by an ophthalmologist. The lens had been given a total dose varying between 150 rad and 250 rad with a

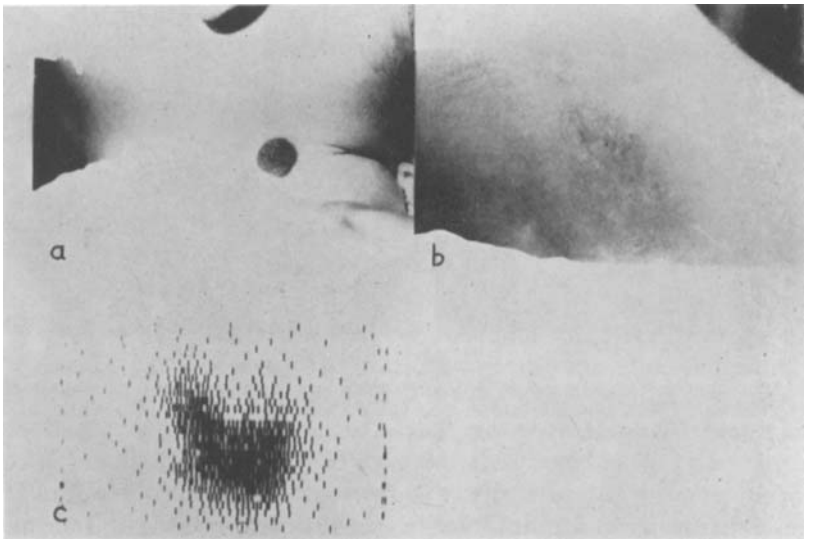
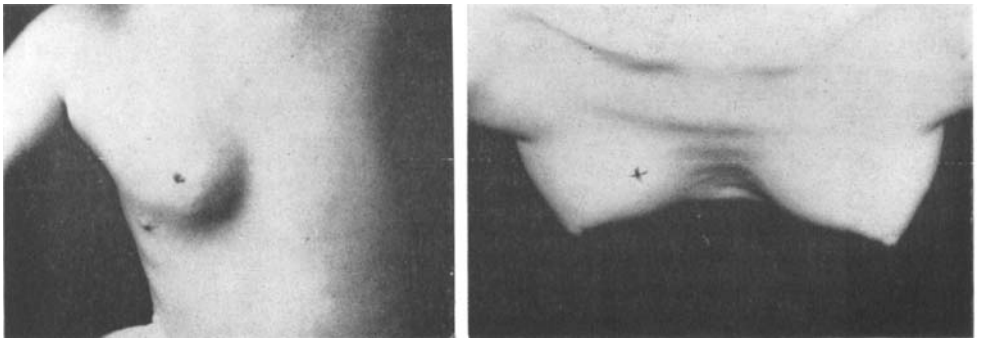


Fig. 2. a) Appearances of haemangioma before radiotherapy. b) State of skin at control-examination with (c) scintigram and radioiodine tracer tests; dose administered 7.5 μC, thyroid uptake 2 hrs 23 %, thyroid uptake 24 hrs 42 %, urine excretion 0—24 hrs 33 %.

fractionation period of 4 months (Table 7b). There were no signs of radiation cataract in any instance.

There appears to be no reference in the literature to *the radiosensitivity of the thyroid gland* in children. The general opinion is, however, that this organ is relatively insensitive. Three patients of the present series were examined by means of radio-iodine tracer tests and scintigrams. The tissue dose in the thyroid gland was estimated at 150, 240 and 375 rad, respectively (Table 7c). The tracer studies in all three patients were within normal limits. Using these methods of detection, a dose of 375 rad apparently caused no changes in the thyroid gland. The appearances before treatment from a case of this type, are shown in Fig. 2, including the present state, the scintigram, and the radioiodine test.

