Characterization of Monoclonal Antibodies Directed against the Envelope Proteins of Feline Leukemia Virus

Susan D. Youngren, Alex P. Vukasin, and Fernando de Noronha

Department of Veterinary Microbiology, New York State College of Veterinary Medicine, Cornell University, Ithaca, New York 14853

ABSTRACT

Monoclonal antibodies directed against the feline leukemia virus (FeLV) envelope proteins, gp70 and p15E, were identified by radioimmunoprecipitation and sodium dodecyl sulfate-polyacrylamide gel electrophoresis. Six of these monoclonal antibodies were specific for the gp70; two for the p15E. Enzyme-linked immunosorbent assay binding assays against FeLV subtypes A, B, and C showed that most of the monoclonal antibodies bound to more than one subtype but have a greater affinity for subtype B. One monoclonal bound exclusively to the FL74 isolate. These studies also indicate that antigenic variability exists between FeLV isolates previously classified as being the same subtype. One antibody was found to bind the gp70s of all FeLV isolates tested and to be directed against a viral neutralizing site. A p15E-specific monoclonal antibody, in addition to binding all the FeLV subtypes, also bound to Moloney and Rauscher murine leukemia viruses, suggesting a group determinant is involved. No binding was seen to human T-cell leukemia virus, bovine leukemia virus, equine infectious anemia virus, or RD114V proteins, however.

INTRODUCTION

FeLV is a type C retrovirus responsible for a wide range of both nonneoplastic diseases, such as immunosuppression and anemia, and malignant diseases which result in a high feline mortality rate. Lymphosarcomas account for the vast majority of the tumors, most of these being FeLV positive. (for review, see Ref. 10). The replication-defective FeSV, which causes multicentric fibrosarcomas in cats, is generated by genetic recombination of a FeLV genome with cat cellular oncogenes. The resulting virus is a pseudotype, the sarcoma virus genome encapsulated by helper leukemia virus proteins. The helper virus confers the subtype and infectious properties to the sarcoma virus (19).

Successful passive immune serotherapy of diseases induced by these viruses has been variable due to the outbred nature of the cat. It has been shown that heterologous sera directed against the major external glycoprotein protects cats against FeSV-induced sarcomas and persistent viremia (5, 6). An absence of efficient humoral response, in the presence of a strong cellular response in fibrosarcoma regressor cats that retain a persistent viremia (7), suggests the importance of a multi-fold approach to eliminating the diseases caused by these viruses.

Viral neutralizing antibody is directed against the external protein, gp70, which is distinct from complement-dependent activity (9).

The envelope of FeLV is composed of a closely associated complex of gp70 and p15E molecules. They appear to exist in stable associations of 4 to 6 gp70s disulfide-bonded to a p15E (18). Subtyping of FeLV isolates has been carried out by taking advantage of the antigenic variation in these external glycoproteins. Isolates have been subtyped A, B, and C on the basis of infectivity interference and serum neutralization assays (21, 22). Natural distribution and host range of FeLV subtypes (11) indicates that variation does exist between isolates of the same subtype.

In order for a serotherapy program to be effective for field use, it must include an efficient means of eliminating infectious circulating FeLV in the animal. Since multiple subtypes are involved in the generation of FeLV (and FeSV)-induced diseases, the administration of a FeLV viral neutralizing antibody, capable of reacting with all the subtypes, would be desirable. MAbs directed against such a determinant would also provide us with the means to determine which site(s) on the gp70 molecule is involved in the generation of viral neutralizing antibodies in the cat.

In order to advance both studies, MAbs directed to the FeLV envelope proteins, gp70 and p15E, have been produced and characterized as to their binding avidity, subtype specificity, and viral neutralizing activity.

