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# Somatic cell genetic analysis of human cell surface antigens: Chromosomal assignments and regulation of expression in rodent–human hybrid cells

(monoclonal antibodies/differentiation antigens/antigen induction)

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ABSTRACT **The expression of 13 newly defined human cell surface antigens identified by monoclonal antibodies was studied in a panel of reduced rodent–human somatic cell hybrid clones. For each antigenic system the segregation of antibody reactivity was concordant with the segregation of a specific human chromosome, permitting the chromosomal assignment of 13 gene loci determining antigen expression. The antigens can be placed in four groups on the basis of their patterns of control in the hybrid cells. (*i*) Presence of a single human chromosome is necessary and sufficient for antigen expression; L230 (assigned to chromosome 2), AJ425, K15 (chromosome 3), SR84 (chromosome 5), JF23, Q14 (chromosome 11), SV13 (chromosome 15), and F10 (chromosome 19). (*ii*) AJ2 (chromosome 10) and J143 (chromosome 17); two antigens coded for by separate human chromosomes but associated as a molecular complex on the surface of $AJ2^+/J143^+$ human cells. (*iii*) F8 (chromosome 19); antigen expression dependent on the growth characteristics of hybrid cells: substrate-adherent cells are $F8^+$, whereas cells growing in suspension are $F8^-$. (*iv*) AO122 and F23 (chromosome 15); antigen expression controlled by the permissive/inducing vs. nonpermissive/noninducing nature of the rodent fusion partner. Hybrids derived from both antigen-positive and antigen-negative human cells can express AO122 and F23 but only when specific rodent cell types are used for hybridization: N4TG-1 neuroblastoma and L cells, but not RAG renal carcinoma cells, permit AO122 expression, whereas RAG and L cells, but not N4TG-1 cells, permit F23 expression. The rapidly expanding list of monoclonal antibodies defining human cell surface molecules provides a range of markers to probe the genetic regulation of antigen diversity in somatic cells.**

The chromosomal mapping of genes controlling expression of human cell surface antigens through the analysis of rodent–human somatic cell hybrids has advanced rapidly since the advent of monoclonal antibodies (1). We have recently assigned genes determining six different cell surface antigens to human chromosomes 1, 12, X, and Y (2–4). In the present study, we have chromosomally mapped 13 distinct antigens, including differentially expressed markers with a restricted distribution on panels of human cells.

## MATERIALS AND METHODS

**Cell Lines and Cell Culture.** Human cell lines and rodent–human hybrid clones listed in Tables 1 and 2 have been described previously (2–4). The human fusion partners for the hybrid cells were SK-N-BE(2) neuroblastoma cells (NSK hybrid clones), short-term cultures of normal kidney epithelial cells (LNK, ANK, RC, and RP clones), and melanoma cells (CE, AM, LM, and LC clones).

**Monoclonal Antibodies.** Monoclonal antibodies AbJF23, AbF8, AbF10, AbSV13, AbSR84, and AbK15 were derived from mice immunized with cultured human cells following published procedures (6). Antibodies BBM.1 (anti-$\beta_2$-microglobulin) and W6/32 (anti-HLA-A, -B, -C) were obtained from the American Type Culture Collection.

**Serological and Immunological Procedures.** Rosetting assays for the detection of cell surface antigens on cultured cells and immunoprecipitation tests were performed according to methods previously described (7).

**Isozyme Analysis.** The isozymes selected for analysis identified at least one marker locus for each human chromosome, except the Y chromosome, and are specified in ref. 2.

**Karyotype Analysis.** Metaphase chromosomes were prepared and stained by the G11 method and by a modification of the trypsin-Giemsa banding technique (2). At least 25 metaphases were evaluated for each NSK, CE, and LC hybrid clone (2).

## RESULTS

Six monoclonal antibodies were generated as part of this study. Their serological specificity and the biochemical nature of the antigens are presented in Table 1 and Fig. 1. Characteristics of the other seven antibodies have been described in detail elsewhere (5–10). The antibodies did not react with the rodent cell lines used for hybridization, but they were reactive with characteristic subsets of the panel of hybrid clones listed in Table 2. The human chromosome content of the hybrid cells was determined by karyotyping and by serological and isozyme markers, and the results are summarized in Table 3.

