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Cytokeratin Expression and Vimentin Content in Large Cell Anaplastic Lymphomas and Other Non-Hodgkin's Lymphomas

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The immunophenotypes of 74 malignant lymphomas (9 Hodgkin's disease, 19 low-grade B-cell, 20 high-grade B-cell, 8 T-cell, and 18 large cell anaplastic lymphomas [LCAL]) have been characterized with antibodies against leucocyte differentiation antigens, keratin, and vimentin. All the non-LCAL were CD45 positive and keratin negative. The LCALs had a more varied immunophenotype, with CD45 present only in 11 of 18 cases and keratin present in 5 of 18 of these rare lymphomas. The lymphoid orign of these latter cases was proven by gene rearrangement studies. All LCALs were CD30+, and, where tested, vimentin positive. Of four different vimentin monoclonal antibodies tested, V9 and MVI stained the highest number of lymphomas. Positive staining of tumor cells was seen in 61 of 71 cases. Vimentin-negative cases included Burkitt's as well as some follicular lymphomas. (Am J Pathol 1991, 138:1413–1422)

A persistent challenge to histopathologists and cytologists is the diagnosis of undifferentiated large cell tumors that most frequently turn out to be high-grade malignant lymphomas or undifferentiated carcinomas.[1,2] This problem has been in large part solved by the use of monoclonal antibodies (MAbs) to the T-200 antigen (CD45) present on malignant lymphomas, and by the use of antibodies specific for keratins, which detect epithelial neoplasms.[3,4] In routinely processed material, which has been formalin fixed and paraffin embedded, keratins can be reliable markers for epithelial cells, if an appropriate broad-specific antibody that works on such material is selected. In one study, such keratin antibodies appear to be more reliable than antibodies recognizing the 'epithelial membrane antigen' (EMA).[5] Although expression of a 40- to 45-kd ('low molecular weight') keratin has been reported in exceptional cases of multiple myeloma,[6] such cases are easily distinguished by morphology and therefore should pose no problem. More serious is the absence of leukocyte common antigen in anaplastic large cell lymphomas[7] as well as the description of a single case of gastric large cell lymphoma that expressed keratin.[8] Such findings may cause difficulty in the differential diagnosis of individual cases of large cell tumors using morphologic and immunologic methods. Although antibodies to intermediate filament proteins appear in general useful tools in diagnostic pathology,[9–13] not all lymphomas are vimentin positive or, furthermore, the percentage of cases showing vimentin positivity of the tumor cells has varied widely in different studies.

Therefore we have investigated non-Hodgkin's lymphomas of low- and high-grade malignancy, including large cell anaplastic lymphomas (LCAL), as well as nine cases of Hodgkin's disease, using different MAbs specific for either keratin or vimentin as well as for leukocyte differentiation antigens. Our results show that the main diagnostic difficulty concerns the LCALs, as by immunocytochemical procedures 5 of 18 LCALs express keratins to a different degree. In one case, the specifity of keratin expression is documented by immunoblotting. Some of the keratin-positive cases lack the expression of leukocyte common antigen. The lymphoid origin of some of these keratin-positive LCALs could be documented by detection of T-cell receptor gene rearrangement.

Material and Methods

Tissue samples from 74 malignant lymphomas were available. (Part of the material was diagnosed and immu-

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nophenotyped in the Lymph Node Registry at the Department of Pathology, University of Kiel, FRG.) One part of each tumor was formalin fixed and paraffin embedded and sections were stained with hematoxylin and eosin, Giemsa, periodic acid-Schiff, and Gomori silver impregnation. The Hodgkin's and non-Hodgkin's lymphomas were classified according to the Rye Classification and the Updated Kiel Classification and transformed into the Working Formulation.[14] Another part of each tumor was snap frozen in liquid nitrogen and stored at −70°C. Five-micron–thick cryostat sections were air dried, fixed in acetone at room temperature for 10 minutes, then in chloroform for 10 minutes, and immunostained. Positive control sections of human tonsils and negative controls, omitting the primary antibody, were studied in parallel.

Immunohistochemistry

The MAbs used are described in Table 1. Immunohistochemical staining was performed using the APAAP (alkaline phosphatase monoclonal anti-alkaline phosphatase) method.[15] The primary antibody was incubated for 30 minutes at room temperature. After washing with TRIS buffer, sections were treated with rabbit anti-mouse gamma G immunoglobulin (IgG; Dakopatts Z 259, at a concentration of 1:70), and then with the mouse APAAP-complex (Dakopatts). Both incubations were for 30 minutes at room temperature. To increase the staining intensity, the incubation with the second antibody and with the APAAP-complex was repeated twice. Naphthol-AS-bi-phosphate (Sigma 2250) and new fuchsin (Merck 4040) were used as substrate and developer, respectively. To inhibit endogenous tissue enzyme activity, the developing solution was supplemented with 0.25 mmol/l (millimolar) levamisole (Sigma L-9756, St. Louis, MO).

