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14. ABSTRACT
We hypothesize that tamoxifen, trifluoperazine or combined tamoxifen-trifluoperazine therapy will effectively treat established neurofibromas and MPNSTs and prolong survival. We also hypothesize that prophylactic treatment with these drugs will prevent neurofibroma and MPNST pathogenesis. To test these hypotheses, we will: 1) determine whether tamoxifen, trifluoperazine or tamoxifen-trifluoperazine therapy effectively inhibits tumor cell proliferation and survival in established neurofibromas and MPNSTs and prolongs the survival of mice with these tumors and 2) determine whether prophylactic therapy with tamoxifen and/or trifluoperazine will prevent the pathogenesis of neurofibromas and MPNSTs. These preclinical trials will be performed using robust mouse models of neurofibroma (Krox20-Cre;Nf1flox/- mice) and MPNST (P0-GGFβ3;Trp53+/- mice) pathogenesis. In Aim 1, mice with established neurofibromas and MPNSTs will be challenged with vehicle, tamoxifen, trifluoperazine or combined tamoxifen-trifluoperazine therapy and we will establish which of these treatments maximally inhibits tumor cell proliferation and survival and improves long term survival. In Aim 2, we will begin treatment of Krox20-Cre;Nf1flox/- and P0-GGFβ3;Trp53+/- mice with vehicle, tamoxifen, trifluoperazine or tamoxifen-trifluoperazine prior to the development of tumors and continue this treatment to 15 months of age. We will then determine if these prophylactic therapies prevent neurofibroma and MPNST pathogenesis or reduce the number and size of tumors in our mice.

15. SUBJECT TERMS-

Nothing listed

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INTRODUCTION

We hypothesize that tamoxifen, trifluoperazine or combined tamoxifen-trifluoperazine therapy will effectively treat established neurofibromas and MPNSTs and prolong survival. We also hypothesize that prophylactic treatment with these drugs will prevent neurofibroma and MPNST pathogenesis. To test these hypotheses, we will: 1) determine whether tamoxifen, trifluoperazine or tamoxifen-trifluoperazine therapy effectively inhibits tumor cell proliferation and survival in established neurofibromas and MPNSTs and prolongs the survival of mice with these tumors and 2) determine whether prophylactic therapy with tamoxifen and/or trifluoperazine will prevent the pathogenesis of neurofibromas and MPNSTs. These preclinical trials will be performed using robust mouse models of neurofibroma (Krox20-Cre;*Nf1*$^{flox/-}$ mice) and MPNST (P_0-GGFβ3;*Trp53*$^{+/-}$ mice) pathogenesis. In Aim 1, mice with established neurofibromas and MPNSTs will be challenged with vehicle, tamoxifen, trifluoperazine or combined tamoxifen-trifluoperazine therapy and we will establish which of these treatments maximally inhibits tumor cell proliferation and survival and improves long term survival. In Aim 2, we will begin treatment of Krox20-Cre;*Nf1*$^{flox/-}$ and P_0-GGFβ3;*Trp53*$^{+/-}$ mice with vehicle, tamoxifen, trifluoperazine or tamoxifen-trifluoperazine prior to the development of tumors and continue this treatment to 15 months of age. We will then determine if these prophylactic therapies prevent neurofibroma and MPNST pathogenesis or reduce the number and size of tumors in our mice.

KEYWORDS: NF1; neurofibroma; malignant peripheral nerve sheath tumor; calmodulin inhibitor; estrogen receptor inhibitor; therapeutic targets.

ACCOMPLISHMENTS

Our progress is on track with our original approved Statement of Work. However, we have been forced to modify our original experimental plan as we have encountered unexpected difficulty with the imaging modalities that we originally proposed to use to identify mice with tumors. We are now using an alternative approach to identifying the mice of interest (see below for a detailed explanation) and are bolstering our original studies with an additional mouse model that is more amenable to our modified approach.

Below, I will first indicate the two Specific Aims of our project and the tasks within each Aim. I will then break out the tasks that were planned for the current funding period and describe the progress we have made in each of these tasks.

Specific Aims and Studies in Approved Statement of Work

Specific Aim 1: Test the hypothesis that tamoxifen, trifluoperazine or tamoxifen-trifluoperazine therapy effectively inhibits tumor cell proliferation and survival in established neurofibromas and MPNSTs and prolongs the survival of mice with these tumors.