**Chromosomal Assignments.** The patterns of reactivity in the hybrid panel (Table 2) were compared with the distribution of human chromosomes in the hybrid clones (Table 3). The numbers of hybrid clones showing a discrepancy between antibody reactivity and presence of individual human chromosomes were evaluated as a measure of concordant/discordant segregation and are presented in Table 4. Each antigen cosegregated with a specific human chromosome, permitting the assignment of 13 different gene loci controlling antigen expression (summarized in Table 5). Most of the antigens can be clearly distinguished from the list of about 20 cell surface antigens defined by monoclonal antibodies that have been mapped (reviewed in ref. 1). The biochemical nature and cell type distribution of antigens L230 (chromosome 2), K15, AJ425 (chromosome 3), SR84 (chromosome 5), AJ2 (chromosome 10), Q14, JF23 (chromosome 11), AO122, F23 (chromosome 15), and F8 and F10

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Abbreviations: MHA, mixed hemadsorption assay(s); EBV, Epstein–Barr virus.

Table 1. Reactivity of monoclonal antibodies with cell surface antigens of cultured human and rodent cells

| Cell type | *n* | Monoclonal antibody SV13 | K15 | F8 | F10 | JF23 | SR84 |
|---|---|---|---|---|---|---|---|
| Human | | | | | | | |
| Neuroblastoma | 4 | ●●●● | ●●●● | ○○◒● | ●●●● | ●○●○ | ●●●● |
| Melanoma | 4 | ●●●● | ●●●● | ◒◒◒● | ●●●● | ●●●● | ●●●● |
| Astrocytoma | 4 | ●●●● | ●●●● | ●◒◒● | ●●●● | ●●●● | ●●●● |
| Choriocarcinoma | 4 | ●●●● | ●●●● | ●●●● | ●●●● | ○○○○ | ●○●○ |
| Renal cancer | 4 | ●●●● | ○●◒◒ | ●●●● | ●●●● | ●●●● | ●●●● |
| Leukemia | 8 | ○○○○ | ●●●● | ○○○○ | ●●●● | ●●●● | ○○○○ |
| | | ○○○● | ●●●● | ○○○○ | ●●●● | ●●●● | ○○○○ |
| EBV$^+$ B cell | 4 | ●●◒◒ | ●●●● | ○○○○ | ●●●● | ●●●● | ●●●● |
| Fibroblast | 4 | ●●●● | ◒◒◒◒ | ◒◒◒◒ | ◒◒●● | ●●●● | ●●●● |
| Normal kidney | 4 | ●●●● | ●●◒◒ | ●●●● | ●●●● | ●●●● | ●●●● |
| Rodent | | | | | | | |
| Mouse | 4 | ○○○○ | ○○○○ | ○○○○ | ○○○○ | ○○○○ | ○○○○ |
| Hamster | 1 | ○ | ○ | ○ | ○ | ○ | ○ |

Serial dilutions of antibody were tested on cultured cells by mixed hemadsorption assays (MHA). Symbols listed under the antibodies refer to the highest dilution of antibody giving a positive reaction with individual cell line. Titer: ●, $1 \times 10^{-4}$–$1 \times 10^{-7}$; ○, $4 \times 10^{-3}$–$1 \times 10^{-4}$; ○, no reactivity at starting dilution of antibody (1:250 *nu/nu* mouse serum). All antibodies are of the IgG1 subclass, as determined by double immunodiffusion in agar with anti-mouse Ig heavy chain-specific antisera (Bionetics, Kensington, MD). *n*, number of cell lines tested. Circles listed in corresponding positions under different antibodies refer to the same cell lines. EBV indicates cells transformed by Epstein–Barr virus. Serological results on an extended cell panel, including cell line designations, are available upon request. Rodent cell lines tested were L cell, A9, RAG, N4TG-1 (mouse), and YH21 (Chinese hamster).