Immunoblot Analysis

Cryostat sections 20 μ in thickness were prepared from frozen tissue samples. These were homogenized in high salt buffer, pH 7.6, and washed (10 mmol/l TRIS, 1 mol/l [molar] KCl, 5 mmol/l ethylenediamine tetra-acetic acid [EDTA], 0.5% Triton X-100, 1 mmol/l PMSF), washed in the same buffer without Triton and then centrifuged. The pellet was resuspended in low salt buffer, pH 7.6 (10 mmol/l TRIS, 5 mmol/l EDTA, 1 mmol/l PMSF), and centrifuged. The pellet was extracted a second time with a low salt buffer and centrifuged, the insoluble material remaining after this step was heated to 95°C for 5 minutes in sample buffer and was separated by electrophoresis on polyacrylamide slab gels according to conventional methods.[16] Proteins were electrophoretically transferred onto nitrocellulose paper as previously described.[17] The nitrocellulose strips were incubated with MAbs specific for keratin 8, keratin 18, or vimentin, according to established procedures.

Southern Blot Analysis

Frozen tissue samples were thawed and a single cell suspension was prepared. Cells were washed. DNA was extracted with phenol/chloroform/isoamylalcohol and precipitated with isopropanol. The DNA was cut using the restriction enzymes *Eco* R1, *Bam* H1, and *Hind*III. Using an 0.8% agarose gel, the fragments were electrophoretically separated and transferred to nitrocellulose paper according to Southern (1975).[18] Filters were hybridized with radioactive P^{32}-probes for TcR β-chain (Yurkat beta 2)[19] and for the Ig heavy chain joining region (JH probe).[20]

Results

A total of 74 malignant lymphomas were investigated. They were classified as low-grade B-cell lymphoma (n = 15), high-grade B-cell lymphoma (n = 20), T-cell lymphoma (n = 8), LCAL (n = 18) of B-(n = 1), T-(n = 12), and unknown cellular origin (n = 5). In addition, nine cases of Hodgkin's disease also were included (Tables

Table 1. *Monoclonal Antibodies to Leukocyte Differentiation Antigens*

Antigen	Antibody	Isotype	Source/reference
CD2	T11	IgG1	Coulter
CD3	Leu4	IgG1	(Becton Dickinson/[BD])
CD4	Leu3a	IgG1	BD
CD5	Leu1	IgG2a	BD
CD11c	KiM1	IgG1	Radzun et al[44]
CD22	HD39	IgG1	Dörken et al[42]
CD25	Tac	IgG1	Uchiyama et al[45]
CD26	DAP IV	IgG2a	Feller et al.[40]
CD30	Ki1/HRS2	IgG1	Dakopatts Pfreundschuh[43]
CD45	LCA (PD7/26,2B11)	IgG1	Dakopatts
CD68	KiM6	IgG1	Parwaresch et al[41]