Specific Aim 2: Test the hypothesis that prophylactic therapy with tamoxifen and/or trifluoperazine will prevent the pathogenesis of neurofibromas and MPNSTs.

Task 1. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in MPNST bearing P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 1-36):

a. Obtain regulatory review and approval for these studies (months 1-2)
b. Perform studies with tamoxifen and trifluoperazine to establish maximum tolerated doses of these agents in C57BL/6 mice (months 2-4)
c. Establish cohorts of P_0-GGFβ3;*Trp53*$^{+/-}$ mice, identify MPNST bearing mice with PET scans and randomize mice into cohorts for treatment with vehicle, tamoxifen, trifluoperazine or tamoxifen and trifluoperazine (months 3-18)

d. Evaluate the effectiveness of the therapeutic regimens described in c (months 12-18)
e. Perform diagnostic, histochemical and immunohistochemical analyses of proliferation and cell death in tumor cohorts (months 18-36)

Task 2. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in neurofibroma bearing Krox20-Cre;*Nf1*$^{flox/-}$ mice (months 1-36):

a. Obtain regulatory review and approval for these studies (months 1-2)
b. Establish cohorts of Krox20-Cre;*Nf1*$^{flox/-}$mice, identify neurofibroma bearing mice with MRI scans and randomize mice into cohorts for treatment with vehicle, tamoxifen, trifluoperazine or tamoxifen and trifluoperazine (months 3-18)
c. Evaluate the effectiveness of the therapeutic regimens described in c (months 12-18)
d. Perform diagnostic, histochemical and immunohistochemical analyses of proliferation and cell death in tumor cohorts (months 18-36)

Task 3. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy extends the survival of MPNST bearing P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 1-36):

a. Obtain regulatory review and approval for these studies (months 1-2)
b. Establish cohorts of P_0-GGFβ3;*Trp53*$^{+/-}$ mice, identify MPNST bearing mice with PET scans and randomize mice into cohorts for treatment with vehicle, tamoxifen, trifluoperazine or tamoxifen and trifluoperazine (months 3-18)
c. Evaluate the effectiveness of the therapeutic regimens described in c (months 12-18)
d. Perform diagnostic, histochemical and immunohistochemical analyses of proliferation and cell death in tumor cohorts (months 18-36)

Task 4. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in neurofibroma bearing Krox20-Cre;*Nf1*$^{flox/-}$ mice (months 1-36):

a. Obtain regulatory review and approval for these studies (months 1-2)
b. Establish cohorts of Krox20-Cre;*Nf1*$^{flox/-}$mice, identify neurofibroma bearing mice with MRI scans and randomize mice into cohorts for treatment with vehicle, tamoxifen, trifluoperazine or tamoxifen and trifluoperazine (months 3-18)
c. Evaluate the effectiveness of the therapeutic regimens described in b (months 12-18)
d. Perform diagnostic, histochemical and immunohistochemical analyses of proliferation and cell death in tumors (months 18-36)

Task 5. To determine whether prophylactic therapy with tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy prevents neurofibroma and MPNST pathogenesis in Krox20-Cre;*Nf1*$^{flox/-}$ and P_0-GGFβ3;*Trp53*$^{+/-}$ mice, respectively (months 18-36):

a. Obtain regulatory review and approval for these studies (months 1-2)
b. Establish cohorts of Krox20-Cre;*Nf1*$^{flox/-}$ and P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 18-22)
c. Treat cohorts with vehicle, tamoxifen, trifluoperazine or tamoxifen and trifluoperazine (months 22-36)
d. Evaluate the effectiveness of the therapeutic regimens described in b (months 22-36)
e. Perform diagnostic, histochemical and immunohistochemical analyses of proliferation and cell death in tumors, if tumors are present (months 30-36)

All five of the Tasks delineated above shared a common initial subtask, which was:

Task 1. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in MPNST bearing P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 1-36):

a. Obtain regulatory review and approval for these studies (months 1-2; **completed**)

Task 2. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in neurofibroma bearing Krox20-Cre;*Nf1*$^{flox/-}$ mice (months 1-36):

a. Obtain regulatory review and approval for these studies (months 1-2; **completed**)

Task 3. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy extends the survival of MPNST bearing P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 1-36):

a. Obtain regulatory review and approval for these studies (months 1-2; **completed**)

Task 4. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in neurofibroma bearing Krox20-Cre;*Nf1*$^{flox/-}$ mice (months 1-36):

a. Obtain regulatory review and approval for these studies (months 1-2; **completed**)