(chromosome 19) indicate that these assignments are distinct from those previously reported. The relationship between SV13 (chromosome 15) and antigen 28.3.7 (ref. 11) and between J143 (chromosome 17) and H207 (ref. 12) cannot be established from the published data.

The analysis of hybrid clones NSK-3 and NSK-5, which are strong J143 expressors but do not contain a complete chromosome 17, permitted the regional assignment of the J143 locus to 17q22-qter: NSK-3 cells have retained a deleted chromosome 17q and NSK-5 cells have retained the fragment 17q22-qter as part of the marker chromosome M2 previously described for the parental SK-N-BE(2) cells (13).

**AJ2/J143 Cell Surface Molecules Are Controlled by Two Gene Loci.** AbAJ2 and AbJ143 define two serologically distinct antigenic systems. AJ2 can be detected on all nucleated human cells in culture and most cell types in tissue sections (9). J143 shows a more restricted distribution, being present on all substrate-adherent human cells but absent from most leukemias, lymphomas, and other cells that grow in suspension culture. Also, J143 expression in tissues is limited to kidney glomeruli and the basal layers of certain epithelia (5). Immunoprecipitation tests have demonstrated the relatedness of these antigenic systems. AbAJ2 precipitated glycoproteins of $M_r$ 170,000 and 140,000 from [$^{35}$S]methionine-labeled extracts of human cells with an additional light chain of $M_r$ 30,000, which is most easily detected by using $^{125}$I-labeled extracts (9). In contrast, AbJ143 precipitated only glycoproteins of $M_r$ 140,000 and the $M_r$ 30,000 light chain from these cells. Sequential immunoprecipitation tests showed that preclearing with AbAJ2 removed all J143 antigen. However, after preclearing with AbJ143, AbAJ2 still precipitated the $M_r$ 170,000 and 140,000 components with a reduction in the amount of the $M_r$ 140,000 glycopeptides (Fig. 1). These results indicate that the J143 epitope is linked to the AJ2 epitope in the membrane of cells expressing both antigens and that J143 and AJ2 reside either on the same polypeptide or on two separate but associated molecules (with some AJ2 molecules lacking the J143 epitope). The finding of an independent segregation pattern for AJ2 (concordant with chromosome 10) and J143 (concordant with chromosome 17) in a panel of rodent–human hybrid clones clearly suggests that AbAJ2 and AbJ143 define epitopes on distinct polypeptides. These are controlled by genes on the two human chromosomes and become linked in the cell membrane of AJ2$^+$/J143$^+$ human cells.

**F8 Expression Is Related to Hybrid Cell Growth Characteristics.** The F8 glycoprotein is a serological marker for cultured human cells that attach to glass and plastic surfaces. It is present on epithelial cells but absent from lymphoid cells and from variants of F8$^+$ cell lines selected for their ability to grow in suspension culture (Table 1 and unpublished observations), indicating that antigen expression is related to the growth characteristics of cultured cells rather than the cell lineages from which they are derived. The assignment of the F8 locus to chromosome 19 allowed us to examine the control of F8 expression in hybrid cells. Among the hybrid clones generated from SK-N-BE(2) human neuroblastoma cells, those that contained a human chromosome 19 and showed substrate-adherent growth were strongly F8$^+$ (NSK-1, NSK-3, NSK-6s). Clones that contained a normal chromosome 19 but grew as suspension cultures (NSK-4, NSK-6) were F8$^-$.

**AO122 and F23 Expression in Hybrids Is Determined by the Cellular Derivation of the Rodent Fusion Partner.** AbAO122 and AbF23 define antigens with a very restricted distribution on a cultured human cell panel (described in detail in refs. 7 and 10). AO122 is present on tumor cells of neuroectodermal origin (melanoma, astrocytoma, neuroblastoma) and fibroblasts but not on other cell types, including epithelial cancers and cultures of kidney epithelium. Conversely, F23 is expressed on normal and malignant kidney epithelial cells and fibroblasts but is absent from melanomas, neuroblastomas, and other cell types. Gene loci controlling the expression of AO122 and F23 in hybrid cells could be assigned to human chromosome 15 by using human neuroblastoma-derived hybrids for AO122 and human kidney epithelium-derived hybrids for F23 (Tables 2 and 3).