MATERIALS AND METHODS

Virus. FL74 virus obtained from Dr. John S. Cole III (Research Resources, Biological Carcinogenesis Branch, NIH, Bethesda, MD) and from cells maintained in tissue culture were both used in these studies. Other FeLV isolates included F422-A and subtypes A, B, and C cloned in feline embryo cell lines (FEA/A, FEA/B, and FEA/C). The RD-114 virus, Moloney-MuLV, equine infectious anemia virus, bovine leukemia virus, and human T-cell leukemia virus were purified from cultures maintained in this laboratory. All the viruses were purified from tissue culture supernatants by a differential centrifugation method described previously (4). The viral pellets were either resuspended in appropriate buffer for immediate use or stored dry in liquid nitrogen. Rauscher-MuLV was obtained from NIH (Bethesda, MD).

Virus Labeling. FL74-FeLV was labeled in vivo with [3H]leucine by suspending the cells in leucine-free McCoy's media (Grand Island Biological Co.) containing [3H]leucine (25 μCi/ml; 130 to 190 Ci/mmol; American) supplemented with 5% fetal calf serum. The cells were maintained for 4 days in culture and the virus purified as described above. For immunoprecipitations, the labeled virus was lysed in 0.01 M Tris-HCl, pH 7.4, 1 mM KC1, 10 mM disodium EDTA, 0.03 M l-2-mercaptoethanol, 1% Triton X-100 for 30 min at 37°.

Fusion Procedure for the Production of Hybridoma Cell Lines. On Day 1, 3-month-old BALB/c mice were inoculated i.p. with undiluted FL74-FeLV suspended in a 1:1 dilution of PBS and complete Freund's adjuvant. Each mouse received 50 μg of virus in a 0.2-ml aliquot; all subsequent injections contained the same w/v ratio. The inoculations were repeated on Day 15 using incomplete Freund's adjuvant and on

3512

CANCER RESEARCH VOL. 44

Received September 9, 1983; accepted April 30, 1984.
Day 30 with only sterile PBS. Approximately 60 days later, the mice were given i.p. and i.v. injections of a virus suspension. The spleen was removed 4 days later and the cells teased out in 10 ml of Dulbecco's modified Eagle's medium (Grand Island Biological Co.). The cells were washed twice in Dulbecco's modified Eagle's medium and then resuspended in the same plus 1.5 x 10^7 P3x63 Ag8 myeloma cells. This mixture was pelleted and resuspended gently in 1 ml of 50% w/v (J. T. Baker) polyethylene glycol 1500 in Dulbecco's modified Eagle's medium. The volume was slowly brought to 25 ml with complete hybridoma media at 37° and allowed to incubate at this temperature for 1 hr. The cells were then pelleted at 800 rpm for 5 min, resuspended in 100 ml of complete hybridoma media supplemented with hypoxanthine, aminopterin, and thymidine (Sigma), and distributed into 96-well tissue culture plates (Costar) containing a fresh prepared feeder layer of mouse thymocytes and macrophages. After 5 days, two-thirds of the media was removed, and fresh complete media plus hypoxanthine and thymidine was added. Viable hybrid cell clones were tested for antibody production by ELISA using disrupted FL74-FeLV. Cell lines producing antibody against FeLV were expanded and cloned 3 times on agar semisolid media.

Production and Purification of MAbs. Magnified hybridoma lines were maintained in hybridoma media at 37° in a 5% CO2 buffered incubator. Antibody was recovered from tissue culture media by precipitation with 50% (v/v) ammonium sulfate at 4°. The precipitate was resuspended and dialyzed overnight versus PBS at 4°. The IgG was then purified using a Protein A-Sepharose column (Pharmacia) equilibrated with 0.05 M Tris-HCl, pH 8.3, and 0.15 M NaCl. Bound antibody was eluted with 0.05 M sodium citrate-citrate, pH 3.5, plus 0.15 M NaCl, and adjusted immediately to the proper pH using 1.0 M Tris-HCl, pH 8.2.