Task 5. To determine whether prophylactic therapy with tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy prevents neurofibroma and MPNST pathogenesis in Krox20-Cre;*Nf1*$^{flox/-}$ and P_0-GGFβ3;*Trp53*$^{+/-}$ mice, respectively (months 18-36):

a. Obtain regulatory review and approval for these studies (months 1-2; **completed**)

We received approval for this animal protocol from the Medical University of South Carolina's IACUC on June 25, 2015. ***Please note, however, that ACURO did not approve this protocol until November 16, 2015.*** This research project exclusively involves experiments utilizing genetically engineered mouse models. Consequently, we were not allowed to start actual experimental work towards the goals of this project until we had obtained ACURO approval.

Task 1. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in MPNST bearing P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 1-36):

b. Perform studies with tamoxifen and trifluoperazine to establish maximum tolerated doses of these agents in C57BL/6 mice (months 2-4; **completed**)

Because we have extensive previous experience with preclinical trials in mouse models, we are well aware that the maximal tolerated dose (MTD) for a specific drug often differs in mice with different genetic backgrounds. Consequently, before beginning the full study, it was necessary that we will first determine the MTD for tamoxifen and trifluoperazine in C57BL/6 mice (the genetic background of the Krox20-Cre;*Nf1*$^{flox/-}$ and P_0-GGFβ3;*Trp53*$^{+/-}$ mice that are being used for our preclinical trials) and, if necessary, adjust the doses that will be used in our studies following the guidelines outlined in our preliminary studies. We began by determining the MTD for tamoxifen and trifluoperazine when administered via intraperitoneal injection to C57BL/6J mice, following a ''3 + 3'' regimen. Under this regimen, groups of three mice were treated with each agent for 1 month, following a dosing regimen in which animals received 5 consecutive days of intraperitoneally injected drug, with 2 days rest in between. This dose was increased in a step-wise fashion until adverse effects such as weight loss, alterations in

grooming behavior, or death were observed. At this point, 3 additional mice were treated with the same dose to verify its effect on these animals; if it has the same effect, the dose immediately below the dose producing toxic effects is considered to be the maximum tolerated dose. For all mice, blood was collected via cardiac puncture, centrifuged to separate the cells from the serum and the serum was frozen in aliquots at -80°C if needed in the future to measure levels of markers of the function of key organs [e.g., liver (ALT and AST enzyme levels) and kidney (blood urea nitrogen (BUN) and creatinine)]. Complete necropsies were performed on all mice and detailed histologic analyses were performed on organs most commonly affected by therapeutic agents (brain, liver, kidney, small and large intestine, lung). We found that tamoxifen administered at the maximum dose we tested primarily had negative effects on small and large intestine, which was evident as blunting of intestinal villi. We did not see any overt histologic changes in any of the tissues we examined from mice receiving the MTD of trifluoperazine. We established that the maximal tolerated dose of tamoxifen in C57BL/6J mice was 30 mg/kg and that for trifluoperazine was 20 mg/kg.

The next subtasks in each of the tasks likewise shared the common goal of establishing the large cohorts of genetically engineered mice with the appropriate genotype and, for Tasks 1-4, evaluating the effectiveness of these regimens:

Task 1. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in MPNST bearing P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 1-36):

c. Establish cohorts of P_0-GGFβ3;*Trp53*$^{+/-}$ mice, identify MPNST bearing mice with PET scans and randomize mice into cohorts for treatment with vehicle, tamoxifen, trifluoperazine or tamoxifen and trifluoperazine (months 3-18; **in progress**)
d. Evaluate the effectiveness of the therapeutic regimens described in c (months 12-18**; in progress**)

Task 2. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in neurofibroma bearing Krox20-Cre;*Nf1*$^{flox/-}$ mice (months 1-36):

b. Establish cohorts of Krox20-Cre;*Nf1*$^{flox/-}$mice, identify neurofibroma bearing mice with MRI scans and randomize mice into cohorts for treatment with vehicle, tamoxifen, trifluoperazine or tamoxifen and trifluoperazine (months 3-18; **in progress**)
c. Evaluate the effectiveness of the therapeutic regimens described in c (months 12-18; **in progress**)

Task 3. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy extends the survival of MPNST bearing P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 1-36):

b. Establish cohorts of P_0-GGFβ3;*Trp53*$^{+/-}$ mice, identify MPNST bearing mice with PET scans and randomize mice into cohorts for treatment with vehicle, tamoxifen, trifluoperazine or tamoxifen and trifluoperazine (months 3-18; **in progress**)
c. Evaluate the effectiveness of the therapeutic regimens described in c (months 12-18 **in progress**)