In a second series of experiments, we extended the

Table 2. Serological typing of rodent–human hybrid clones with monoclonal antibodies to human cell surface antigens

| Hybrid | Monoclonal antibody | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L230 | K15 | AJ425 | SR84 | AJ2 | JF23 | Q14 | SV13 | AO122 | F23 | J143 | F8 | F10 |
| NSK-1s | – | – | – | 125 | 3000 | 1000 | 3000 | 100 | 100 | – | 1000 | – | – |
| NSK-2 | – | – | – | – | – | 5000 | – | 300 | – | – | – | – | – |
| NSK-3 | – | – | – | – | – | – | – | 300 | 100 | – | 1000 | 100 | 500 |
| NSK-4 | – | – | – | – | – | 200 | 300 | 300 | 25 | – | – | – | 100 |
| NSK-5 | – | – | 5000 | – | 3000 | 5000 | 3000 | 300 | 300 | – | 5000 | – | – |
| NSK-9/2 | – | – | – | 1500 | – | – | 3000 | 300 | 100 | – | – | – | – |
| CE25/1 | – | | – | | – | – | – | – | – | | – | – | – |
| CE12 | – | 125 | 125 | 125 | – | – | – | 300 | 300 | | 1500 | | – |
| CE12/6/1 | – | – | – | 3000 | – | – | – | – | – | | 1500 | – | – |
| RAG4Y | – | – | – | | – | – | – | – | – | | – | – | – |
| RAG194/1 | – | | – | – | 3000 | – | | – | – | – | – | 1500 | 300 |
| LNK1 | – | 300 | 1500 | – | 1500 | 1500 | 1000 | – | – | – | 1500 | 1000 | 100 |
| ANK3 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| ANK4/4 | 100 | – | – | – | – | – | – | 1000 | 125 | 300 | – | – | – |
| ANK4/14 | 100 | – | – | – | – | – | – | 300 | 500 | 300 | – | – | – |
| RC1/2 | – | 125 | 25 | – | – | – | – | – | – | – | – | – | – |
| RC1/3 | – | – | – | – | – | – | – | – | – | – | – | 300 | 1500 |
| RC1/7 | – | 300 | 25 | – | – | – | – | – | – | – | – | 100 | 100 |
| RC1/9 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| RC2 | – | – | – | 125 | – | – | – | – | – | – | – | – | – |
| RC3 | – | 25 | 1500 | | 1500 | 1500 | 300 | 1500 | | 300 | 100 | 1000 | 300 |
| RC5 | – | – | – | – | – | – | – | 300 | – | 50 | 300 | – | – |
| RP1/1 | – | – | – | – | – | – | – | – | – | – | 1500 | – | – |
| RP1/9 | – | – | – | – | – | – | – | – | – | – | – | – | – |
| AM2/8 | 250 | 250 | | | – | – | – | – | – | | | – | – |
| AM2/14 | – | – | | | – | – | – | – | – | – | | – | – |
| AM4/5 | 250 | – | | – | | – | – | – | – | – | – | – | – |
| AM4/13 | – | – | | | | – | – | – | – | | – | – | – |
| LM2 | – | 50 | 1500 | – | 300 | 300 | – | – | – | – | 1000 | – | – |
| LC1/3/45 | 100 | | – | | – | – | – | – | – | | – | – | – |

Serial dilutions of antibody were tested on cultured cells by MHA. The number listed under the antibody refers to the reciprocal of the highest dilution of antibody ($\times 10^{-3}$) giving a positive reaction with the cell line shown on the left. "–", No reactivity at starting dilution of antibody (1:250 *nu/nu* mouse serum).

