Choroidal metastases and choroidal melanomas: comparison of ultrasonographic findings

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Abstract

***Aims*—The purpose of the study was to analyse, whether the shape and the height to base ratio in B-scan ultrasonography are appropriate to differentiate choroidal melanomas from metastases.**

***Methods*—Between 1991 and 1996 16 eyes of 16 patients with choroidal metastases from breast carcinomas and 66 eyes of 66 patients with choroidal melanomas were evaluated ultrasonographically. The diagnosis of choroidal melanoma has been confirmed histologically in all eyes. Irradiated tumours were excluded from the study. Fisher's exact test and χ^2 test were used for statistical analysis.**

***Results*—Choroidal metastases demonstrated a significantly lower height to base ratio in B-scan (mean 0.18, SD 0.08) than melanomas (mean 0.6 (0.16); $p < 0.001$). A polygonal tumour surface was significantly more frequent in metastases (13 out of 16 metastases and in six out of 66 melanomas, $p < 0.001$). A choroidal excavation could be demonstrated in 38 melanomas and in no metastatic tumour ($p < 0.001$). The reflectivity was significantly higher in metastases than in melanomas.**

***Conclusion*—The combined use of height to base ratio and reflectivity enables a highly significant discrimination between choroidal melanomas and metastases from the breast, thus probably constituting appropriate variables for the clinical differentiation.**

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Metastatic tumour to the uvea is probably the most common intraocular malignancy.[1 2] The tumour that most frequently metastasises to the uvea is carcinoma of the breast (65% of uveal metastases in one series[3]).

The clinical diagnosis of metastatic uveal tumour may be quite difficult in patients without a history of extraocular malignancy. A metastatic tumour of the uvea is the initial clinical manifestation of systemic cancer in nearly one fourth of patients.[4] In approximately 10% of cases the location of the primary tumour remains unknown despite extensive examination.[3] In contrast with primary uveal melanomas, metastatic tumours are likely to occur multifocally and bilaterally (20–30%).[2 5]

Choroidal metastasis may appear clinically similar to other amelanotic tumours. In these patients the tumours have to be ultrasonographically differentiated by evaluating reflectivity, internal structure, and degree of vascularisation. However, even the ultrasonographic picture of metastatic tumours (for example, metastasis of carcinoid tumour of the lung) may resemble choroidal melanomas.[6]

The purpose of this study was to analyse, whether variables of B-scan ultrasonography are appropriate to differentiate choroidal metastasis of the breast—as the most frequent metastatic tumour to the uvea—from choroidal melanoma.

Methods

Between 1991 and 1996 16 eyes of 16 female patients (mean age 60 (SD 15) years) with choroidal metastases from breast carcinomas and 66 eyes of 66 patients (35 female and 31 male patients; mean age 64 (13) years with choroidal melanomas were evaluated ultrasonographically, using a standardised A and B-mode system (Cooper Vision Digital B, Kretz 7200 MA, USA, Innovative Imaging I3). The diagnosis of choroidal melanoma has been confirmed histologically in all eyes after enucleation.

The A-mode transducer had the following specifications—nominal frequency of 8 MHz, non-focused, diameter 5 mm; the B-mode transducer was of the type—mechanical sector scanning, frame rate 10 or 12 Hz, nominal frequency of 10 MHz, focus at 20 mm from exit window of scan head. The transducer was applied posterior to the limbus and opposite the location of the tumour. The tumours were examined at 60 dB gain settings. B-mode variables were: base diameter, prominence, shape, choroidal excavation. A-mode variables were: prominence, reflectivity, regularity. The maximum height of the tumour obtained by A and B-mode was defined as prominence and the maximum dimension observed with B-mode as base diameter. For each tumour the height to base ratio was calculated. The tumours were classified as mushroom, dome, and polygonal shaped. A convex mass was defined as dome shaped when the growth of the lesion was restrained by Bruch's membrane. A mushroom-shaped surface was assumed when the tumour broke through Bruch's membrane. A polygonal tumour surface was defined as irregular surface contour without offering the picture of a mushroom-shaped lesion. Reflectivity quantified the mean echo amplitude of the tumour in percentage of the maximum display height. Irradiated tumours were excluded from the study. Data were analysed if significant differences of the ultrasonographic variables between choroidal melanomas and metastases of breast carcinoma existed. Fisher's exact test and χ^2 test were used for statistical evaluation.

Table 1 Echographic findings of choroidal metastases (n= 16)

No	HB ratio*	Reflect†	Shape‡	No	HB ratio*	Reflect†	Shape‡
1	0.17	60	poly	9	0.17	90	poly
2	0.08	80	poly	10	0.09	90	poly
3	0.15	60	poly	11	0.12	70	poly
4	0.21	90	poly	12	0.21	80	poly
5	0.26	80	dome	13	0.18	90	poly
6	0.31	60	dome	14	0.12	80	dome
7	0.40	70	poly	15	0.14	60	poly
8	0.14	80	poly	16	0.16	70	poly

*Height to base ratio; †A-scan reflectivity in %; ‡B-scan shape: dome = dome shaped, mush = mushroom shaped, poly = polygonal shaped.