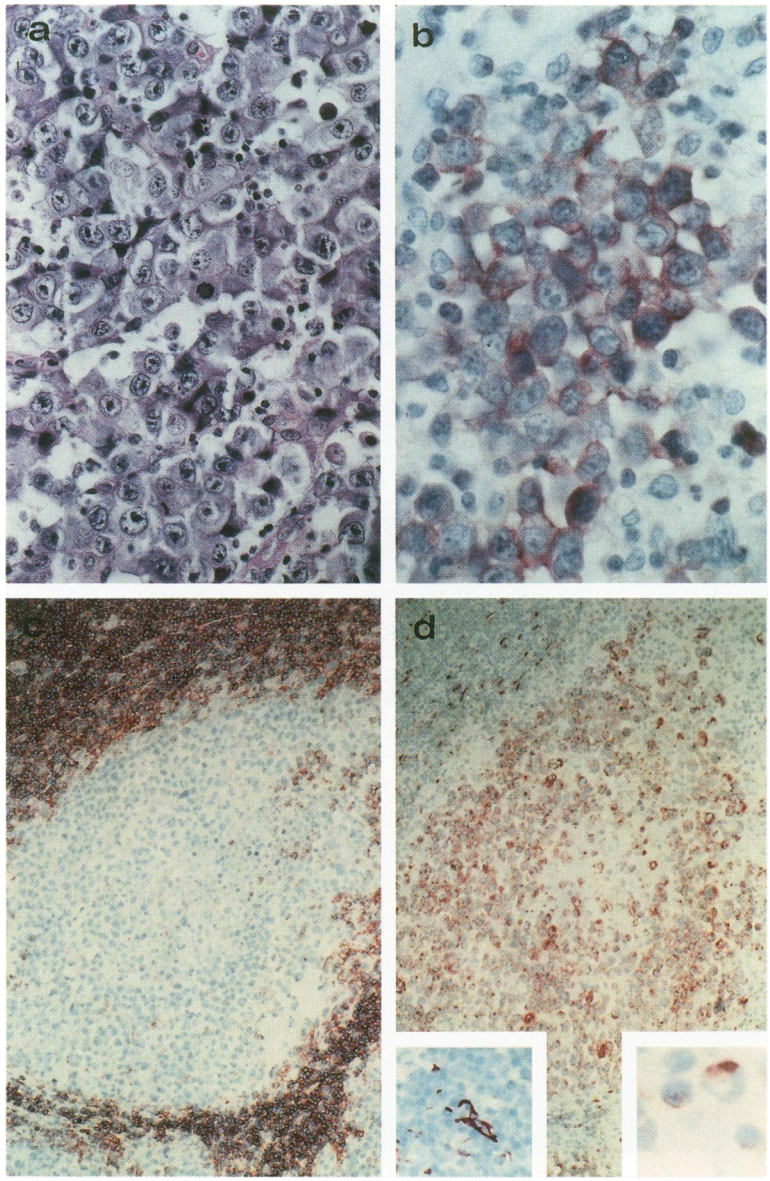

Figure 1. **a:** *Notice large pale cytoplasm and pleomorphic nuclei with nucleoli of variable size in this large cell anaplastic lymphoma (Giemsa stain, ×400).* **b:** *Tumor cells express cytoplasmic and/or membrane positivity (APAAP procedure, Ki-1 (CD30) MAb, ×400).* **c:** *No staining of tumor cells by MAb against LCA (CD45). In contrast, normal positive lymphocytes surround anaplastic large tumor cells (Table 2, T-cell type; case 2, cryostat section, APAAP, LCA [CD45], ×160).* **d:** *A parallel section shows strong cytoplasmic keratin positive tumor cells with broad specific keratin antibody KL 1 as well as MAb against cytokeratin 18 (inset right, ×400). In contrast keratin immunoreactive fibroblastic reticulum cell with typical dendritic shape (inset left, KL1 ×1400) (Table 3, T-cell type case 2, cryostat section, APAAP, KL 1, ×160).*

Table 2. *Monoclonal Antibodies to Intermediate Filaments and Epithelial Membrane Antigen (EMA)*

Antibody	Specificity	Isotype	Source/reference
V9	Vimentin	IgG1	Dakopatts
MVI	Vimentin	IgG1	Eurodiag., Holland.
PKV-2*	Vimentin	IgG1	Labsystems, Finland
43aE8	Vimentin	IgM	Enzo Diagn., USA
KL1	Pan keratin	IgG1	Dianova, FRG
CK2	Keratin 18	IgG1	Osborn, FRG
CK7	Keratin 7	IgG1	Osborn, FRG
CK19	Keratin 19	IgG1	Osborn, FRG
CK8	Keratin 8	IgG1	Osborn, FRG
EMA/E29	EMA	IgG2a	Dakopatts

* This clone is designated PKV-2 by us to distinguish it from an earlier PKV clone (PKV-1) which stained vimentin only in mitotic but not interphase cells.