serological typing to hybrid clones derived from human cell types that did not express AO122 or F23 and were surprised to find expression of these antigens in certain hybrid combinations. Hybrid clones that had retained a normal human chromosome 15 fell into two groups: hybridization of human nonexpressor cells with mouse A9 and L cells, which had been found to be permissive for AO122 and F23 expression in the first series of experiments, yielded hybrid clones that were strongly antigen-positive. Thus, ANK4 human kidney hybrid cells were AO122$^+$, and LC2/4, LM48, and AM1 human melanoma hybrids were F23$^+$. In contrast, hybridization of AO122$^-$ human kidney epithelial cells with RAG mouse renal cancer cells resulted in a series of hybrid clones containing a normal human chromosome 15 (clones RC1, RC2, RC3, RC4, RC5, RC7) but lacking AO122 expression. Correspondingly, the fusion of F23$^-$ human neuroblastoma cells with N4TG-1 mouse neuroblastoma cells resulted in seven hybrid clones that failed to express F23 in the presence of human chromosome 15 (clones NSK-1, NSK-1s, NSK-3, NSK-4, NSK-5, NSK-9, and NSK-10).

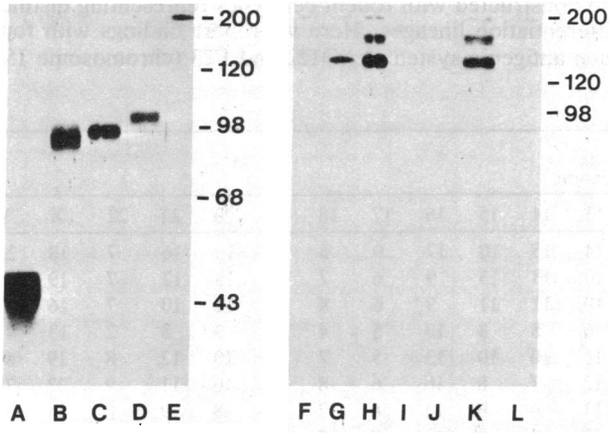


FIG. 1. Fluorogram of immunoprecipitates obtained with monoclonal antibodies and separated by NaDodSO$_4$/PAGE. Nonidet P-40 extracts of [$^3$H]glucosamine-labeled SK-LC-8 cells (lanes A–C) and Con A-Sepharose-bound fractions of [$^{35}$S]methionine-labeled SK-MEL-28 cells (lanes D and E) were used in tests with AbF10 (lane A). AbJF23 (lane B), AbF8 (lane C), AbSV13 (lane D), and AbSR84 (lane E). Con A-Sepharose-bound fractions of [$^{35}$S]methionine-labeled LA-N-1 cells were used in sequential immunoprecipitation tests by using AbJ143 (twice: lanes G and I) followed by AbAJ2 (lane K) or AbAJ2 (twice: lanes H and J) followed by AbJ143 (lane L). Lane F shows a control experiment with an unrelated antibody. Positions of molecular weight markers ($M_r \times 10^{-3}$) are indicated on the right.

## DISCUSSION

Antibodies defining cell surface antigens provide useful markers for the analysis of phenotypic diversity in somatic cells. Studies of human cancer cells with mouse monoclonal antibodies have identified a large number of new cell surface antigens, and these can be classified according to their expression in tissues and cultured cell panels into three categories: antigens expressed by virtually all cell types (species antigens), antigens expressed by a variable range of unrelated cell types, and antigens that have a restricted distribution and generally follow certain cell lineages or differentiation pathways. Chromosomal mapping of loci de-