Table 2 Echographic findings of choroidal melanomas (n = 66)

No	HB ratio*	Reflect†	Shape‡	No	HB ratio*	Reflect†	Shape‡
1	0.32	0	dome	34	0.86	20	mush
2	0.58	30	dome	35	0.73	20	dome
3	0.42	40	dome	36	0.83	50	dome
4	0.52	20	dome	37	0.61	20	dome
5	0.46	50	dome	38	0.85	20	dome
6	0.48	30	dome	39	0.95	20	mush
7	0.41	10	poly	40	0.66	10	dome
8	0.34	10	dome	41	0.23	0	dome
9	0.61	20	much	42	0.44	40	dome
10	0.51	20	dome	43	0.57	40	dome
11	0.61	40	dome	44	0.60	30	dome
12	0.65	50	mush	45	0.40	0	dome
13	0.53	20	dome	46	0.65	30	dome
14	0.50	10	dome	47	0.75	10	dome
15	0.63	10	mush	48	0.89	40	mush
16	0.51	30	dome	49	0.75	10	mush
17	0.41	0	dome	50	0.36	30	dome
18	0.46	0	dome	51	0.46	0	mush
19	0.74	40	dome	52	0.78	30	mush
20	0.69	30	dome	53	0.82	0	dome
21	0.62	10	poly	54	0.69	30	mush
22	0.53	40	dome	55	0.64	10	dome
23	0.63	40	dome	56	0.61	40	dome
24	0.69	50	mush	57	0.60	0	poly
25	0.46	0	dome	58	0.64	30	dome
26	0.69	20	dome	59	0.55	0	poly
27	0.84	40	dome	60	0.54	10	poly
28	0.58	10	dome	61	0.71	10	mush
29	0.51	20	dome	62	0.72	20	dome
30	0.53	20	mush	63	0.83	50	dome
31	0.76	20	mush	64	0.45	20	dome
32	0.49	20	dome	65	0.68	30	dome
33	0.36	0	poly	66	0.83	30	dome

*Height to base ratio; †A-scan reflectivity in %; ‡B-scan shape: dome = dome shaped, mush = mushroom shaped, poly = polygonal shaped.

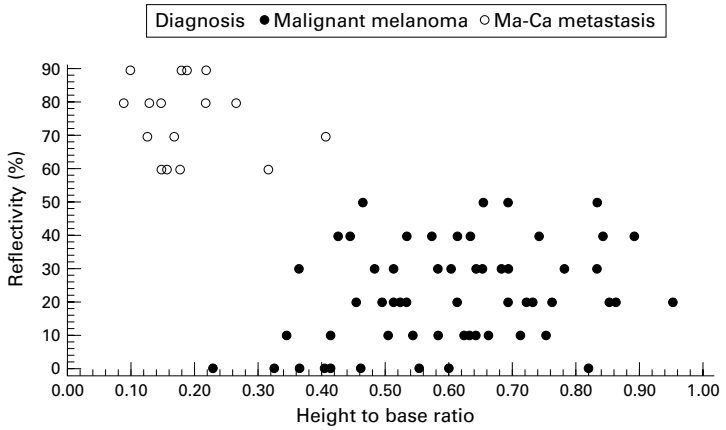

Figure 1 Comparison of metastases and melanomas concerning reflectivity (%) and height to base ratio demonstrates a significant different distribution pattern.

Results

The results are summarised in Tables 1 and 2.

TUMOUR DIMENSION

The prominence of the metastatic tumours (n = 16) in B-scan ranged between 0.8 and 8 mm (mean 2.7 (SD 1.9) mm). The base diameter of these tumours ranged between 4.3 and 16.3 mm (mean 12.4 (3.4) mm).

The choroidal melanomas (n = 66) demonstrated a height between 3.5 and 21 mm (mean 8.3 (3.2) mm) and a base diameter between 4.4 and 22 mm (mean 12.8 (3.3) mm).

REFLECTIVITY (FIG 1)

Metastases had a significantly higher reflectivity in A-scan than melanomas ($p < 0.001$). The reflectivity in A-scan of the metastases ranged between 60% and 90% (mean 76% (SD 12%)). The mean reflectivity of the melanomas was 22% ranging between 0% and 70% (SD 15%).

HEIGHT TO BASE RATIO (FIG 1)

For each tumour the height to base ratio was calculated, referring to the maximal prominence and the maximal base diameter of the tumour. Metastatic tumours had significantly lower height to base ratios that melanomas ($p < 0.001$).The metastases demonstrated height to base ratios ranging between 0.08 and 0.31 (mean 0.18 (SD 0.08)), whereas the height to base ratios of the melanomas ranged between 0.23 and 0.95 (mean 0.6 (SD 0.16)).

