

AD _____

Award Number: W81XWH-04-1-0634

TITLE: The Role of CRELD1 Isoform 9b in the Pathogenesis of Breast Cancer

PRINCIPAL INVESTIGATOR: Cheryl L. Maslen, Ph.D.

CONTRACTING ORGANIZATION: University of Oregon
Portland, OR 97239

REPORT DATE: October 2006

TYPE OF REPORT: Final

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release;
Distribution Unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

1. REPORT DATE (DD-MM-YYYY) 01-10-2006			2. REPORT TYPE Final		3. DATES COVERED (From - To) 30 SEP 2004 - 29 SEP 2006	
4. TITLE AND SUBTITLE The Role of CRELD1 Isoform 9b in the Pathogenesis of Breast Cancer					5a. CONTRACT NUMBER	
					5b. GRANT NUMBER W81XWH-04-1-0634	
					5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Cheryl L. Maslen, Ph.D. E-Mail: maslenc@ohsu.edu					5d. PROJECT NUMBER	
					5e. TASK NUMBER	
					5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of Oregon Portland, OR 97239					8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012					10. SPONSOR/MONITOR'S ACRONYM(S)	
					11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution Unlimited						
13. SUPPLEMENTARY NOTES						
14. ABSTRACT: Purpose: The goal is to develop a mouse model that expresses isoform 9b in mammary tissues, and to determine if CRELD1-9b causes or predisposes the mice to develop breast tumors, or participates in cancer progression. Scope: This study will determine if expression of CRELD1-9b contributes to the cause and/or progression of breast cancer. Information from this study will be used to better understand the relationship of CRELD1-9b to breast cancer tumor biology, and to develop it as a new marker for early detection of breast cancer or breast cancer progression. Since utilization of exon 9b appears to be unique to cancer cells it is thought to participate in the malignant process and hence would be a potentially viable target for therapeutic intervention. Major findings: We have tested two different mammalian expression vectors for expression of the CRELD1-9b under the control of the mouse mammary tumor virus (MMTV) promoter. The promoter is inducible, giving us control over mammary tissue-specific expression. One of the vectors exhibited superior performance in expressing CRELD1-9b.						
15. SUBJECT TERMS Cell adhesion, proliferation, migration, isoform						
16. SECURITY CLASSIFICATION OF:				17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON USAMRMC
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U	19b. TELEPHONE NUMBER (include area code)			

Table of Contents

Cover.....	
SF 298.....	2
Introduction.....	3
Body.....	3
Key Research Accomplishments.....	6
Reportable Outcomes.....	6
Conclusions.....	7
References.....	7
Appendices.....	7

INTRODUCTION: *CRELD1* is a recently identified gene that encodes a protein thought to be involved in cell adhesion/migration [Rupp et al., 2002]. *CRELD1* resides on chromosome 3p25.3, coinciding with a locus for familial breast cancer. Investigation of alternative splicing of *CRELD1* led to the discovery of a cryptic exon embedded in intron 9 (exon 9b) that when utilized produces an alternatively spliced product CRELD1-9b. Transcripts utilizing exon 9b are expressed by breast cancer cells, but not by normal mammary tissue. Normally CRELD1 is tethered to the cell surface by a two pass transmembrane domain. Utilization of exon 9b produces an altered full-length molecule by eliminating the transmembrane domain and replacing it with a unique carboxyl-terminus. This results in a molecule that is completely secreted into the extracellular space as it is no longer tethered to the cell membrane. Since the extracellular domain of the molecule is unaltered we propose that CRELD1-9b will act as a “decoy” molecule, modulating the function of membrane-bound CRELD1 by competitively binding ligand and making it unavailable to the membrane bound isoform. Based on the expression of CRELD1-9b by breast cancer cells, and the coincident location of the CRELD1 gene with a breast cancer susceptibility locus, we hypothesize that expression of CRELD1-9b plays a role in the development or progression of breast cancer. The purpose of this study is to develop a mouse model that expresses isoform 9b in mammary tissues, and to determine if CRELD1-9b causes or predisposes the mice to develop breast tumors, or participates in cancer progression. The scope of this study is to develop tools to determine if expression of CRELD1-9b contributes to the cause and/or progression of breast cancer.