Antibody was also collected by injecting 1 x 10^7 hybridoma cells i.p. into BALB/c mice that had been treated 10 to 21 days previously with pristane. Seven to 10 days later, 0.5 to 5.0 ml of ascitic fluid were extracted from the peritoneal cavity of each mouse. The ascitic fluid was centrifuged for 30 min at 30,000 to remove cell debris.

Immunoglobulin Typing. The MAbs were screened for their immunoglobulin class and subtype by agar gel diffusion for 24 to 48 hr at room temperature. Antibody was recovered from tissue culture media by precipitation with 50% (v/v) ammonium sulfate at 4°. The precipitate was resuspended and dialyzed overnight versus PBS at 4°. The IgG was then purified using a Protein A-Sepharose column (Pharmacia) equilibrated with 0.05 M Tris-HCl, pH 8.3, and 0.15 M NaCl. Bound antibody was eluted with 0.05 M sodium citrate-citrate, pH 3.5, plus 0.15 M NaCl, and adjusted immediately to the proper pH using 1.0 M Tris-HCl, pH 8.2.

Antibody binding was carried out overnight at 4° in Buffer 3 (50 mM Tris-HCl, pH 7.4, 1 mM disodium EDTA, 150 mM NaCl, 0.1% BSA, 0.05% Tween 20). After a washing with PBS plus 0.02% Tween 80, rabbit anti-mouse IgG peroxidase (100 μg/well; Sigma) were added, and the plates were incubated at room temperature for 2 hr. The colorimetric reaction was initiated by the addition of 150 μl of substrate buffer (o-phenylene-diamine in 0.025 M citric acid, 0.05 M sodium phosphate, and 0.04% H2O2) and terminated after 20 min by the addition of 150 μl of 2.5 M H2SO4.

Absorbance was read in a Gifford Staser II spectrophotometer at 492 nm, a background absorbance being obtained from wells coated only with BSA. In order to ensure detection of binding to the various viral subtypes, the MAbs were used at a concentration giving an approximately 1:10-1:5 reading for the FL74 virus wells.

RESULTS

Identification of Monoclonal Reactivities. Viable hybridoma cells were initially selected which produced sufficient titers of antibody to obtain a positive binding in an ELISA with coupled FL74-FeLV antigens. After 3 successive clonings to ensure pure hybridoma lines, the antigenic reactivities were identified by radioimmunoprecipitation using 3H-labeled FL74 virus.

Heterologous sera raised against one or more of the FeLV proteins were used to establish the conditions for immunoprecipitation assay (Fig. 1). Multispecific goat sera precipitates all the viral proteins. It is clear from the results that monospecific sera raised against the major glycoprotein, gp70, also precipitate the p15E molecule. This is most probably due to the presence of gp70-p15E complexes in the inoculum, since these are difficult to completely dissociate. When goat anti-p10 sera was tested, all the low-molecular weight proteins of FeLV were seen. In contrast to the anti-gp70 sera, these results are due to the difficulty in separating proteins that have molecular weights within a small range.

Eight of the hybridoma lines produced MAbs which precipitated the external FeLV proteins, gp70 and p15E (Table 1). Six of these MAbs bound gp70: (a) 6G3; (b) 1C1; (c) 4B1; (d) 6D4; (e) 8F3; and (f) 7B3. 1C12 and 6B2 are unique to the p15E molecule. Radioimmunoprecipitations of 6G3, 1C12, and 6B2 are shown in Fig. 2. M101 is the mouse anti-FeLV sera obtained from the inoculated mice prior to the removal of the spleen.

Finter and Fleissner (17) found that about 10% of the gp71 in intact virions of MuLV were in a disulfide-linked complex with p15E. In FeLV, this envelope complex can be seen on nonreducing SDS-PAGE at approximately 90,000. Due to this strong interaction of these molecules, it is difficult to dissociate all the complexes prior to immunoprecipitation. To delineate the binding characteristics of several MAbs, it was necessary to dissociate...
and electrophoretically separate the gp70 and p15E molecules prior to antibody binding. Fig. 3 shows the results of a Western blot carried out to determine against which envelope proteins 8F3 and 7B3 were directed. It is clear that both of these monoclonals bind the gp70 molecule. No difference in the radioimmunoprecipitation patterns of the monoclonals was seen using either hybridoma cell supernatant or Protein A-chromatography-purified MAbs.

