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Workshop Report: Proposed Nomenclature for the Carcinoembryonic Antigen (CEA) Gene Family

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A 'CEA' workshop was held recently during the XVIIth ISOBM Meeting in Freiburg, September 18–22, 1989. A major purpose of the workshop was to propose a systematic nomenclature to be used by all interested participants in describing members of the CEA and pregnancy-specific β_1-glycoprotein (PSG) or Schwangerschaftsprotein 1 (SP1) gene and protein families. The following proposal which found general agreement from participants is offered for adoption by those working in the field. By way of introducing new names for previously described genes, we have included an appendix that lists both the new and the old designations for CEA and PSG family members. Inquiries and inconsistencies related to this proposal should be addressed to one of the authors.

CEA Gene and Protein Families

The CEA gene family (and the corresponding CEA protein family) are divided into the CEA and PSG subgroups based on sequences similarities. Gene members are named with a three-letter designation following conventions of the Human Gene Mapping Workshop 9.5 and applied genetic conventions. The names of newly characterized protein members should include their apparent molecular weight. All nonhuman CEA-like genes should be abbreviated CGM (for CEA gene-family member) preceded by a genus and species prefix, e.g. mmCGM for *Mus musculus* CGM.

CEA Subgroup

The genes encoding well-characterized proteins are named according to protein names, e.g. the CEA gene encodes the 180-kD CEA polypeptide, the NCA gene encodes both the 50- and 90-kD NCA polypeptide forms and the BGP (not BGP1 gene) gene encodes BGP1 protein(s). All other members of the CEA subgroup are given provisional assignments by the investigator of CGMn, where n represents a previously unused number. For example, the recently described cDNA clone which probably corresponds to the NCA95 protein is named CGM6.

PSG Subgroup

As for the CEA subgroup, PSG subgroup members will be designated PSGn. In order to avoid confusion, it was suggested that anyone who identifies a new member of this gene family can obtain a provisional number from one of the authors (W. Zimmermann). Where applicable, permanent assignments will be made at proposed annual CEA Workshops or as an ongoing process by the authors.

mRNA Variants

RNA variants or polyadenylation variants of CEA or PSG gene family members, as determined by cDNA cloning, or provisionally on the basis of exon structure from genomic DNA, will be designated by the addition of lower-case letters. For example, CEAa and CEAb represent polyadenylation variants of the single CEA genomic transcription unit, while BGPa, BGPb, BGPc and BGPd represent the alternate splice products of the BGP genomic transcription unit, and likewise describe the proteins they encode; newly discovered variants will be named in alphabetical sequence.

Domains

The derived polypeptide sequences of the CEA family members can be subdivided by sequence comparison into several regions which are supposed to represent domains or signal sequences. They can be characterized as containing:

(a) A *l*eader [L] sequence (not domain).

(b) An IgV-like or *N*-terminal [N] domain.

(c) IgC-like domains, comprising two different types designated A or B; the three repeating regions in CEA would be symbolized A1-B1, A2-B2, A3-B3, or most PSGs would show an A1-A2-B2 arrangement of IgC-like domains.

(d) Carboxy-terminal domains that are abbreviated as (i) M (for *m*embrane-associated sequence) for those CEA family members with a hydrophobic domain that is likely cleaved for phosphatidylinositol glycan (PIG) linkage to membranes, such as is found in CEA, NCA and CGM6 precursor proteins; (ii) C for carboxy-terminal domains such as are found in PSG proteins that do not have the characteristics of PIG-tailed sequences (designated C, for *C*-terminal sequence); (iii) TM for domains that have hydrophobic qualities that are likely to be *trans*membrane, and (iv) Cyt for carboxy-terminal domains that are likely to be *cyto*plasmatic, such as those found in BGP isoforms (e.g. Cyt1 and Cyt2, for the sequence of BGPa and BGPc, respectively).

Examples: The CEA precursor protein would have the linear domain sequence L-N-A1-B1-A2-B2-A3-B3-M, the BGP isoform BGPa L-N-A1-B1-A2-TM-Cyt1 and PSG1a L-N-A1-A2-B2-Ca.

Exons

Exons in genomic DNA are designated according to the regions or domains they contain; thus, the first exon of NCA, containing the 5′ untranslated region of the mRNA (5′UTR) and some of the leader sequence, would be 5′/L, and the second exon, containing the remainder of the leader sequence and the N-terminal domain would be designated L/N, etc.

Table 1. CEA and PSG gene family members

Old gene or clone name	New gene or RNA name	Old gene or clone name	New gene or RNA name
CEA subgroup		*PSG subgroup*	
CEA [1–4]	CEAa[1]	PSG93 [16], PSβG-D [17], hPSP11 [18], FL-NCA-2 [19], hPS3 [20], $PSG1_a$ [21]	PSG1a
CEA [5]	CEAb[2]	PSG16 [16]	PSG1b
NCA [4, 6–9]	NCA	PSβG-C [17]	PSG1c
hsCGM6 [10], GN-1 [11], M6 [12]	CGM6	FL-NCA-1 [22], $PSG1_d$ [21]	PSG1d
BGPI [13], TM-1 CEA [14]	BGPa	PSβG-E [17]	PSG2
TM-2 CEA [14]	BGPb	pSP1-i [23], hc17 [24], PS35 [25]	PSG3
TM-3 CEA [14]	BGPc	hsCGM4 [15], hHSP2 [18], PSG4 [21]	PSG4
TM-4 CEA [14]	BGPd	FL-NCA-3 [19], PSβG HL [26]	PSG5
hsCGM1 [15]	CGM1	hsCGM3 [15], PSG6 [21]	PSG6
hsCGM2[3] [15]	CGM2	PSG7 [27]	PSG7
		CGM35 [5]	PSG8
		$PS_{K\alpha}$ [28, 29]	PSG9
		PSG10 [29]	PSG10
		PS34 [25]	PSG11

[1] Short polyadenylation mRNA variant.
[2] Long polyadenylation mRNA variant.
[3] Although it was originally thought that this gene represents a separate entity more detailed evolutionary analyses indicate inclusion within the CEA subgroup [30].

A list of CEA and PSG gene family members, whose assignments are based on the conventions proposed above is presented in table 1.

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