Table 3. Human chromosome content of rodent–human hybrid clones

| Hybrid | Human chromosome | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | X | Y |
| NSK-1s | ● | | ○ | ○ | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | | ● | | | ● | ●* | ●* | ● | |
| NSK-2 | ○ | | | | | | | | ● | | ○ | | | ● | ○ | | | | | | ● | | | |
| NSK-3 | ○ | | | | | ● | ○ | ● | | | | ● | | ● | ● | | ○ | | ● | ● | ○ | | | |
| NSK-4 | ○ | | | ● | | ● | | ● | | | ● | ● | | ● | ● | | | | ● | | ● | | ● | |
| NSK-5 | ○ | | ○ | | | ● | ● | ○ | | ● | ● | ● | | ● | ● | | ○ | | | ● | ● | | | |
| NSK-9/2 | | | | | ● | | ● | | | | ⊙ | | | ● | ● | ● | | | | ● | ● | | ● | |
| CE25/1 | ○ | | | | | | | | | | | ● | | | | | | | | | | | ● | |
| CE12 | ○* | | ● | ● | ● | ○ | | ● | | | | ●* | ●* | | ● | ● | ● | | | ● | ● | ● | ●* | |
| CE12/6/1 | | | | ● | ● | ○ | | ● | | | | ●* | ● | | | ● | ● | | | ● | ●* | ●* | ●* | |
| RAG4Y | | | | | | | | | | | | | | | | | | | | | | | | ● |
| RAG194/1 | | | | ● | | | | | | ● | | | | | | ● | | | ● | | ● | | ● | |
| LNK1 | | | ● | ● | | ● | | ● | | ● | ● | | | | | ● | ● | | ● | | | | | |
| ANK3 | | | | | | | | | | | | | | | | | | | | ● | | | ● | |
| ANK4/4 | | ● | | | | | | | | | | ● | | | ● | | | | | | | | ● | |
| ANK4/14 | | ● | | | | | | | | | | | | | ● | | | | | | | | ● | |
| RC1/2 | ● | | ● | | | | | | ● | | | | ● | ● | | ● | | | | | ● | | ● | — |
| RC1/3 | ● | | | | | | | | | | | | | | | ● | | | ● | | | | ● | — |
| RC1/7 | ● | | ● | | | | | | ● | | | ● | | | | ● | | | ● | | ● | | ● | — |
| RC1/9 | | | | | | | | | | | | | ● | | | ● | | | | | ● | | ● | — |
| RC2 | | | | | ● | ● | | | | | | | ● | ● | | | | ● | | ● | ● | ● | ● | |
| RC3 | ● | | ● | | | | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | ● | — |
| RC5 | | | | | | | | | | | | | ● | ● | ● | ● | ● | | | | ● | | ● | — |
| RP1/1 | | | | | | | | | | | | | ● | | | ● | ● | | | | | | ● | — |
| RP1/9 | | | | | | | | | | | | | ● | | | ● | | | | | | ● | ● | — |
| AM2/8 | | ● | ● | | | | | | | | | | | | | | ○ | | | | | | ● | — |
| AM2/14 | | | | | | | | | | | | | | | | | | | | | | | ● | — |
| AM4/5 | | ● | | | | | | | | | | | | | | | | | | | | | ● | — |
| AM4/13 | | | | | | | | | | | | | | | | | | | | | | | ● | — |
| LM2 | | | ● | | | | | ● | | ● | ● | | | | | | ○ | | | | | | | |
| LC1/3/45 | | ● | | | | | | | | | | | | | | | ○ | ● | | | ● | | | |

Presence of human chromosomes as determined by karyotyping, isozyme analysis, and testing with monoclonal antibodies to cell surface markers for chromosomes 1 (AJ9, T87), 6 (W6/32), 12 (A127, M68, V1), 15 (BBM.1), and X and Y (O13, F21) (see ref. 1). ●, Chromosome present; ○, rearranged copy or part of the chromosome present; no entry, chromosome not present. —, Not tested.
*Chromosome present in 5–25% of cells.

termining human cell surface antigens is progressing rapidly, and in this study, 13 assignments have been made, including loci specifying antigens whose expression is restricted to certain cell types. With the chromosomal assignment of human loci for differentiation- or lineage-restricted antigens, questions can be asked about the regulation of antigen expression in hybrids containing the relevant chromosome and constructed with rodent cell types representing distinct differentiation lineages. Here we report findings with four such antigenic systems: AO122 and F23 (chromosome 15),

