

2020

Insights into Gene Expression and the Influence of Regulatory Mechanisms within Meningioma - A Bioinformatic Approach

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Carr, L. (2020) 'Insights into Gene Expression and the Influence of Regulatory Mechanisms within Meningioma - A Bioinformatic Approach', The Plymouth Student Scientist, 13(1), p. 1-27.
<http://hdl.handle.net/10026.1/16503>

The Plymouth Student Scientist
University of Plymouth

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Supplementary Material

Supplementary Material 1- Full list of transcription factor and miRNAs that have potential influence on the observed gene expression of Grade 1 v.s Grade 3. Highlighted in orange are the shared miRNA found in both groups. Pax4 is highlighted in purple and FOX transcription factor family are highlighted in blue.

| GEO2R TF | X2K TF downregulated genes | X2K TF upregulated genes | GSEA TF | GSEA miRNA |
|----------|----------------------------|--------------------------|--------------------------|---|
| LMO4 | UBTF | E2F4 | E2F1DP1_01 | CTCAGGG_MIR125B_MIR125A |
| NFIA | SMC3 | SIN3A | SGCGSSAAA_E2F1DP2_01 | ATCATGA_MIR433 |
| ZFH3 | RFX5 | MAX | CCGNMNTNACG_UNKNOWN | GACAGGG_MIR339 |
| SIX2 | AR | MYC | E2F4DP2_01 | GCAAGGA_MIR502 |
| CREBRF | SMAD4 | FOXM1 | KTGGYRSGAA_UNKNOWN | GTCAGGA_MIR378 |
| SMAD7 | USF2 | NFYA | E2F_Q3_01 | AATGTGA_MIR23A_MIR23B |
| FOXJ3 | NFE2L2 | NFYB | E2F1DP1RB_01 | AGGAAGC_MIR5163P |
| SMAD9 | TRIM28 | E2F6 | MYAATNNNNNNNGGC_UNKNOWN | CTCTGGA_MIR520A_MIR525 |
| FOXP1 | SOX2 | E2F1 | GGAANCGGAANY_UNKNOWN | ACACTGG_MIR199A_MIR199B |
| MEF2C | TCF3 | GABPA | GKCGCNNNNNNTGAYG_UNKNOWN | GTGCCTT_MIR506 |
| AFF1 | ZKSCAN1 | ELF1 | TGCCAAR_NF1_Q6 | GCATTTG_MIR105 |
| PHTF1 | TRIM28 | MYC | MYOGENIN_Q6 | TGCTGCT_MIR15A_MIR16_MIR15B_MIR195_MIR424_MIR497 |
| ZMYM6 | USF1 | CREB1 | WGTTNNNNNAAA_UNKNOWN | CAGTATT_MIR200B_MIR200C_MIR429 |
| GPBP1L1 | FOXA1 | TAF1 | PAX4_02 | ACCAAAG_MIR9 |
| RERE | GATA2 | BRCA1 | CTTTAAR_UNKNOWN | CTTTGTA_MIR524 |
| TAF12 | ESR1 | ATF2 | YKACATTT_UNKNOWN | AAGCCAT_MIR135A_MIR135B |
| BMPR1A | RELA | PML | TAATTA_CHX10_01 | TGCTTTG_MIR330 |
| SNAI3 | ZC3H11A | CREB1 | IRF2_01 | GCACTTT_MIR175P_MIR20A_MIR106A_MIR106B_MIR20B_MIR519D |
| MLXIPL | ZNF384 | IRF3 | HNF4ALPHA_Q6 | TGAATGT_MIR181A_MIR181B_MIR181C_MIR181D |
| SCMH1 | ZMIZ1 | SP1 | SRY_01 | AACATTC_MIR4093P |
| TBR1 | SUZ12 | FOS | | |
| ZKSCAN5 | TP63 | YY1 | | |
| SLC2A4RG | ERG | NRF1 | | |

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|--------------|--------------|---------|--|--|
| UBN1 | FOXP2 | SIX5 | | |
| ZNF133 | TCF3 | BCLAF1 | | |
| ZNF207 | CTCF | ZNF384 | | |
| AHCTF1 | IRF1 | FLI1 | | |
| SCML2 | MYOD1 | ZBTB33 | | |
| FOXM1 | NANOG | SP2 | | |
| RAI1 | FOS | ZMIZ1 | | |
| E2F2 | NRF1 | STAT3 | | |
| REXO4 | SUZ12 | USF1 | | |
| MYBL1 | EGR1 | PBX3 | | |
| GATAD2A | SIX5 | USF2 | | |
| E2F7 | ZEB1 | TAF7 | | |
| KDM5B | STAT3 | KLF4 | | |
| PTTG1 | BRCA1 | RFX5 | | |
| | CHD1 | ETS1 | | |
| | GATA1 | NR2C2 | | |
| | CBX3 | ZBTB7A | | |
| | ZBTB7A | CBX3 | | |
| | EZH2 | SRF | | |
| | REST | YY1 | | |
| | SALL4 | EGR1 | | |
| | NFIC | IRF1 | | |
| | IRF3 | SPI1 | | |
| | RCOR1 | KAT2A | | |
| | TP53 | CHD1 | | |
| | SPI1 | ERG | | |
| | STAT3 | TCF7L2 | | |
| | POU5F1 | PPARD | | |
| | NR2C2 | SOX2 | | |
| | RAD21 | BHLHE40 | | |