The results of γ-class typing are also presented in Table 1. Rabbit anti-mouse sera directed against specific globulin classes were used to type the MAbs in agarose immunodiffusion plates.

All the antibodies discussed here were γG1 except 1C12, which was γG2a.

Relative Avidities of the MAbs to FL74-FeLV Antigens. Serial dilutions of the Protein A-purified monoclonals were tested...
against a constant quantity of FL74 virus by ELISA, the absorbance of the reaction plotted versus the MAb concentration, and on the basis of the plateau regions of the titration curves, a single concentration of MAb (1 mg/100 ml) was taken to compare binding strength. Table 2 shows the relative binding strengths of the 8 monoclonals. A wide range in binding strength was seen which was not dependent upon the target protein(s). The high- and mid-range avidity MAbs consistently bound well in all our assays. Since a large quantity of virus was bound to the ELISA wells, and a wide range of antibody dilutions used, we feel that these results do not reflect the number of binding sites available on the viral proteins. Due to the low values for 7B3, 1C1, and 6B2, much higher concentrations were used when these monoclonals were tested against the FeLV subtypes.

The fact that the monoclonals were first purified by Protein A chromatography from cell-free hybridoma supernatants raised the question as to whether the concentrations of protein represented only mouse IgG. A small constituent of the fetal bovine serum used in tissue culture is capable of binding to Protein A and therefore may be present in these samples. To test this, an equivalent volume of hybridoma media containing fetal bovine serum was passed through a Protein A-Sepharose column used for MAb purification, the bound bovine component eluted and measured. An insignificant amount of IgG was found to be present in the eluant which would not alter the results described above.

FeLV Subtype and Viral Group Specificity. In order to determine whether these MAbs were directed against subtype specificities on the gp70 and p15E molecules, ELISA assays were carried out using several FeLV isolates. These included FL74, containing subtypes A, B, and C; virus purified from cloned FEAs producing each of the subtypes and the F422 cell line, producer of type A FeLV. As can be seen from the results presented in Table 3, all the monoclonals bound to FL74 viral proteins at a greater efficiency than to any of the subtypes. We found this to be unusual, since we would have expected the binding to be much stronger against the same quantity of a purified subtype. Only 1C1 (anti-gp70) and 1C12 (anti-p15E) bound all the FeLV isolates strongly. Weak binding for several of the MAbs was consistent and above background wells coated only with BSA. 6G3 can be seen to interact with the gp70s of all the subtypes, although only weakly to FEA/A and FEA/C. Other weak interactions exist between 7B3 and FEA/C and F422/A, and between 6B2 and FEA/A. When the results of the binding to FEA/A and F422/A isolates are compared, we must conclude that even though previous tests have indicated they are the same subtype, antigenic variation does exist between their gp70 molecules. In all cases, stronger binding was seen to subtype B FeLV, whereas none of the MAbs showed specific reactivity to either subtype A or subtype C.

In contrast to the other MAbs, which react well to at least one of the subtypes, 8F3 shows specificity for a unique FL74 determinant. In order to further characterize 8F3, feline fibroblasts (FEA cells) were infected with either the FL74 or F422 isolates of FeLV. Virus produced by these cells was used in binding assays against 8F3 and the other MAbs described here. We saw no difference in the binding results. 8F3 again bound only the FEA/FL74 virus but not the virus produced by the FEA/F422 cells. No binding studies were carried out using the infected cells.

These binding studies indicate that antigenic variability exists between FeLV isolates previously characterized and designated A, B, or C. The other assays used to type these isolates have been based upon antigenic sites necessary for infectivity and viral neutralization. Antigenic variability between isolates used here does not seem unreasonable due to the specific nature of the MAbs.