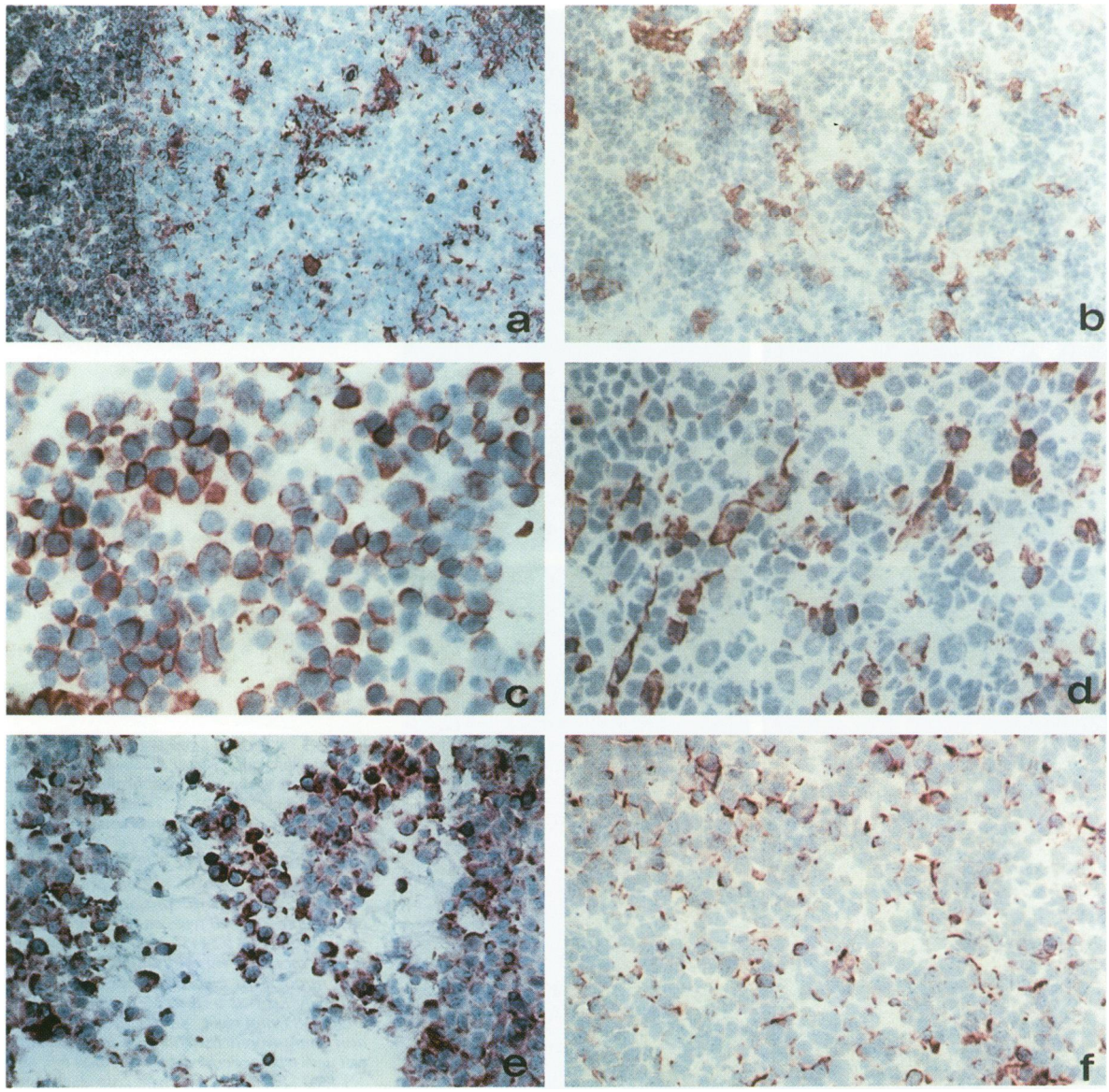

Figure 2. **a**: *MAb vimentin V9 shows strong immunoreactivity with interfollicular macrophages, dendritic, and endothelial cells and small lymphoid cells outside the germinal center. Follicular center lymphocytes completely lack vimentin expression (Normal germinal center, APAAP, V9, ×160).* **b**: *Only histiocytic cells show vimentin expression (with MAb MVI), and in contrast tumor cells are negative (Burkitt lymphoma, APAAP, MVI, ×160).* **c**: *MAb vimentin V9 shows immunoreactivity with more than 50% of neoplastic cells (Centroblastic lymphoma, APAAP, V9, ×400).* **d**: *Polymorphic variant of centroblastic lymphoma which appears to lack vimentin. Only a few dendritic cells express vimentin (Centroblastic lymphoma, APAAP, V9, ×400).* **e**: *Tumor cells display strong immunoreactivity (Plasmacytoma, APAAP, MVI, ×250).* **f**: *Twenty percent of tumor cells are labeled with MAb V9; in some cells it was difficult to determine if this population is composed of tumor cells (Immunoblastic lymphoma, APAAP, V9, ×250).*

2, 3). Large cell anaplastic lymphomas (a typical example is shown in a Giemsa-stain in Figure 1a), were subdivided further by their immunophenotypic properties, which are listed in Table 3. In LCAL (Figure 1a), all tumor cells expressed CD30 (Figure 1b). They were designated as T-cell type (n = 12) when CD2 or CD3 or CD5 were detected, and as B-cell type when CD22 was found. Those cases of LCAL that did not have detectable leukocyte common antigen expression as assayed with CD45 were positive for at least one of these markers.