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|---------|---------|--|--|
| YY1 | ATF3 | | |
| CREB1 | NANOG | | |
| VDR | SPI1 | | |
| EGR1 | HDAC2 | | |
| ELF1 | ZKSCAN1 | | |
| SRF | TRIM28 | | |
| HDAC2 | CEBPD | | |
| SPI1 | TP53 | | |
| BHLHE40 | RCOR1 | | |
| KAT2A | TCF3 | | |
| FOXA2 | UBTF | | |
| RUNX1 | CEBPB | | |
| YY1 | SALL4 | | |
| PBX3 | POU5F1 | | |
| HNF4A | STAT5A | | |
| EZH2 | BCL3 | | |
| CEBPD | RUNX1 | | |
| STAT5A | NFIC | | |
| CREB1 | FOSL2 | | |
| KLF4 | NELFE | | |
| TCF7L2 | TCF3 | | |
| CEBPB | PPARG | | |
| SIN3A | SMAD4 | | |
| NFYA | FOXA1 | | |
| GABPA | TRIM28 | | |
| NFYB | HNF4A | | |
| ETS1 | REST | | |
| SP1 | VDR | | |
| SP2 | ZC3H11A | | |
| TAF1 | STAT3 | | |

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|--|--------|--------|--|--|
| | NELFE | FOXP2 | | |
| | ATF2 | FOXA2 | | |
| | IRF8 | CTCF | | |
| | PPARG | AR | | |
| | BCLAF1 | ZEB1 | | |
| | BCL3 | EGR1 | | |
| | E2F1 | RAD21 | | |
| | PPARD | IRF8 | | |
| | MYC | REST | | |
| | TAF7 | ESR1 | | |
| | ZBTB33 | RELA | | |
| | FLI1 | NFE2L2 | | |
| | E2F4 | MYOD1 | | |
| | REST | GATA1 | | |
| | FOSL2 | SMC3 | | |
| | E2F6 | EZH2 | | |
| | PML | TP63 | | |
| | MAX | GATA2 | | |
| | MYC | EZH2 | | |
| | | SUZ12 | | |

Supplementary Material 2- Full list of transcription factor and miRNAs that have potential influence on the observed gene expression of non-aggressive v.s aggressive. Highlighted in orange are the shared miRNA found in both groups. Pax4 is highlighted in purple and FOX transcription factor family are highlighted in blue.

| GEO2R TF | X2K TF downregulated genes | X2K TF upregulated genes | GSEA TF | GSEA miRNA |
|----------|----------------------------|--------------------------|------------------|-------------------------|
| SMAD9 | SUZ12 | E2F4 | MYCMAX_01 | ATGTCAC MIR-489 |
| MLXIPL | SOX2 | SIN3A | SCGGAAGY_ELK1_02 | TCTCTCC MIR-185 |
| ZMYM6 | SMAD4 | MAX | CATRRAGC_UNKNOWN | GTCAGGA MIR-378 |
| ZNF207 | NFE2L2 | MYC | STAT3_02 | TAGGTCA MIR-192 MIR-215 |

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|--------------|--------------|--------------|----------------------|---|
| GPBP1L1 | UBTF | FOXM1 | SGCGSSAAA_E2F1DP2_01 | CTTTGCA MIR-527 |
| FOXJ3 | GATA2 | GABPA | E2F1_Q6 | GTTTGTT MIR-495 |
| TGIF2 | AR | NFYB | ALPHACP1_01 | AGGGCAG MIR-18A |
| ATOH8 | GATA1 | NFYA | ATF_B | CTACCTC_LET7A_LET7B_LET7C_LET7D_LET7E_LET7F_MIR98_LET7G_LET7I |
| GATAD2A | SALL4 | E2F6 | TAAWWATAG_RSRFC4_Q2 | CTCAGGG_MIR125B_MIR125A |
| ZNF263 | SPI1 | ELF1 | TST1_01 | CTATGCA_MIR153 |
| RFX2 | SMC3 | BRCA1 | TGCCAAR_NF1_Q6 | GCATTG_MIR105 |
| TAF12 | ESR1 | MYC | IRF1_01 | CACTTG_MIR520G_MIR520H |
| PTTG1 | FOXA1 | E2F1 | PAX4_04 | AACATTC_MIR4093P |
| SCML1 | SPI1 | TAF1 | PAX4_02 | ATATGCA_MIR448 |
| SP4 | TRIM28 | CREB1 | FREAC2_01 | AACTGGA_MIR145 |
| LMO4 | HDAC2 | PML | HNF4ALPHA_Q6 | TGCTGCT_MIR15A_MIR16_MIR15B_MIR195_MIR424_MIR497 |
| RAI1 | USF2 | CREB1 | PXR_Q2 | CAGTATT_MIR200B_MIR200C_MIR429 |
| ZFP36L2 | MYOD1 | YY1 | RTTTNNNYTGGM_UNKNOWN | CAGGGTC_MIR504 |
| FOXP1 | BHLHE40 | FLI1 | IRF2_01 | TGAATGT_MIR181A_MIR181B_MIR181C_MIR181D |
| ZNF585B | ZC3H11A | ATF2 | PITX2_Q2 | GCACTTT_MIR175P_MIR20A_MIR106A_MIR106B_MIR20B_MIR519D |
| ZFH3 | TCF3 | SIX5 | | |
| NFIC | USF1 | NRF1 | | |
| UHRF1 | TCF3 | BCLAF1 | | |
| SMAD7 | NRF1 | IRF3 | | |
| GTF2IRD1 | TRIM28 | FOS | | |
| TEAD2 | RFX5 | SP2 | | |
| FOXI2 | CBX3 | SP1 | | |
| SIX2 | SUZ12 | USF2 | | |
| E2F7 | ZNF384 | KLF4 | | |
| MYBL1 | PPARG | ZNF384 | | |
| THRA | RELA | ETS1 | | |
| NFIA | POU5F1 | USF1 | | |
| ZNF133 | EZH2 | ZBTB33 | | |
| ZBED8 | YY1 | BHLHE40 | | |