In addition to the FeLV-isolates, these monoclonals were tested against several heterologous virus isolates. As can be seen in Table 4, only 3 MAbs showed interspecies reactivities, and only then to murine isolates. Previous immunological studies using multispecific sera have indicated homologies between FeLV and MuLVs (23). No reactivity was seen to the endogenous feline virus RD114, to equine infectious anemia virus, bovine leukemia virus, or to human T-cell leukemia virus. MAbs not shown in Table 4 reacted only with FeLV, as is seen with 1C1.

Viral Neutralizing Assays. Viral neutralizing activity was assessed for each of the MAbs against the FeLV subtypes by foci formation on CCC81 (sarcoma virus-positive leukemia virus-negative) and CCL64 mink cells as previously described for multispecific sera (7). Tissue culture-purified MAbs were used for these studies, since murine ascites fluid produced a significant

**Table 2**

<table>
<thead>
<tr>
<th>MAb</th>
<th>Absorbance</th>
<th>Relative avidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1C12</td>
<td>2.88</td>
<td>High</td>
</tr>
<tr>
<td>6G3</td>
<td>2.80</td>
<td>High</td>
</tr>
<tr>
<td>4B1</td>
<td>2.56</td>
<td>High</td>
</tr>
<tr>
<td>8F3</td>
<td>2.10</td>
<td>Middle</td>
</tr>
<tr>
<td>6D4</td>
<td>1.87</td>
<td>Middle</td>
</tr>
<tr>
<td>7B3</td>
<td>0.77</td>
<td>Low</td>
</tr>
<tr>
<td>1C1</td>
<td>0.20</td>
<td>Low</td>
</tr>
<tr>
<td>6B2</td>
<td>0</td>
<td>Low</td>
</tr>
</tbody>
</table>

* Virus (1.0 µg) absorbed to reaction wells.  
* Measured at 492 nm.

### Table 3

<table>
<thead>
<tr>
<th>MAb</th>
<th>FL74</th>
<th>FEA/A</th>
<th>FEA/B</th>
<th>FEA/C</th>
<th>F422</th>
</tr>
</thead>
<tbody>
<tr>
<td>6G3</td>
<td>gp70</td>
<td>1.75</td>
<td>0.05</td>
<td>0.69</td>
<td>0.08</td>
</tr>
<tr>
<td>1C1</td>
<td>gp70</td>
<td>0.89</td>
<td>0.15</td>
<td>0.50</td>
<td>0.24</td>
</tr>
<tr>
<td>4B1</td>
<td>gp70</td>
<td>1.43</td>
<td>0</td>
<td>1.44</td>
<td>0.46</td>
</tr>
<tr>
<td>6D4</td>
<td>gp70</td>
<td>0.80</td>
<td>0</td>
<td>0.84</td>
<td>0.14</td>
</tr>
<tr>
<td>8F3</td>
<td>gp70</td>
<td>0.94</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7B3</td>
<td>gp70</td>
<td>0.64</td>
<td>0</td>
<td>0.21</td>
<td>0.07</td>
</tr>
<tr>
<td>6B2</td>
<td>p15E</td>
<td>0.88</td>
<td>0.06</td>
<td>0.70</td>
<td>0.24</td>
</tr>
<tr>
<td>1C12</td>
<td>p15E</td>
<td>1.80</td>
<td>0.30</td>
<td>0.92</td>
<td>0.45</td>
</tr>
</tbody>
</table>

* Absorbance values at A450.

### Table 4

**Interspecies binding by FeLV-directed MAbs**

<table>
<thead>
<tr>
<th>Virus†</th>
<th>6G3</th>
<th>1C1</th>
<th>6B2</th>
<th>1C12</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL74</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>RD114</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M-MuLV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-MuLV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELIA‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HTLV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† Lysed virus (2 µg) absorbed to reaction wells.  
‡ +, ≥0.10-A A450; −, <0.10-A A450.