Keratin Immunocytochemistry

When MAbs specific for the individual keratin polypeptides 18, 19, and 7 were used, a positive reaction was seen only with the antibody specific for keratin 18 (CK2). When the KL1 antibody was used on the LCALs, listed in Table 3, however, this antibody positively stained tumor cells in 5 of 18 cases. In three cases, all tumor cells appeared positive, whereas in the other two cases 10% to 50% of tumor cells were positive. Two of these cases also

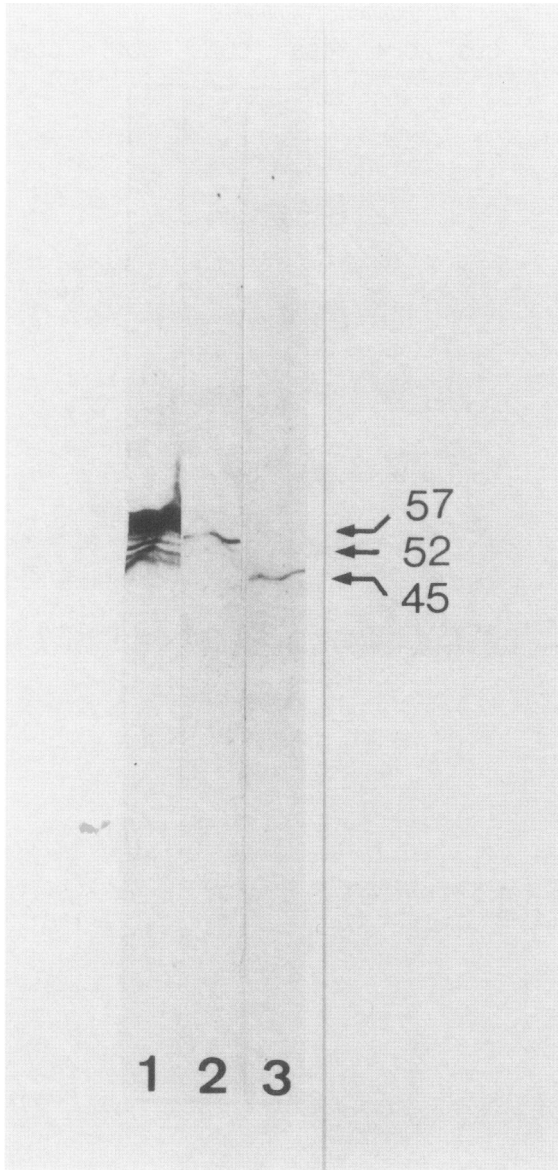

Figure 3. *Immunoblotting of cytoskeletal fraction from LCAL T-cell type no. 2, Table 3 with lane 1 vimentin MAb V9, lane 2 keratin 8 specific MAb CK8, lane 3 keratin 18 specific MAb. Note that a strong reaction is seen with the vimentin MAb and a weaker reaction with the two keratin MAbs. The bands of low molecular weights in lane 1 are due to breakdown products of vimentin. The molecular weights indicated on the right were obtained from a parallel immunoblot of HeLa cytoskeletons reacted with the same antibodies. They show the positions of vimentin (57 kd), keratin 8 (52 kd), and keratin 18 (45 kd).*

stained positively with antibody CK2 (keratin 18). Three cases that had TcR β-chain gene rearrangement had immunophenotypically detectable keratin expression (Table 3). Figure 1c and d show a case of LCAL stained with antibodies against CD45 (c) and KL1 (d). Only small reactive lymphoid cells are CD45 positive, whereas tumor cells are unlabeled. In contrast, tumor cells are stained by the antibodies KL1 (Figure 1d) and CK2 (Figure 1d, inset right side). Additionally in LCALs as in other malignant lymphomas fibroblastic reticulum cells are labeled by the keratin antibodies (Figure 1d, inset left side). These cells can be clearly distinguished from neoplastic cells by their morphology. All control stainings were negative.

Vimentin Immunocytochemistry

Thirty-six B- and T-cell lymphomas were tested with four different monoclonal vimentin antibodies obtained from different sources (V9, MVI, PKV, and 43βE8). The results are presented in Table 4. Antibodies V9 and MVI resulted in identical staining patterns, with PKV giving similar pattern but staining fewer tumor cells in about 10% of the cases. Figure 2a demonstrates the positive reaction of V9 with follicle mantle cells and macrophages in a case of lymphadenitis. Centroblasts and centrocytes remain unstained. Figure 2c (V9) and e (MVI) show the strong labeling of tumor cells in a centroblastic lymphoma and a plasmacytoma, respectively. In contrast, 43βE8 labeled most normal cells, but tumor cells were positive in only 9 of 27 cases that were clearly positive with V9, MVI, and PKV antibodies. Those cases, which showed weak expression for V9, MVI, and PKV, were negative for 43βE8 (Table 3). In Figure 2b, negativity of a Burkitt lymphoma is demonstrated; only the so-called starry sky macrophages are labeled. Even within the distinct lymphoma entities, the vimentin expression was variable, ranging from a weak positivity in about 10% of the tumor cells to strong positivity visible in all tumor cells (Table 4). Figure 2c and d compares the difference in two centroblastic lymphomas. Because the V9 antibody showed consistently strong labeling and also stained the most cells in any given tumor, this antibody was selected to investigate the vimentin content of LCALs. Results are listed in Table 3.