Hypoplasia or aplasia of the female breast after radiation treatment in childhood has been reported in a few papers (RÜBE 1954, GREGL & WEISS 1962, inter alia). The authors agree on the high *radio-sensitivity of the breast anlage* but no definite information is yet available on the tolerance limit. Among 27 females in whom the haemangiomas were situated near a mammilla, two presented evidence of slight mammary hypoplasia. The appearances of one of these haemangiomas, before treatment and in its present state, is shown in Fig. 3. The doses to the breast tissue in these two patients could be estimated at 580 and 1 150 rad respectively, given in one treatment, and in two treatments with an interval of 4 months, respectively.



a b

Fig. 3. a) Appearances of haemangioma with large subcutaneous mammiform extension before radiotherapy (1 150 rad). The mammilla can be seen below the haemangioma. b) State at re-examination: the patient is now 17 years old; slight hypoplasia of the right breast.

Three patients with multiple haemangiomas received radium therapy in several areas, with a relatively high *total body irradiation.* The values determined for the different regions are shown in Table 8. One patient (50 04 14) was reexamined at the clinic 10 years after the irradiation. No signs could be found of any injurious effects from the treatment. The other two patients have written to say that they are healthy and well 5 to 10 years after treatment. It is naturally still an unanswered question whether any injurious effects may develop at a later date.

Discussion

It has always been a matter of controversy whether all haemangiomas should be treated and what form such treatment should take. Many types of treatment have been suggested in the past. But it is agreed today that the only treatment that should be primarily considered is radiotherapy.

The opinion of the present authors that radiotherapy of haemangiomas is not generally indicated is based on the following facts.

1. The tendency to spontaneous regression is great. Haemangiomas are common in small children, are seen more rarely in school children, and are very unusual in adults. LISTER (1938) found in his material that nearly all haemangiomas had disappeared by the age of five. WALTER (1953) showed that 96 % had healed after 5 years without radiotherapy and 94 % with radiotherapy. Major haemangiomas with subcutaneous components have less tendency to heal spontaneously according to ANDREWS (1938) and the final cosmetic result is worse.

2. Haemangiomas are benign lesions of almost exclusively cosmetic significance. The dangers of general and local after-effects from the radiation

treatment must therefore be balanced against the difficulties which a haemangioma residue, small or large, can cause from the psychologic, and sometimes from the functional point of view.

The opinion generally expressed in the literature is that haemangiomas should be treated as early as possible, preferably before the age of 3 or 6 months. As a theoretical basis for this opinion STRANDQUIST (1939) argues that embryonic tissue is more sensitive to radiotherapy and that there are embryonic cells in growing haemangioma. The importance of early treatment is elsewhere regarded as an axiom, without any evidence being produced to support the contention. WALTER (1953) was unable to find any difference between the groups < 1 year and 1 to 5 years in his material. The result in the material dealt with in this paper is similar for the age groups < 1 year and 1 to 2 years (Table 3), which gives no support to the advocates of early treatment.

Certain haemangiomas show very rapid growth during the first months of life. LISTER (1938) was unable to observe this progression after the age of 8 months and could find no accounts in the literature of progression after the age of 12 months. He stated that haemangiomas that have shown rapid growth likewise show rapid regression over the following years. The opposite opinion, however, was maintained by COSTELLO (1949): haemangiomas that grow rapidly do not disappear spontaneously.

It would appear to the authors that it is best to refer children with haemangiomas to a radiotherapy clinic for a decision regarding treatment. The first examination should be carried out during the first six months of life. At this stage an observation period of about 6 months is indicated for the majority of haemangiomas. Later, when the child is about one year old a second examination may confirm tendencies to regression or progression and a decision may be made regarding the necessity for radiotherapy. Progressive haemangiomas and major haemangiomas showing no or hardly any tendency to regression should then be given radiotherapy to stop further growth and to hasten regression. A further observation period is generally indicated in the case of other haemangiomas.

There may be indications for early treatment before the age of one year in the case of haemangiomas that are growing rapidly and are situated on the face, because:

1. There is a risk that the haemangiomas may grow so as to interfere with vision or make eating difficult;
2. A major haemangioma on the face that has not receded completely is disfiguring and may produce psychologic disturbances;
3. There is difficulty in persuading the mother to wait for a spontaneous regression when the haemangioma shows a tendency to grow.