ELIA, equine infectious anemia; BLV, bovine leukemia virus; HTLV, human T-cell leukemia virus.
background neutralizing activity. The results of the neutralization assays are presented in Table 5. Neutralization values of less than 15% were not reproducible and were therefore considered negative. Three MAbs, 6G3, 6D4, and 8F3, showed no neutralizing activity against the FL74 isolate or subtypes A, B, and C. 4B1 displayed a very strong neutralizing activity to both B (98.5%) and C (82.1%) FeLVs, correlating well with the binding data. 7B3 showed only weak activity to type B, and complete loss of viral infectivity was never seen.

MAb 1C1, which bound to all the FeLV subtypes tested, also prevented foci formation by all the isolates. In addition to the previously described FeLV isolates, we attempted to neutralize the infectivity of Snyder-Theilen FeLV and FeSV. The isolate used here contained a FeSV:FeLV ratio of 1:50. Essentially complete neutralization of infectious FeLV was observed. This was not the case with FeSV, however, most probably due to the 50-fold excess of FeLV in the reaction.

### DISCUSSION

Eight MAbs raised against FL74-FeLV have been shown to have reactivities to the external glycoproteins of the virus by radioimmunoprecipitation and SDS-PAGE. Six bind to the gp70 alone; 2 bind to the p15E molecule.

A wide range of binding strengths exist between these MAbs which is not dependent upon the target viral antigen or immunoglobulin subclass. FeLV subtype specificity of the MAbs was directed predominantly against the B determinants, although in most cases weaker interactions did exist with the other subtypes. The binding studies do reveal antigenic variability between FeLVs obtained from different cell lines. Previous subtyping techniques have focused on the antigenic determinants involved in viral infectivity and neutralization, while many of our monoclonals are specific for nonneutralizing sites.

The unique nature of the determinant recognized by 8F3 raises the possibility that this MAb is directed against an epitope on the feline oncornavirus-associated cell membrane antigen. Early studies suggested that this was a tumor antigen on feline lymphosarcoma and fibrosarcoma cells (for a review, see Ref. 24). Recent work by Vedbrat et al. (26) and Snyder et al. (25) indicates that the feline oncornavirus-associated cell membrane antigen reactivity in feline sera is directed against a polymorphic group of epitopes that are related to, but distinct from those on the gp70 of FeLV-C. MAb 8F3 does not appear to be directed against a feline-oncornavirus-associated cell membrane antigen component as it binds to virus produced by both FL74 cells and feline fibroblasts infected with FL74-FeLV (FEA/FL74). This MAb binds to neither F422-FeLV nor FeLV-C. We have not carried out binding studies using the infected cells to determine if this epitope is expressed on the cell surface. The possibility that this determinant is expressed on the cell but not on mature particles of these cells cannot be ruled out.

RNA-fingerprinting studies of several FeLV isolates have indicated that genomic differences occur not only between the subtypes A, B, and C but also between the Glasgow-1 and Rickard subtype A isolates (20). Our ELISA assays also suggest that antigenic variability exists between 2 independent subtype A FeLVs. At the present time, we do not know the location of these variable regions. Studies by Bruck et al. (1), indicating that antigenic variation may occur between bovine leukemia virus isolates from different cell lines, also lends support to our results.

Of special interest are the 2 MAbs that bind to all the FeLV subtypes tested; 1C12 (anti-p15E) and 1C1 (anti-gp70). 1C12, which also binds to M-MuLV and R-MuLV in our ELISA assays, shows no reactivity to other retroviruses tested thus far. In his studies on MuLV, Lostrum et al. (13) found an anti-p15E monoclonal that was reactive with FeLV but not RD-114 virus. It would be interesting to determine whether these 2 monoclonals are directed against the same region of these molecules. MAb 1C1, even though of low binding strength, is directed against a viral neutralizing site on all the FeLV isolates tested to date. Other investigators, using MAbs directed against the external glycoproteins of retroviruses, MMTV (15), MuLV (16), and bovine leukemia virus (2), have indicated that distinct sites exist on these molecules that are involved in viral neutralization. It has been proposed that the antibody binds close to or directly upon the site of the glycoprotein that is necessary for cell receptor recognition prior to infectivity. Their evidence supports a mechanism of steric hindrance.