DNA Rearrangement

In nine cases of LCAL, DNA rearrangement studies for TcR β-chain and Ig heavy chain genes were performed. All nine cases showed one or both alleles rearranged when probed for the TcR β-chain gene. Three cases also had rearranged Ig heavy chain genes. The results are summarized in Table 3 and a typical example is shown in Figure 4.

Immunoblotting

One large cell anaplastic lymphoma that had large numbers of KL1- and CK2-positive tumor cells by immunocytochemistry (Table 3, T-cell type, case 2) was investigated by immunoblotting. As shown in Figure 3, specific bands for keratins 8 and 18 could be detected at 52 and

Table 3. *Genotypic and Immunophenotypic Properties of CD30 + Large Cell Anaplastic Lymphomas**

No.	Genotype	EMA	Ker.†	V9	CD45	CD2	CD3	CD4	CD5	CD22	CD25	CD26
T-cell type												
1	ND	−	+	+	−	+	−	+	−	−	−	−
2	TcR+	+	+	+	−	−	+	+	−	−	+	−
3_s	TcR+	+	(+)	+	−	−	+	+	+	−	−	+
4	TcR+	−	−	+	+	+	−	−	−	−	+	+
5_s	ND	−	−	+	+	+	+	+	−	−	+	+
6	ND	−	−	+	−	−	−	+	+	−	+	−
7	ND	(+)	(+)	+	(+)	+	+	+	−	−	+	−
8	ND	(+)	−	+	+	−	−	−	+	−	−	−
9	ND	+	−	+	+	+	(+)	+	(+)	−	+	+
10	ND	+	+	ND	−	+	+	+	+	−	+	+
11	ND	(+)	−	ND	(+)	+	+	+	−	−	+	−
12	TcR+	+	(+)	ND	+	+	+	+	+	−	(+)	−
Undefined												
1	TcR+, IgH+	−	−	+	+	−	−	−	−	−	−	−
2	TcR+	−	−	+	+	−	−	−	−	−	−	−
3	TcR+	+	−	+	−	−	−	+	−	−	+	+
4	TcR+, IgH+	+	−	+	+	−	−	−	−	−	+	−
5	ND	−	−	+	−	−	−	−	−	−	(+)	−
B-cell type												
1_s	TcR+, IgH+	−	−	+	+	−	−	−	−	+	+	+

* All cases were CD30 positive and CD11c and CD68 negative.
† Ker.:keratins tested with broad specific keratin antibody KL1; and in most cases with antibodies specific for keratin polypeptides 7, 18, and 19. Those cases that were positive with KL1 were positive also with the CK2 antibody (keratin 18), but not with the CK 7 and CK 19 antibodies.
s, Secondary evolving from other non-Hodgkin lymphoma.
ND, Not done
TcR, T-cell receptor beta-chain gene.
IgH, Immunoglobulin heavy chain gene.
+, 50%–100% positivity.
(+), 10%–50% positivity.
−, Negative.

45 kd, respectively. The amount of these keratin polypeptides was extremely small, and the gels had to be overloaded to obtain an immunologic reaction. This LCAL also contained large amounts of vimentin (57 kd) by immunoblotting (Figure 3).

Discussion

Diagnostic Implications

In this study, we tested 56 cases of high-grade and low-grade non-Hodgkin's lymphomas, 18 cases of LCAL, and 9 cases of Hodgkin's disease for the expression of different keratins, for vimentin, and for the leukocyte common antigen. All cases were investigated on frozen sections using the sensitive alkaline phosphatse-anti-alkaline phosphatase detection system. The results in Tables 3 and 4 show that immunocytochemistry can be of value in the differential diagnosis of large cell lymphoma and anaplastic carcinoma. In most cases the use of CD45 and keratin antibodies distinguish these two entities (Table 3). It is also clear, however, that the LCALs, which are rare tumors forming about 5% of malignant high-grade lymphomas, display very varied immunophenotypes. These lymphomas, which are discussed further below, can be