BODY: The following data was generated in the 2004-2005 grant period. Due to technical hurdles which required a change in approach, and subsequent administrative difficulties in acquiring a necessary vector due to a lag in obtaining Material Transfer Agreement between institutions we were allowed a one-year no cost extension for this project. Those results will be provided in an upcoming final report.

Task 1. Create a mammalian expression construct that will express *CRELD1* isoform 9b under the control of the mammary gland-specific whey acidic protein (WAP) promoter (Months 1-2).

- a. Clone isoform 9b cDNA by RT-PCR from cDNA isolated from breast cancer cells (QuickClone cDNA™, Clontech) into a shuttle vector, sequence to confirm integrity of the clone (Month 1).

Progress – Task 1a completed as follows:

Isoform 9b cDNA was isolated using RT-PCR and cloned into a PCR product TOPO™ shuttle vector (Invitrogen). Insert positive clones were identified by restriction digestion and bi-directionally sequenced to confirm the identity and integrity of the insert (Figure 1).

```
gaattgcatcttatgcgccctttccccacccatccccacagcccctgcaatacccagtttgccctcttttgcttgtaataacg
cagatcccagcgccacggcaccttagaacagacctttttctttctcgcggtgggctgactccttcagtgaagcctctccac
gccctctatctgtaggtccccagcctgggtaaaagATGGCCCCATGGCCCCGAAGGGCCTAGTCCCAGCTGTGCTCTGGGGC
CTCAGCCTCTTCCTCAACCTCCCAGGACCTATCTGGCTCCAGCCCTCTCCACCTCCCCAGTCTTCTCCCCGCCTCAGCCCC
ATCCGTGTCATACCTGCCGGGGACTGGTTGACAGCTTTAACAAGGGCCTGGAGAGAACCATCCGGGACAACTTTGGAGGTGG
AAACTGCTGCTGGGAGGAAGAGAATTTGTCCAAATACAAAGACAGTGAGACCCGCTGGTAGAGGTGCTGGAGGGTGTGTGC
AGCAAGTCAGACTTCGAGTGCCACCGCTGCTGGAGCTGAGTGAGGAGCTGGTGGAGAGCTGGTGGTTTTACAAAGCAGCAGG
AGGCCCCGGACCTCTTCCAGTGGCTGTGCTCAGATTCCTGAAGCTCTGCTGCCCGCAGGCACCTTCGGGCCCTCCTGCCT
TCCCTGTCTGGGGGAACAGAGAGGCCCTGCGGTGGCTACGGGCAGTGTGAAGGAGAAGGGACACGAGGGGGCAGCGGGCAC
TGTGACTGCCAAGCCGGCTACGGGGGTGAGGCCCTGTGGCCAGTGTGGCCTTGGCTACTTTGAGGCAGAACGCAACGCCAGCC
ATCTGGTATGTTTCGGCTTGTTTTGGCCCTGTGCCGATGCTCAGGACCTGAGGAATCAAAGTGTGCAATGCAAGAAGGG
CTGGGCCCTGCATCACCTCAAGTGTGTAGACATTGATGAGTGTGGCACAGAGGGAGCCAACCTGTGGAGCTGACCAATTCTGC
GTGAACACTGAGGGCTCCTATGAGTGCCGAGACTGTGCCAAGGCCTGCCTAGGCTGCATGGGGGCAGGGCCAGGTGCGCTGTA
AGAAGTGTAGCCCTGGCTATCAGCAGGTGGGCTCCAAGTGTCTCGATGTGGATGAGTGTGAGACAGAGGTGTGTCCGGGAGA
```