Task 4. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in neurofibroma bearing Krox20-Cre;*Nf1*$^{flox/-}$ mice (months 1-36):

b. Establish cohorts of Krox20-Cre;*Nf1*$^{flox/-}$mice, identify neurofibroma bearing mice with MRI scans and randomize mice into cohorts for treatment with vehicle, tamoxifen, trifluoperazine or tamoxifen and trifluoperazine (months 3-18; **in progress**)

c. Evaluate the effectiveness of the therapeutic regimens described in b (months 12-18; **in progress**)

For the interim analysis, our biostatistician recommended that we look for an effect size of at least 2 (following the measures outlined below) in the treatment versus control groups. One-way ANOVA with a Dunnett test for adjustment of pair-wise comparisons (compared to the control group) will be used for sample size calculation. We determined that 20 mice per group would give us 95% power to detect at least an effect size of 2 between the treatment groups and the control (vehicle) group, given 5% type I error. We also recognize NIH's recent recommendation that animal experiments include both male and female animals to avoid a sex bias. Consequently, our original experimental design was that each cohort would include 20 male and 20 female mice; male and female mice will be analyzed both independently and in a stratified fashion. In accordance with these goals, we have established the full cohort of P_0-GGFβ3;*Trp53*$^{+/-}$ mice necessary for Tasks 1 and 3 and are currently following them to identify MPNST-bearing mice which are then randomized into treatment cohorts. We have established the Krox20-Cre;*Nf1*$^{flox/-}$mice necessary for Tasks 2 and 4; work with these mice is still ongoing, as the genotype of these animals is more complicated than that of P_0-GGFβ3;*Trp53*$^{+/-}$ mice and thus takes longer to generate. Krox20-Cre;*Nf1*$^{flox/-}$mice are also being followed to identify neurofibroma-bearing mice which are then randomized into treatment cohorts.

In our initial research plan, we proposed identifying tumor-bearing mice using a combination of radiologic imaging (PET scans for MPNSTs, MRI for neurofibromas) and monitoring of clinical signs that we had established as reliable indicators of tumorigenesis in several of our previously published studies. However, a large series of studies we have now performed with our genetically engineered mouse models have convinced us that neither PET or MRI has sufficient specificity to reliably identify tumor-bearing mice (i.e., while these modalities can recognize the neoplasms of interest, our necropsy examinations indicate that these imaging methods can be fooled, particularly when attempting to identify tumors early in their course). We have also noted that this occurs most commonly when the results of the imaging studies and examination of clinical signs are discordant; the clinical signs are simply more reliable. In addition, our imaging facility has been crippled by problems with their instrumentation. Consequently, we have modified our approach to identifying tumor-bearing mice and are now focusing on using clinical signs for the initial identification of tumor-bearing mice. In this circumstance, our primary readout for drug effectiveness will be survival times following the initiation of therapy and changes in proliferation and apoptotic indices as originally proposed.

Having said that, though, we still think that it is advantageous to follow post-treatment MPNST sizes in our preclinical trials. Consequently, we will supplement our studies with P_0-GGFβ3;*Trp53*$^{+/-}$ mice with trials in *Nf1*$^{+/-}$; *p53*$^{+/-}$ mice, a model of NF1-associated MPNSTs that is widely used and accepted by the NF research community. This well-studied mouse model develops MPNSTs with 100% penetrance and with a short latency (3-6 months of age). Further, MPNSTs develop at superficial sites in *Nf1*$^{+/-}$; *p53*$^{+/-}$ mice and thus do not require imaging for tumor detection; these tumors are instead easily palpable and can be measured with calipers (in contrast to P_0-GGFβ3;*Trp53*$^{+/-}$ mice, which mainly develop trigeminal tumors), which is advantageous for assessing tumor response to therapy. We will begin drug treatment in *Nf1*$^{+/-}$; *p53*$^{+/-}$ mice when there is approximately a 1.5 cm^3 palpable tumor. Of note, *Nf1*$^{+/-}$; *p53*$^{+/-}$ mice are also on a C57BL/6 background so the MTDs that we have established for tamoxifen and trifluoperazine will also be applicable to this model.