Early treatment of haemangiomas situated in the perineum and adjoining areas may be indicated because of the danger of maceration and infection, both of which are difficult to treat.

There is no definite indication for early treatment of haemangioma situated in other parts of the body.

Contact roentgen therapy appears to be superior to radium therapy from both the theoretical and the practical points of view. Radium therapy implies total body irradiation for both patient and staff and ought therefore to be avoided (NORDBERG 1961). Contact roentgen therapy is easier to apply. The duration of the treatment is a matter of seconds, during which time the child and the roentgen tube can be fixed in relation to each other so that the field of treatment is strictly defined. If the extent of the beam is strictly limited, the total irradiation is kept at a minimum for both patient and staff.

Practically all haemangiomas that receive radiotherapy should therefore be given contact roentgen therapy. The majority of haemangiomas with subcutaneous extensions may also be treated successfully by compression of the haemangioma and, if necessary, modification of the quality of the rays to, for example, 50 kV, 2 mm Al additional filter, FSD 40 mm. This quality has a HVL that is about that of 8 mm soft tissue and has, as is shown in Fig. 1, a depth dose distribution that practically corresponds to that of a normal radium applicator. Fifty-eight haemangiomas with subcutaneous components in the present material were given contact roentgen therapy and 136 haemangiomas of this type received radium therapy; after one year 43 % and 40 %, respectively, had disappeared completely, and 26 % and 24 %, respectively, were incompletely cured, whereas at the time of the control examination 40 % and 47 %, respectively, showed no changes in the skin and 3 % and 7 %, respectively, were cosmetically unsatisfactory. It is only very seldom therefore that radium therapy is indicated. A few haemangiomas with large deep components may require roentgen treatment which should, if possible, be tangential.

The surface dose at the first treatment should be 800 to 900 r for contact roentgen therapy. WALTER (1953) has shown that a lesser dose gives worse one-year results. A dose of 400 r gives only 9 % healing compared with 45 % for a dose of 800 r. A higher dose, of say 1 000 to 1 500 r, may produce more rapid healing but at the same time the cosmetic result will be worse (HULTBERG 1943 and WALTER 1953, inter alios); there will be an increase in pigmentation, depigmentation and atrophy of the skin. The frequency of haemangiomas that showed no skin changes whatsoever at reexamination in the present material was three times greater when the surface dose during treatment was ≤ 900 r than when the dose was > 900 r (Tables 4a and 4b).

Conclusions

1. Radiotherapy is not generally indicated for the treatment of haemangiomas.

2. Rapidly growing haemangiomas on the face should be treated early

for functional, psychologic and cosmetic reasons. Haemangiomas in the perineum and adjoining regions should also be treated early because of the risk of infection and ulceration.

3. Haemangiomas should be treated in principle with contact roentgen therapy of a quality adjusted to the deepest component of the haemangioma, a HVL corresponding to 3 to 8 mm soft tissue.

4. The suitable surface dose for the first treatment is 800 to 900 r.

SUMMARY

The results of radiation treatment of 1191 haemangiomas in 830 patients have been re-examined with special reference to changes in the appearances of the lesion one year later, the appearances of the skin 5 to 15 years following therapy, and the possibility of injurious effects from the treatment.

ZUSAMMENFASSUNG

Eine Untersuchung der Resultate nach radiologischer Behandlung von 1191 Hämangiomen bei 830 Patienten wurde ausgeführt. Spezielles Interesse wurde folgende Faktoren gewidmet: das Aussehen des Hämangioms ein Jahr nach der Behandlung; das Aussehen der Haut 5 bis 15 Jahre nach der Behandlung; und die Möglichkeit von schädlichen Wirkungen der Behandlung.

RÉSUMÉ

Les auteurs ont ré-examiné les résultats du traitement par les radiations de 1191 hémangiomes chez 830 malades; ils ont particulièrement étudié les modifications de l'aspect de la lésion au bout d'un an, l'aspect de la peau 5 à 15 ans après le traitement et la possibilité de lésions dues au traitement.

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