GAACAAGCAGTGTGAAAACACCGAGGGCGGTTATCGCTGCATCTGTGCCGAGGGCTACAAGCAGATGGAAGGCATCTGTGTG
AAGGAGCAGATCCCAGGTGCATTCCCCATCTTAACCTGATTTAACCCCTGAAACAACCCGACGCTGGAAGTTGGGTTCTCATC
CCCACTCTACATATGTAATAATGAAGATGCAGAGAGATGAAGCTACTTTCCAGGGCTATATGGCAAGCAAGTCGCAAAGCT
GGGATCCCAATCCAGACAGTCTGACCGTGGAACGAGACTCATAACAGTCTCAGCAGGCTTCTTCTCAGAGATGAcagaagacg
agtgggtgggtgctgcagcagatggttctttggcatcatcatctgtgcactggccacgctggctgctaagggcgacttgggtgtt
caccgccatcttcattggggctgtggcggccatgactggctactgggtgtcagagcgcagtgaccgtgtgctggagggcttc
atcaagggcagataatcgcgccaccacctgtaggacctcctcccaccacgctgccccagagcttgggctgcctcctcctgc
tggacactcaggacagcttggtttatttttgagagtgggtaagcaccctacctgccttacagagcagcccaggtagccag
gcccggcagacaaggcccctggggtaaaaagtagccctgaaggtggataccatgagctcttcacctggcggggactggcag
gcttcacaatgtgtgaatttcaaaagtttttccttaatgggtggctgctagagctttggcccctgcttaggattaggtgggtcc
tcacaggggtggggccatcacagctcctcctgccagctgcatgctgccagttcctgttctgtgttcaccacatccccacac
cccatggcacttatttattcatctcaggaaataaagaaaggtcttggaaagt

Figure 1. Sequence of isoform 9b cDNA coding region. The start (ATG) and termination (TGA) codons are underlined. The 5' and 3' untranslated regions are in lower case letters, the coding region is in upper case letters. The total cDNA length is 2.1 kb, encoding a 422 amino acid protein.

b. Subclone isoform 9b cDNA into expression vector with WAP promoter (Month 2).

Progress – Task 1b completed as follows:

The cDNA was excised from the TOPO shuttle vector and subcloned into an expression vector under the control of the mammary gland-specific whey acid protein (WAP) promoter [Sternlicht et al., 1999] kindly provided by Dr. Werb. Clones with appropriate sized inserts were identified with restriction digestion.

c. DNA sequence analysis to confirm the clone sequence and integrity (Month 2).

Progress – Task 1c completed as follows:

Five positive clones were sequenced to confirm the insert identity and integrity. All five clones had proper inserts.

- d. Appended sub-task d. Upon advice from the investigators that provided the vector, the CRELD1-9b constructs were transfected into cultured mouse mammary epithelial cells (ATCC) to test for expression potential. Northern blot analysis indicated that none of the clones were expressing CRELD1-9b (data not shown). Consequently, an additional 10 clones were selected and sequenced to verify the inserts. These clones were individually transfected into the mouse mammary cells. No expression of CRELD1-9b was detected from any of the clones. Transfection efficiency of the cells was tested by transfection with a *lacZ* expressing construct. Post-transfection β -galactosidase staining indicated that transfection efficiency was high (>80%), indicating that poor transfection was not a problem and that this vector system was not suitable for this application.
- e. Appended sub-task e. In order to complete Task 1 we investigated the availability of other suitable expression vectors. Vectors that utilize the mouse mammary tumor virus (MMTV) promoter have been successfully used to express exogenous gene products specifically in mouse mammary tissues. We identified sources for three different vectors that use the MMTV promoter and are suitable for transgene expression. The MkbpA II construct was provided by Dr. Jeffrey Rosen, Baylor College of Medicine [Li et al., 2003]. This vector construct contains the MMTV-LTR fragment, which is transcriptionally active when induced with dexamethasone. The pBS-SK-MMTV and pUC18-MMTV-TVA vectors were obtained from Dr. Dezhong Liao at Wayne State University. Both express exogenous inserts from the MMTV promoter under the control of dexamethasone. The CRELD1-9b insert was individually subcloned into each of these vectors downstream of the MMTV promoters. Due to the

different cloning challenges presented by each vector, the MkbpA II vector construct (designated Mkbp-CRELD1-9b) was the first to be completed. Clones were selected as before and the inserts sequenced to confirm identity and integrity (data not shown).