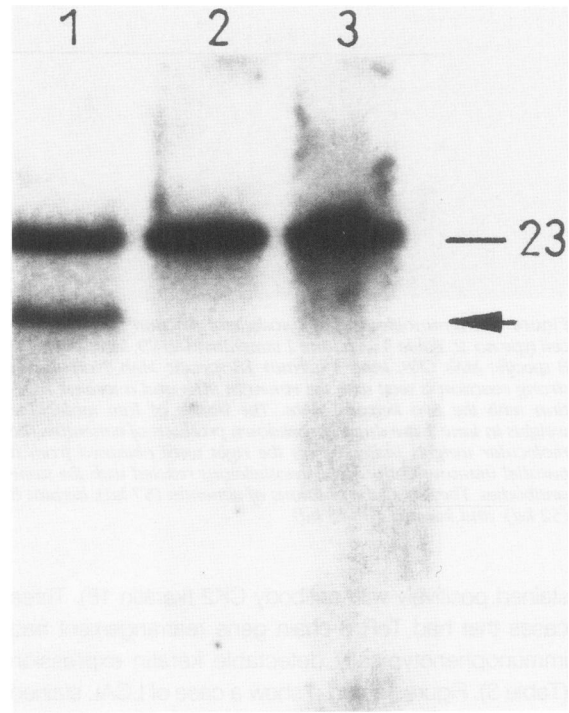

Figure 4. *Southern blot analysis of a LCAL (lane 1, Table 3 case no. 2, T-cell immunophenotype), Hodgkin's disease, mixed cellularity (lane 2), and human placenta (lane 3). DNA was digested with* BamH1 *and probed for TcR Cβ. Note the 23-kb germline band and the rearranged band in lane 1 in the LCAL.*

Table 4. *Immunoreactivity for Intermediate Filament Proteins Keratin and Vimentin in Non-Hodgkin's Lymphoma of B- and T-cell Types and in Cases of Hodgkin's Disease*

Histologic subtype Kiel class	Working formulation	No. of cases	Keratin	Vimentin*
B cell				
CLL	Sm Lc	3	−	+ − ++
HCL	nfsp	2	−	+ − ++
Plasmacytoma		4	−	+
IC	Sm Lc	4	−	+ − ++
CC	Df Sm Cl	3	−	−/+ +/++
CB/CC	Fo Mx Sm Cl/Lrg	3	−	− / +†
CB	Df Lrg	10	−	− / +
IB	Lrg Ib	5	−	−<+ †<++
LB		2	−	+ / ++
Burkitt's		3	−	−
T-cell lymphoma		8	−	++
Hodgkin's disease				
NS, MC, LP		9	−	++
Total		56	0	46

−, tumor cells negative; +: 10%–50% tumor cells positive; ++, > 50% tumor cells positive; CLL, chronic lymphocytic leukemia; HCL hairy cell leukemia; IC, immunocytoma; CC: centrocytic; CB/CC, centroblastic/centrocytic; CB, centroblastic; IB: immunoblastic; LB, lymphoblastic Sm Lc, Small lymphocytic; Df Sm Cl, diffuse small cleaved; Fo Mx Sm Cl/Lrg, follicular mixed, small cleaved and large cell; Lrg Ib, large cell immunoblastic; Df Lrg: diffuse large cell; nfsp, Not further specified.

Hodgkin's disease NS, Nodular sclerosing; MC, mixed cellularity; LP, lymphocyte predominance.

Tested with broad specific keratin–antibody KL1, in single cases additional testing with antibodies CK2 (keratin 18), CK19 (keratin 19) and CK7 (keratin 7) gave identical results.

* Results with V9 and MVI are shown. PKV stained fewer tumor cells. 43aE8 stained all Hodgkin's lymphomas, but only ⅓ of the non-Hodgkin's lymphomas that were positive with V9 and MVI.

† In some cases it was difficult to decide whether this population are tumor cells.

diagnosed with certainity when antibodies against keratin, vimentin, CD45, and CD30 are used as a panel.

Immunophenotype of Large Cell Anaplastic Lymphoma

The immunophenotype of LCALs is somewhat variable. Whereas all large cell anaplastic lymphomas expressed vimentin, about one third did not express the leukocyte common antigen (CD45). The majority of these LCALs were characterized as T-cell lymphomas because they expressed CD2, CD3, CD4, or CD5. In addition, 10 of 18 cases expressed EMA. Five cases were positive when tested with the broad-reacting KL1 antibody, with three cases showing a positivity in all tumor cells. Interestingly these three cases did not express leukocyte common antigen, but were positive for CD3, CD4, or CD5, in addition to CD30. Moreover in one keratin-positive, CD45-negative case, the rearrangement of the T-cell receptor beta-chain gene could be demonstrated, which invariably documented the lymphoid origin (Figure 4). Immunoblotting of the same lymphoma detected bands with molecular weights of 52 and 45 kd, corresponding to keratins 8 and 18 (Figure 3).