SHAPE

Metastatic tumours had more frequently a polygonal surface in comparison with choroidal melanomas ($p < 0.001$): 13 metastases had a polygonal surface, three showed a dome-shaped contour. No mushroom-shaped surface was observed among the metastases. Forty six of the 66 choroidal melanomas had a dome-shaped surface, 14 a mushroom-shaped surface, and six had a polygonal surface.

CHOROIDAL EXCAVATION

Choroidal excavation was significantly more frequent in choroidal melanomas than in metastases ($p < 0.001$). Thirty eight melanomas demonstrated choroidal excavation, whereas no choroidal excavation was observed among the metastatic tumours. All melanomas that showed choroidal excavation had a maximal prominence of less than 8 mm (mean 5.8 (SD 0.8) mm).

STATISTICAL ANALYSIS

A complete discrimination of the tumours concerning the diagnosis (choroidal metastasis *v* choroidal melanoma) was achieved by the variable reflectivity or height to base ratio, using Fisher's exact test and χ^2 test. With regard to this complete discrimination no multivariate statistical procedure was necessary.

Discussion

Recent studies have shown that the incidence of intraocular metastasis is much higher than it was postulated earlier. The incidence is approximately 8–10% with a clear preponderance of metastases to the posterior choroid.[7 8]

Typical clinical features have been described for both choroidal melanoma and metastasis of carcinoma, where the diagnosis is often supported by the presence of a history of systemic cancer. Nevertheless, the clinical appearance of choroidal melanoma and choroidal metastasis

from carcinoma may be very similar and the diagnosis is quite difficult in these cases (especially in the absence of a history of systemic cancer).

Ultrasonography remains a very important method in the clinical evaluation of intraocular tumours. Differences of the ultrasonographic picture are based on the differences in the histoarchitecture of metastatic tumours and choroidal melanomas. A metastatic tumour from the breast presents histologically as solid epithelial nests or glandular structures, providing echo producing interfaces, resulting in high reflectivity and an irregular internal structure in ultrasonography.[9 10] Melanomas are densely cellular masses of low to moderate vascularisation with only a few necrotic areas, thus containing only few echo producing interfaces. As a result these tumours are of low to medium reflectivity with a regular internal structure.[10–15] These findings were confirmed by our study; metastasis from breast carcinoma had a significant higher reflectivity than melanomas ($p < 0.001$).

Metastatic tumours have a different growth pattern in the uvea than melanomas. Metastases appear to infiltrate and replace the normal choroidal architecture more diffusely than melanomas.[1 3 12] Melanomas are slowly growing tumours and they usually expand beneath an intact Bruch's membrane. They typically assume a nodular configuration and grow as fairly circumscribed thickening of the choroid. By further growth melanomas perforate Bruch's membrane and assume a mushroom-shaped configuration.[11 12 14] That different growth pattern of metastases and melanomas has been confirmed by the ultrasonographic finding in this study. There was a significant higher height to base ratio in melanomas (mean 0.6 (SD 0.16)) than in metastases (mean 0.18 (SD 0.08)). Coleman *et al* described a different height to base ratio for melanomas and metastases 20 years ago, however without providing numerical data.[16] Perri *et al* described in 42 patients with choroidal metastases a flat infiltrating and irregular shape in B-scan ultrasonography, supporting this characteristic finding.[9] This indicates that the height to base ratio in ultrasonography is of potentially clinical value for the discrimination of choroidal melanomas from metastasis of carcinomas.

Furthermore, the combined use of reflectivity and height to base ratio may constitute a highly significant variable for the discrimination of melanomas from metastases, as it was demonstrated by our study (Fig 1). This interesting finding has to be confirmed by further studies, including choroidal metastases from other carcinomas (for example, lung).

Choroidal excavation is a typical finding in choroidal melanomas, but it can also be produced by other choroidal lesions.[12–14 17] The presence or absence of choroidal excavation in a choroidal lesion depends on the difference in reflectivity between the normal choroidal tissue and the abnormal tissue replacing the choroid. In our study choroidal excavation was significantly more frequent in choroidal melanomas than in metastases ($p < 0.001$); 58% of melanomas demonstrated this phenomenon whereas no choroidal excavation was observed among the metastatic tumours. This supports the findings of other authors: Fuller *et al* described a choroidal excavation in 65% of melanomas and Coleman *et al* found choroidal excavation in 42% of melanomas.[12 13] Verbeek demonstrated a choroidal excavation in 70% of melanomas and approximately 20% of metastases.[15] Although he found in his analysis of echographic findings in 325 melanomas, 44 metastases, 19 haemangiomas and other intraocular tumours, a correct diagnosis determined by ultrasonography in 95% of cases, the differentiation of metastases from other tumours presented as the most difficult problem.[15]

In conclusion, this study demonstrates that the height to base ratio alone and the combined use of height to base ratio and reflectivity enable a highly significant discrimination between choroidal melanomas and metastases from the breast, thus probably constituting appropriate variables for clinical differentiation. Further studies are necessary to confirm this assumption.

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