- f. Appended sub-task f. DNA from selected Mkbp-CRELD1-9b plasmids was purified in sufficient quantities to perform expression assays using cultured mouse mammary epithelial cells as before. The cells were transiently transfected with the expression constructs and the cells culture in the presence (+) and absence (-) of dexamethasone to induce the promoter. Northern blot analysis was used to determine if induced *CRELD1-9b* expression could be detected. Figure 2 shows a northern blot displaying induction of *CRELD1-9b* expression from this construct.

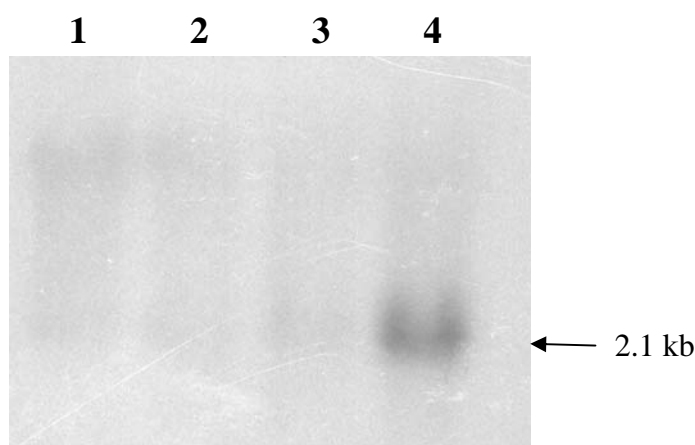


Figure 2. Northern blot analysis of RNA isolated from culture mouse mammary epithelial cells using a probe that detects *CRELD1-9b*. This probe does not cross-react with other *CRELD1* isoforms. Lane 1 contained the RNA from cells that were transfected with the MkbpA II vector with no insert (“empty vector) cultured in the absence of dexamethasone. Lane 2 contained RNA from cells transfected with empty vector and cultured in the presence of dexamethasone. Lane 3 contained RNA from cells transfected with the Mkbp-CRELD1-9b construct and cultured in the absence of dexamethasone. Lane 4 contained RNA from cells transfected with the Mkbp-CRELD1-9b construct and cultured in the presence of dexamethasone. *CRELD1-9b* expression was detected only in lane 4. The 2.1 kb band is consistent with the expected size for *CRELD1-9b* mRNA. This demonstrates that the Mkbp-CRELD1-9b construct is expressed by mouse mammary epithelial cells under induction of the exogenous MMTV promoter when induced with dexamethasone. This experiment also demonstrated that there is tight control of expression of the endogenous construct.

KEY RESEARCH ACCOMPLISHMENTS: Task 1 has been completed using an alternative approach that resulted in the successful construction of a mammalian expression vector system that is capable of transcribing exogenous *CRELD1-9b* under the control of dexamethasone induction.

REPORTABLE OUTCOMES: The preliminary results from this work were reported in an abstract and poster presentation at the Era of Hope 2005 Department of Defense Breast Cancer Program, Philadelphia PA, June, 2005.

CONCLUSION: A suitable expression system has been created that can be used to target expression of CRELD1-9b to mouse mammary epithelial cells in vivo.

REFERENCES:

Li Y, Welm B, Podsypanina K, Huang S, Chamorro M, Zhang X, Rowlands T, Egeblad M, Cowin P, Werb Z, Tan LK, Rosen JM, Varmus HE. 2003. Evidence that transgenes encoding components of the Wnt signaling pathway preferentially induce mammary cancers from progenitor cells. *Proc Natl Acad Sci* 100:15853-15858.

Rupp PA, Fouad GT, Egelston CA, Reifsteck CA, Olson SB, Knosp WM, Glanville RW, Thornburg KL, Robinson SW, Maslen CL. 2002. Identification, genomic organization and mRNA expression of CRELD1, the founding member of a unique family of matricellular proteins. *Gene* 293:47-57.

Sternlicht MD, Lochter A, Sympon CJ, Huey B, Rougier JP, Gray JW, Pinkel D, Bissell MJ, Werb Z. 1999. The stromal proteinase MMP3/stromelysin-1 promotes mammary carcinogenesis. *Cell* 98:137-146.

APPENDICES: None

SUPPORTING DATA: Included in the **BODY** section.