Although plasmacytomas[6,21] and a large cell gastric lymphoma with plasmoblastic differentiation[8] appear immunoreactive with keratin antibodies, the keratin-positive lymphomas in our study did not show a histomorphology that could be interpreted as plasmocytic or plasmoblastic differentiation. Furthermore these cases expressed T-cell antigens. This coexpression in malignant lymphomas is not yet understood, but may reflect a loss of the control of keratin expression similar to that noted recently in the very rare SV40-transformed fibroblast growing *in vitro*.[22,23] Furthermore keratin immunoreactivity in single cases of mesenchymal neoplasms was demonstrated.[24–27]

For diagnostic purposes, the finding of a minority of LCALs, which are keratin positive and common leukocyte antigen negative, has to be taken into account, although we again stress that these represent a very small fraction of lymphomas seen in the routine pathology. Attention is drawn also to the reticulum cells originally reported by Franke and Moll,[28] and also found in this study. Because fibroblastic reticulum cells can be found in relatively high numbers in some malignant lymphomas, it is important that such cells are not mistaken for tumor cells. We also note that if CD30 and keratin positivity are found together in nonhemopoietic neoplasms, embryonal carcinoma has to be considered in the differential diagnosis.[29]

Vimentin Content

In this study, 65 of 74 (88%) malignant lymphomas showed unequivocal staining of the tumor cells with the V9 vimentin antibody. Thirty-six different low- and high-grade malignant lymphomas were tested using four dif-

ferent monoclonal vimentin antibodies. Under these conditions, a positive reaction was seen in the majority of the different lymphoma types with V9 and MVI. This was independent of their B- or T-cell origin. When the vimentin antibodies were compared on the same specimen (Table 4), extensive antibody-dependent differences in the reactivity patterns could be observed. The V9 and MVI antibodies showed the broadest specificity and yielded essentially equivalent reactions on each of the different lymphomas. The PKV-2 antibody labeled the same spectrum of lymphomas as did V9 and MVI, but the number of tumor cells stained was usually lower. In contrast, the antibody 43βE8, which is an IgM, labeled only about 30% of the non-Hodgkin's lymphomas that were positive with V9 and MVI.

Previous results on the vimentin content of non-Hodgkin's lymphomas have ranged from 0% to 100%, and our data may help to explain such striking differences in results from different laboratories. Thus we assume that the negative results of Gown and Vogel[30] (0/18) are due to the use of the 43βE8 antibody, perhaps because the relatively small amount of vimentin present in lymphomas is not detected by this antibody in Carnoy's- or methacarn-fixed paraffin-embedded material. Giorno and Sciotto[31] used both 43βE8 and PKV-1, which in contrast to PKV-2 stains mitotic[32] but not interphase cells in tissue culture. Thus it may not be surprising that in this study[31] only 11 of 30 malignant lymphomas were vimentin positive, and indeed this number compares quite well with the fraction of non-Hodgkin's lymphomas found to be positive with 43βE8 in this study. Because the Giorno et al study was published in 1985, it is likely that the earlier PKV clone from the same manufacture was used and shown elsewhere not to stain all vimentin-positive cells in tissue culture. In other studies of the vimentin content in malignant lymphomas, vimentin has been shown to present in many[33] or in all of the lymphomas tested on frozen sections.[34,35] A recent study of 47 fine needle aspirates with V9 has also reported 100% of the cases positive for vimentin.[36]

V9 and MVI are well-characterized vimentin MAbs that give equivalent results on sections and on cells in tissue cultures to vimentin polyclonal antibodies. The differing patterns of reactivity in lymphomas of 43βE8 (and to a lesser extent PKV-2), as well as the differences observed for tumor and stromal cells in the same specimen with 43βE8, may reflect either that 43βE8 is a less sensitive antibody, or could be caused by differences of accessibility of the 43βE8 epitope during the cell cycle or during transformation (see results on PKV-1 in references 32 and 37).

Möller et al[33] have recently suggested that certain distinct B-cell lymphoma subsets may lack vimentin. In particular, their finding that Burkitt lymphomas were vimentin negative can be used as an argument for its follicular center derivation. In our study, three of three Burkitt's lymphomas were also vimentin negative. Such data agree with the observation that Burkitt's lymphoma cell and cell lines do not exprèss vimentin as assayed either by vimentin-specific antibodies or by vimentin mRNA probes.[38,39] In our study, however, lack of vimentin expression was not confined to Burkitt's lymphomas, but also occurs in occasional cases of low-grade lymphomas orginating from sites other than the follicular center. Thus it would be interesting to examine whether the vimentin-negative non-Burkitt's lymphomas show a chromosomal deletion or translocation involving chromosome 8 (8p-, t(8;14) or t(8;22), similar to that seen in Burkitt's lymphomas.

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