Immunohistochemical Study of Glutathione S-Transferase-π in Meningiomas


Departments of Neurosurgery and **Second Pathology, Nara Medical University, Kashihara, Nara; *Department of Health Science, College of Integrated Arts and Sciences, Osaka Prefecture University, Sakai, Osaka

Abstract

Immunostaining for glutathione S-transferase-π was investigated in various subtypes of meningioma for the purpose of biological characterization. Specimens included five normal meninges and 25 meningiomas (10 meningothelial type, 6 fibrous type, 5 transitional type, 3 microcystic type, and 1 secretory type). In the meningothelial type, most cells showed strongly positive staining. In the fibrous type, all cells were negative. In the transitional type, only the meningothelial components were positive. In the microcystic type, meningothelial cell clusters and arachnoid trabecular cells were positive. In the secretory type, the meningothelial components and the pseudopsammoma-body-producing cells were positive. These results suggest that the meningothelial type and the fibrous type have a different basis of development and biological features. The results also suggest that arachnoid trabecular cells and meningothelial cells share the same origin, and that the arachnoid trabecular cells serve as supportive cells and as cells which detoxify harmful substances in the subarachnoid space. The pseudopsammoma-body-producing cells in the secretory type represent the outcome of epithelial differentiation of meningothelial cells with their biological character being preserved.

Key words: glutathione S-transferase-π, microcystic meningioma, arachnoid trabecular cell, secretory meningioma

Introduction

Meningioma is a tumor which develops from the cells constituting the arachnoid villi. Vimentin and epithelial membrane antigen are well-known markers of this tumor. Glutathione S-transferase (GST)-π has recently attracted much attention, because of its involvement in detoxification of various substances such as anti-cancer agents and because it is expressed in various tumor cells. We previously reported that the immunostaining response indicating GST-π in human gliomas increases in tumors with greater malignancy. The present study assessed the usefulness of GST-π as a meningioma marker, by immunostaining of various subtypes of meningioma.

Materials and Methods

Surgical specimens of five normal meninges and 25 meningiomas were obtained from operations or autopsies performed at our department in the last 4 years. The meningiomas were 10 of the meningothelial type, six of the fibrous type, five of the transitional type, three of the microcystic type, and one of the secretory type. The specimens were fixed in 10% buffered formalin and embedded in paraffin, then cut into 4 μm sections. Immunostaining for GST-π used the strept-avidin-biotin method following the kit instructions (Histofine SAB-PO(R) Kit; Nichirei Corp., Tokyo), using rabbit anti-GST-π antibody as the primary antibody.
Table 1  Immunostaining for GST-7r in various types of meningioma

<table>
<thead>
<tr>
<th>Histological subtypes</th>
<th>No. of cases</th>
<th>Staining intensity*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal meninges</td>
<td></td>
<td>- + + +</td>
</tr>
<tr>
<td>arachnoid membrane</td>
<td>5</td>
<td>5 0 0 0</td>
</tr>
<tr>
<td>arachnoid villi</td>
<td>5</td>
<td>0 0 0 5</td>
</tr>
<tr>
<td>Meningiomas</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>meningothelial</td>
<td>10</td>
<td>0 1 9</td>
</tr>
<tr>
<td>fibrous</td>
<td>6</td>
<td>0 0 0</td>
</tr>
<tr>
<td>transitional</td>
<td>5</td>
<td>0 1 4</td>
</tr>
<tr>
<td>microcystic</td>
<td>3</td>
<td>0 0 3</td>
</tr>
<tr>
<td>secretary</td>
<td>1</td>
<td>0 0 1</td>
</tr>
</tbody>
</table>

*: no positive response in most visual fields, +: weakly positive responses or positive responses in less than 40% of all visual fields, + +: strongly positive responses or positive responses in over 40% of all visual fields.

Results

The GST-7r immunostaining responses in the meninges and meningioma specimens were rated on a 3-point scale (Table 1). In normal meninges, only the arachnoid villi showed positive staining, and the arachnoid membrane showed no staining. In the meningothelial type, the cytoplasm of most cells was strongly positive (Fig. 1). In the fibrous type, all cells were negative (Fig. 2). In the transitional type, only the meningothelial components were positive. In the microcystic type, both the meningothelial cell clusters and the chicken-wire-like microcystic components were strongly positive (Fig. 3). In the secretory type, the meningothelial components and the pseudopsammoma-body-producing cells were positive (Fig. 4).

Discussion

The development of meningioma has been much investigated. Yamashima et al.22) carried out an electron microscopic study and found that the dural border cells which constitute the arachnoid villi are the basis for the development of fibrous type meningioma, and that the arachnoid barrier cells are the basis for meningothelial type meningioma.7) In the present immunostaining study, only the meningothelial components were positively stained for GST-7r in the meningothelial or transitional type, and no fibrous components in the fibrous or transitional type showed any positive response. These results suggest that the meningothelial and fibrous types have different biological features.

The microcystic type showed positive immunostaining in the meningothelial cell clusters and the chicken-wire-like microcystic components. Masson8) first named the microcystic type of meningioma as meningioma humide. Later, Eimoto and Hashimoto9) reported that the proliferation resembled the growth pattern of the subarachnoid space. Tsunoda et al.17,18) proposed that the microcystic type represents differentiation into arachnoid trabecular cells, because the microcystic component resembles the arachnoid trabecular cells which support the normal subarachnoid space under an electron microscope. In the present study, arachnoid trabecular cells were found to be GST-7r positive. Therefore, the arachnoid trabecular cells and the meningothelial cells are likely to share the same origin, and the arachnoid trabecular cells are not only supportive cells but cells which detoxify harmful substances in the normal subarachnoid space.

The secretory type of meningioma, accompanied by pseudopsammoma bodies, was first reported by Kepes.6) At present, this type is regarded as involving epithelial differentiation of meningothelial cells.8,9,15-19) In the present study, the meningothelial components and the pseudopsammoma-body-producing cells were positively stained, suggesting that the pseudopsammoma-body-producing cells are the outcome of epithelial differentiation of meningothelial cells with their biological character being preserved.

Acknowledgment

This study was supported by a Grant-in-Aid for Scientific Research (No. 05671180) from the Ministry of Education, Science and Culture, Japan.

References

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Neur Med Chir (Tokyo) 35, November, 1995
Fig. 1  Photomicrograph showing immunostaining of the meningothelial type for GST-π. The meningothelial components are positively stained.  × 100.

Fig. 2  Photomicrograph showing immunostaining of the fibrous type for GST-π. The fibrous components are not stained.  × 100.

Fig. 3  Photomicrograph showing immunostaining of the microcystic type for GST-π. The meningothelial cell clusters and chicken-wire-like microcystic components are positively stained.  × 100.

Fig. 4  Photomicrograph showing immunostaining of the secretory type for GST-π. The meningothelial components and the surrounding pseudoparamoma-body-producing cells are positively stained.  × 100.

meningiomas. 


*Address reprint requests to: M. Nakamura, M.D., Department of Neurosurgery, Nara Medical University, 840 Shijo-cho, Kashihara, Nara 634, Japan.*