Task 5. To determine whether prophylactic therapy with tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy prevents neurofibroma and MPNST pathogenesis in Krox20-Cre;*Nf1*$^{flox/-}$ and P_0-GGFβ3;*Trp53*$^{+/-}$ mice, respectively (months 18-36):

b. Establish cohorts of Krox20-Cre;*Nf1*$^{flox/-}$ and P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 18-22)

In our original grant application, we had proposed to establish the cohorts of Krox20-Cre;*Nf1*$^{flox/-}$ and P_0-GGFβ3;*Trp53*$^{+/-}$ mice required for this Task in the latter half of this project. However, in light of the delay in getting our animal protocol approved by ACURO, we went ahead and began establishing these cohorts. In light of our current experience with Krox20-Cre;*Nf1*$^{flox/-}$ mice, we also plan to begin the prophylactic long-term drug treatments at a slightly later age than we originally proposed. Krox20-Cre;*Nf1*$^{flox/-}$ mice survive for approximately 11-12 months with morbidity beginning around 8 months. We had initially proposed starting drug treatment for these studies at 6 weeks of age. In the best interest of the animals, we will instead begin treatment 2 months prior to onset of morbidity for both mouse models to reduce the trauma to the mice from IP drug treatment.

Tasks 1-4 indicated below are planned for the later phases of this project and will be performed in the upcoming funding period. Task 5 is already underway:

Task 1. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in MPNST bearing P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 1-36):

--Perform diagnostic, histochemical and immunohistochemical analyses of proliferation and cell death in tumor cohorts (months 18-36)

Task 2. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in neurofibroma bearing Krox20-Cre;*Nf1*$^{flox/-}$ mice (months 1-36):

--Perform diagnostic, histochemical and immunohistochemical analyses of proliferation and cell death in tumor cohorts (months 18-36)

Task 3. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy extends the survival of MPNST bearing P_0-GGFβ3;*Trp53*$^{+/-}$ mice (months 1-36):

--Perform diagnostic, histochemical and immunohistochemical analyses of proliferation and cell death in tumor cohorts (months 18-36)

Task 4. To determine whether tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy inhibits tumor cell proliferation and survival in neurofibroma bearing Krox20-Cre;*Nf1*$^{flox/-}$ mice (months 1-36):

--Perform diagnostic, histochemical and immunohistochemical analyses of proliferation and cell death in tumors (months 18-36)

Task 5. To determine whether prophylactic therapy with tamoxifen, trifluoperazine or combined tamoxifen/trifluoperazine therapy prevents neurofibroma and MPNST pathogenesis in Krox20-Cre;*Nf1*$^{flox/-}$ and P_0-GGFβ3;*Trp53*$^{+/-}$ mice, respectively (months 18-36):

--Treat cohorts with vehicle, tamoxifen, trifluoperazine or tamoxifen and trifluoperazine (months 22-36)

--Evaluate the effectiveness of the therapeutic regimens described in b (months 22-36)

--Perform diagnostic, histochemical and immunohistochemical analyses of proliferation and cell death in tumors, if tumors are present (months 30-36)

Opportunities for Training and Professional Development

Nothing to Report

Dissemination of Results to Communities of Interest

Nothing to Report

Plan during the Next Reporting Period to Accomplish Goals

As indicated by the research plan outlined above, the experiments we have begun are relatively long term (15-18 month) experiments. Consequently, during the next reporting period, we will continue to follow the cohorts that we have established and assess the effectiveness of the therapeutic regimens that we are testing. We anticipate that we will be able to obtain information as to whether these regimens have effects on animal survival and tumor mass; more detailed assessments of parameters such as the impact these regimens have on tumor cell proliferation and survival are planned for the later stages of this project. We will also be continuing the prophylactic regimens that are proposed as Task 5.

IMPACT

Impact on the development of the principal discipline(s) of the project

Nothing to Report

Impact on other disciplines

Nothing to Report

Impact on technology transfer

Nothing to Report

Impact on society beyond science and technology

Nothing to Report

CHANGES/PROBLEMS

Changes in approach and reasons for change

As noted above, we have encountered unexpected problems with our imaging modalities for tumor identification. We will be using our previously described clinical signs to identify tumor-bearing mice instead.

Actual or anticipated problems or delays and actions or plans to resolve them

As noted above, we did experience a delay in getting ACURO to approve our animal protocol. As a result of this delay, we have moved up our schedule for Task 5, which will ensure that we complete this task during the funding period of this grant.