We are in the process of finishing competition assays with these monoclonals to determine if they share antigenic determinants, and shortly will begin mapping the sites on the FeLV gp70 and p15E molecules to which these monoclonals correspond. Additional MAbs are being produced and characterized so that these studies may be more extensive. Localization of viral neutralizing sites on the FeLV gp70 will be invaluable, advancing the production of vaccines containing only the portion of the molecule necessary to stimulate an immune response in the animal.

MAbs to the external proteins of FeLV will be useful in both the diagnosis and serotherapy of FeLV- and FeSV-infected animals. High-avidity antibodies can be used immediately as very specific and sensitive probes for detection of FeLV in cat sera. In the past, we have shown that viral neutralizing activity is present in the sera of experimental regressor cats that become virus-free. It is our hope to augment the humoral antibody response to FeLV and FeSV in infected animals and are currently preparing a set of serotherapy experiments using several of these MAbs. In addition to these, anti-fes MAbs kindly supplied by Dr. Fred Reynolds, and described elsewhere (27), will be used to treat developing fibrosarcomas. We do not expect that the findings from the first serotherapy will be conclusive, since tremendous variability exists in the dosage and timing of antibody administration to infected animals. These monoclonals have a great potential beyond the current serotherapy studies. Tagged with radioactive tracers, the MAbs may be used for localization of viral infected and/or dispersed tumorigenic cells. Immunotoxins, such as ricin, which has already been used in other studies

### Table 5

<table>
<thead>
<tr>
<th>MAb</th>
<th>FL74</th>
<th>FEA/A</th>
<th>FEA/B</th>
<th>FEA/C</th>
<th>ST-FeLV</th>
<th>ST-FeSV</th>
</tr>
</thead>
<tbody>
<tr>
<td>6G3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NT</td>
<td>NT</td>
</tr>
<tr>
<td>1C1</td>
<td>82.3</td>
<td>98.1</td>
<td>65.5</td>
<td>62.5</td>
<td>90.8</td>
<td>37.8</td>
</tr>
<tr>
<td>4B1</td>
<td>0</td>
<td>0</td>
<td>98.5</td>
<td>82.1</td>
<td>NT</td>
<td>NT</td>
</tr>
<tr>
<td>6D4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NT</td>
<td>NT</td>
</tr>
<tr>
<td>8F3</td>
<td>0</td>
<td>0</td>
<td>50.5</td>
<td>0</td>
<td>NT</td>
<td>NT</td>
</tr>
<tr>
<td>7B3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NT</td>
<td>NT</td>
</tr>
<tr>
<td>8B2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NT</td>
<td>NT</td>
</tr>
<tr>
<td>1C12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NT</td>
<td>NT</td>
</tr>
</tbody>
</table>

* Titrated on CCL64 cells.

NT, not tested.
(for a review, see Ref. 28), could be coupled to a specific antitumor monoclonal, alleviating the need to administer high doses of toxic material to an animal.

REFERENCES


Characterization of Monoclonal Antibodies Directed against the Envelope Proteins of Feline Leukemia Virus

Susan D. Youngren, Alex P. Vukasin and Fernando de Noronha

Cancer Res 1984;44:3512-3517.

Updated version  Access the most recent version of this article at: http://cancerres.aacrjournals.org/content/44/8/3512

E-mail alerts  Sign up to receive free email-alerts related to this article or journal.

Reprints and Subscriptions  To order reprints of this article or to subscribe to the journal, contact the AACR Publications Department at pubs@aacr.org.

Permissions  To request permission to re-use all or part of this article, contact the AACR Publications Department at permissions@aacr.org.