Table 4. Discordancy analysis for chromosomal assignments

| Antigen | Human chromosome | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | X | Y |
| L230 | 10 | 0 | 10 | 10 | 10 | 11 | 8 | 11 | 9 | 11 | 11 | 11 | 14 | 15 | 10 | 17 | 9 | 6 | 11 | 13 | 16 | 7 | 18 | 2 |
| K15 | 5 | 9 | 0 | 8 | 10 | 10 | 9 | 7 | 7 | 7 | 7 | 9 | 10 | 13 | 13 | 9 | 6 | 7 | 8 | 13 | 12 | 7 | 19 | 4 |
| AJ425 | 4 | 10 | 0 | 8 | 10 | 8 | 8 | 6 | 7 | 5 | 5 | 8 | 10 | 11 | 11 | 9 | 6 | 8 | 7 | 11 | 10 | 7 | 16 | 5 |
| SR84 | 7 | 8 | 7 | 5 | 0 | 5 | 4 | 6 | 7 | 8 | 7 | 8 | 6 | 8 | 8 | 10 | 5 | 4 | 10 | 3 | 8 | 2 | 13 | 4 |
| AJ2 | 6 | 10 | 5 | 6 | 9 | 7 | 4 | 7 | 8 | 0 | 2 | 8 | 11 | 10 | 10 | 13 | 5 | 7 | 6 | 10 | 12 | 8 | 19 | 6 |
| JF23 | 5 | 12 | 6 | 7 | 10 | 5 | 6 | 6 | 7 | 3 | 0 | 7 | 12 | 7 | 8 | 16 | 6 | 8 | 8 | 10 | 11 | 9 | 22 | 7 |
| Q14* | 5 | 9 | 5 | 5 | 7 | 4 | 3 | 6 | 8 | 2 | 0 | 6 | 11 | 6 | 6 | 12 | 6 | 7 | 6 | 8 | 9 | 8 | 14 | 5 |
| SV13 | 6 | 12 | 12 | 11 | 10 | 8 | 7 | 10 | 11 | 11 | 7 | 6 | 13 | 5 | 0 | 16 | 8 | 12 | 12 | 9 | 8 | 11 | 17 | 8 |
| AO122* | 3 | 9 | 7 | 6 | 6 | 3 | 4 | 6 | 8 | 7 | 5 | 3 | 7 | 4 | 0 | 7 | 5 | 9 | 6 | 4 | 4 | 6 | 7 | 8 |
| F23* | 6 | 2 | 6 | 6 | 5 | 6 | 4 | 5 | 6 | 5 | 4 | 3 | 7 | 4 | 0 | 10 | 4 | 4 | 7 | 6 | 7 | 6 | 9 | 2† |
| J143 | 8 | 14 | 6 | 7 | 9 | 5 | 8 | 4 | 12 | 6 | 5 | 7 | 8 | 9 | 7 | 11 | 0 | 11 | 10 | 8 | 11 | 9 | 18 | 8 |
| F8‡ | 4 | 10 | 6 | 5 | 10 | 7 | 8 | 6 | 8 | 6 | 7 | 7 | 13 | 11 | 10 | 8 | 7 | 7 | 0 | 11 | 10 | 8 | 18 | 7 |
| F10 | 4 | 12 | 8 | 6 | 12 | 7 | 9 | 7 | 9 | 7 | 7 | 7 | 14 | 11 | 11 | 10 | 9 | 8 | 0 | 13 | 11 | 10 | 18 | 5 |

Numbers listed refer to numbers of hybrid clones in Tables 2 and 3 showing discordance between presence of chromosomes indicated above and expression of antigens indicated on the left. Rearranged chromosomes not evaluated.
*Discordancies based on antigen-negative hybrid clones not included for hybrids derived from human cells not expressing antigen Q14 (AM, LM clones), AO122 (LNK, ANK, RC, RP clones), or F23 (NSK clones).
†Two additional hybrid clones, not listed in Table 3, were $F23^+$ and lacked the Y chromosome.
‡Antigen not expressed on cells growing in suspension; NSK-4 clone not included for F8 analysis.