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|--------------|--------------|---------|--|--|
| YBX1 | ZBTB7A | PBX3 | | |
| FOXM1 | HNH4A | SPI1 | | |
| HOXB7 | CTCF | YY1 | | |
| ZNF217 | VDR | IRF1 | | |
| EPAS1 | BRCA1 | ZBTB7A | | |
| NPAS1 | ZMIZ1 | ZMIZ1 | | |
| MEF2C | TP63 | NANOG | | |
| AFF1 | NANOG | RFX5 | | |
| E2F2 | FOXP2 | TCF7L2 | | |
| ZNF514 | RUNX1 | STAT3 | | |
| BMPR1A | ERG | ATF3 | | |
| RERE | BCLAF1 | RCOR1 | | |
| ATF5 | TCF7L2 | CTCF | | |
| ZNF300 | STAT3 | SPI1 | | |
| SCAND1 | STAT3 | TAF7 | | |
| ARID4A | REST | HNH4A | | |
| KDM5B | FOXA2 | NR2C2 | | |
| ZNF586 | SRF | CHD1 | | |
| NFIX | ZEB1 | POU5F1 | | |
| SLC2A4RG | KLF4 | TRIM28 | | |
| ZNF219 | CHD1 | CEBPD | | |
| SIX1 | TP53 | SRF | | |
| LHX2 | STAT5A | SOX2 | | |
| PA2G4 | IRF1 | NFIC | | |
| SCMH1 | NELFE | ZKSCAN1 | | |
| TCEAL1 | SIX5 | CBX3 | | |
| MTA3 | KAT2A | EGR1 | | |
| TARDBP | EGR1 | CEBPB | | |
| FLI1 | ETS1 | BCL3 | | |
| ELF1 | MYC | ZC3H11A | | |

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|--------------|---------|--------------|--|--|
| UBN1 | NFIC | SMC3 | | |
| GATA2 | EGR1 | RUNX1 | | |
| ID3 | RAD21 | STAT3 | | |
| FOXS1 | IRF3 | PPARD | | |
| TBR1 | TAF1 | RAD21 | | |
| SNAPC4 | FOS | STAT5A | | |
| ZNF436 | ZBTB33 | UBTF | | |
| REXO4 | RCOR1 | PPARG | | |
| NOCT | PPARD | TCF3 | | |
| TSC22D3 | ZKSCAN1 | TRIM28 | | |
| ZNF138 | ELF1 | ERG | | |
| NFE2 | IRF8 | HDAC2 | | |
| LZTS1 | FOSL2 | FOXP2 | | |
| AATF | CEBPD | NELFE | | |
| ELF3 | NR2C2 | SALL4 | | |
| TWIST1 | YY1 | FOXA2 | | |
| JDP2 | PBX3 | TCF3 | | |
| ZNF837 | MYC | KAT2A | | |
| TCF3 | NFYB | TP53 | | |
| | TAF7 | ZEB1 | | |
| | CREB1 | VDR | | |
| | CEBPB | FOSL2 | | |
| | BCL3 | REST | | |
| | FLI1 | FOXA1 | | |
| | ATF2 | SMAD4 | | |
| | E2F6 | EZH2 | | |
| | SP2 | GATA2 | | |
| | EZH2 | IRF8 | | |
| | NFYA | REST | | |
| | ATF3 | EZH2 | | |

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|--|-------|--------|--|--|
| | REST | AR | | |
| | SP1 | SUZ12 | | |
| | E2F4 | ESR1 | | |
| | E2F1 | TP63 | | |
| | PML | RELA | | |
| | GABPA | NFE2L2 | | |
| | SIN3A | GATA1 | | |
| | CREB1 | EGR1 | | |
| | MAX | MYOD1 | | |
| | | SUZ12 | | |