Changes that had a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

Nothing to Report

PRODUCTS

MANUSCRIPTS, ABSTRACTS and PRESENTATIONS

Manuscripts

Carroll SL. The challenge of cancer genomics in rare nervous system neoplasms: malignant peripheral nerve sheath tumors as a paradigm for cross-species comparative oncogenomics. *The American Journal of Pathology* 2016; 186(3): 464-477. PMID: 26740486 PMCID: PMC4816695

Hanemann CO, Blakeley JO, Nunes FP, Robertson K, Stemmer-Rachamimov A, Mautner V, Kurtz A, Ferguson M, Widemann BC, Evans DG, Ferner R, **Carroll SL**, Korf B, Wolkenstein P, Knight P, Plotkin SR and the REiNS International Collaboration. Current status and recommendations for biomarkers and biobanking in neurofibromatosis. *Neurology* 2016; 87(7 Supplement 1): S40-48. DOI: 10.1212/WNL.0000000000002932. PMID: 27527649

Wolkenstein P, Stemmer-Rachamimov A, Ortonne N, Korf BR, Plotkin S, Riccardi VM, Miller DC, Huson S, **Carroll SL**, Jackson R, Stathis M, Verma S, , Blakeley JO. Current definitions for cutaneous neurofibromas. 2017 (Submitted).

Abstracts

Nothing to Report

Presentations

"Molecular Mechanisms Driving the Pathogenesis of NF1-Associated PNS Neoplasms", MUSC Department of Pathology and Laboratory Medicine Faculty Grand Rounds (June 22, 2016)

"Neurofibromatosis Type 1 Syndrome and Associated Tumors", International Society of Bone and Soft Tissue Pathology Symposium on "Tumor Syndromes in Bone and Soft Tissue Pathology", United States and Canadian Academy of Pathologists 106th Annual Meeting (San Antonio, TX; March 5, 2017)

LICENSES APPLIED FOR AND/OR ISSUED

Nothing to Report

DEGREES OBTAINED THAT ARE SUPPORTED BY THIS AWARD

Nothing to Report

DEVELOPMENT OF CELL LINES, TISSUE OR SERUM REPOSITORIES

Nothing to Report

DATABASES AND ANIMAL MODELS

Nothing to Report

FUNDING APPLIED FOR BASED ON WORK SUPPORTED BY THIS AWARD

Nothing to Report

EMPLOYMENT OR RESEARCH OPPORTUNITIES APPLIED FOR AND/OR RECEIVED BASED ON EXPERIENCE/TRAINING SUPPORTED BY THIS AWARD

Nothing to Report

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

Name:	*Steve Carroll*
Project Role:	*Principle Investigator*
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	*8*
Contribution to Project:	*No Change*
Funding Support:	

Name:	*Ann-Marie Broome*
Project Role:	*Co-Investigator*
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	*8*
Contribution to Project:	*No Change*
Funding Support:	

Name:	*Stuart Worley*
Project Role:	*Research Specialist*
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	*8*
Contribution to Project:	*No Change*
Funding Support:	

Name:	*Suraj Dixit*
Project Role:	*Post-Doc*
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	*8*
Contribution to Project:	*No Change*
Funding Support:	

Name:	*Jody Longo*
Project Role:	*Scientist*
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	*8*
Contribution to Project:	*No Change*
Funding Support:	

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Nothing to Report

What other organizations were involved as partners?

Nothing to Report

Financial support;

- **In-kind support**
- **Facilities**
- **Collaboration**

Nothing to Report

Personnel exchanges

Nothing to Report

Other

Nothing to Report

Special Reporting Requirements

Nothing to Report

APPENDICES

Appendix Item 1: **Carroll SL**. The challenge of cancer genomics in rare nervous system neoplasms: malignant peripheral nerve sheath tumors as a paradigm for cross-species comparative oncogenomics. *The American Journal of Pathology* 2016; 186(3): 464-477. PMID: 26740486 PMCID: PMC4816695

Appendix Item 2: Hanemann CO, Blakeley JO, Nunes FP, Robertson K, Stemmer-Rachamimov A, Mautner V, Kurtz A, Ferguson M, Widemann BC, Evans DG, Ferner R, **Carroll SL**, Korf B, Wolkenstein P, Knight P, Plotkin SR and the REiNS International Collaboration. Current status and recommendations for biomarkers and biobanking in neurofibromatosis. *Neurology* 2016; 87(7 Supplement 1): S40-48. DOI: 10.1212/WNL.0000000000002932. PMID: 27527649