Table 5. Chromosomal assignments of loci controlling expression of human cell surface antigens defined by monoclonal antibodies

| Chromosome | Gene | Antigen* |
|---|---|---|
| 2 | *MSK8* | L230 (gp145/100)† |
| 3 | *MSK9* | K15 (gp85)†‡ |
| 3 | *MSK10* | AJ425 |
| 5 | *MSK11* | SR84 (gp200/140) |
| 10 | *MSK12* | AJ2 (gp170/140/30)† |
| 11 | *MSK13* | Q14 (gp130) |
| 11 | *MSK14* | JF23 (gp90) |
| 15 | *MSK15* | SV13 (gp105) |
| 15 | *MSK16* | AO122 (gp265)† |
| 15 | *MSK17* | F23 (gp140) |
| 17§ | *MSK18* | J143 (gp140/30) |
| 19 | *MSK19* | F8 (gp95) |
| 19 | *MSK20* | F10 (gp50) |

Gene designations are according to rules adopted in ref. 1.
*gp, Glycoprotein; numbers represent $M_r \times 10^{-3}$ as determined by $NaDodSO_4$/PAGE.
†Additional or variable components depending on cell type tested.
‡Immunoprecipitation experiment not shown.
§Regional assignment to 17q22-qter.

Q14 (chromosome 11), and F8 (chromosome 19). For each of these antigens, we have identified a permissive rodent cell type that allows antigen expression in hybrids formed with antigen-expressing human cells. In the case of hybrids derived from human cell types that do not express antigen, both expressor and nonexpressor hybrid phenotypes can be generated, depending on the antigenic system and on the rodent cell partner. When $Q14^-$ MeWo melanoma cells are fused with a rodent cell known to permit expression of Q14 in fusions with $Q14^+$ human cells, no Q14 is expressed by hybrid cells containing the Q14-coding human chromosome 11 (MeWo cells and the MeWo hybrids were unreactive with AbQ14 and with antibodies to at least two additional epitopes of the gp130 molecule, described in ref. 14). In contrast, AO122 and F23 can be found in hybrids derived from nonexpressor human cells, with expression *vs.* nonexpression in hybrids depending on the rodent cell type used as the fusion partner. Thus, some rodent cells are capable of inducing AO122 or F23 antigen expression in hybrids and some lack this inducing activity. (Analysis of hybrids derived from $AO122^+$ or $F23^+$ human cells with rodent cells that do not induce antigen in hybrids derived from nonexpressor human cells is needed to show whether the noninducing rodent phenotype is also a nonpermissive phenotype.) The specificity of antigen induction (AO122 is induced in L-cell but not RAG hybrids; F23 is induced in L-cell but not N4TG-1 hybrids) suggests that the differentiation program of the rodent fusion partner actively regulates the expression of these cell surface traits. It is striking that among the hybrid clones tested, the rodent cell types inducing cell surface expression of AO122 and F23 correspond to the human cell types normally expressing these antigens (7, 10). Thus, the nonexpressor phenotype of human cells with regard to Q14 and AO122/F23 appears to be regulated in different ways, with AO122/F23 (but not Q14) expression capable of being induced by signals from the appropriate rodent cell type. The synthesis of human albumin and other liver-specific proteins in hybrids derived from fusions between human leukocytes or amniocytes and mouse hepatoma cells provides a precedent for the induction of silent traits in rodent–human somatic cell hybrids (15, 16).

Analysis of F8 demonstrates another level of control regulating antigen expression. The F8 distribution among NSK clones shows that N4TG-1 cells are permissive for F8 but that the F8 phenotype is conditional on the growth characteristics of the hybrid and is restricted to substrate-adherent hybrid cells. This restriction is seen both in rodent–human hybrids and in human cells, indicating that regulatory mechanisms affecting F8 are shared by mouse and human cells. Further studies are needed to determine whether the correlation between growth characteristics and F8 expression reflects a functional role of F8 in morphogenesis and cell adhesion or the coordinated expression of unrelated phenotypic traits.

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