

Table S1. Formula of culture media used in this study

Media	Components	Provider	Final concentration
Neural induction medium	DMEM/F12 Glutamax (100X) Non-Essential Aminoacids(100X) Beta-Mercaptoethanol (1000X) Penicillin-Streptomycin (100X) N2 supplement (100X) B27 supplement (50X) SB431524 LDN193189	Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Sigma Millipore Selleck chemical	1X 1X 1X 1X 1X 1X 10uM 250nM
OPC medium	DMEM/F12 Glutamax (100X) Non-Essential Aminoacids(100X) Beta-Mercaptoethanol (1000X) Penicillin-Streptomycin (100X) N2 supplement (100X) B27 supplement (50X) Retinoic acid (RA) Smoothened agonist (SAG) Insulin Basic fibroblast growth factor	Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Sigma Millipore Sigma Millipore Sigma Millipore Prospec	1X 1X 1X 1X 1X 1X 100nM 1μM 25ug/ml 20ng/ml
OD maturation medium	DMEM/F12 Glutamax (100X) Non-Essential Aminoacids(100X) Beta-Mercaptoethanol (1000X) Penicillin-Streptomycin (100X) N2 supplement (100X) B27 supplement (50X) Insulin Biotin T3 PDGF-AA IGF-1 HGF NT3 cAMP	Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Thermo Fisher Sigma Millipore Sigma Millipore Sigma Millipore Prospec Prospec Pepprotech Prospec Sigma Millipore	1X 1X 1X 1X 1X 1X 25μg/ml 100ng/ml 60ng/ml 10ng/ml 10ng/ml 5ng/ml 10ng/ml 1μM

Table S2. Primer sequences used for quantitative RT-PCR

Primer	Forward (5' – 3')	Reverse (5' – 3')
Beta actin	CAC CAT TGG CAA TGA GCG GTT C	AGG TCC TTG CGG ATG TCC ACG T
Olig2	CGA CTC ATC TTT CCT TCT CTA A	CGC ACT TAC CTC ATC ATT G
PDGFR-a	GAC TTT CGC CAA AGT GGA GGAG	AGC CAC CGT GAG TTC AGA ACG C
Sox10	ATG AAC GCC TTC ATG GTG TGG G	CGC TTG TCA CTT TCG TTC AGC AG
Nanog	CTC CAA CAT CCT GAA CCT CAG C	CGT CAC ACC ATT GCT ATT CTT CG
MBP	AGG ATT TGG CTA CGG AGG CAG A	GGT TTT CAG CGT CTA GCC ATG G
CNPase	CTG CTA GAG TGC AAG ACG CTC	GTG CCA TCA CGG TAC TTG TCC
MAG	GCT CAG TGT CAT GTA TGC ACC	GGA GCA CAA GAT AGA GAC CGT

Table S3. DEGs list (VNP2 vs VN)

ensembl	baseMean	log2FoldChange	lfcSE	pvalue	padj	symbol
ENSG00000120907	37.05883	2.063729	0.504234	1.65E-06	9.32E-05	ADRA1A
ENSG00000186105	31.90858	1.945468	0.534636	1.05E-05	0.000467	LRRC70
ENSG00000188404	150.2998	1.791755	0.241054	5.02E-15	1.14E-12	SELL
ENSG00000074803	136.1073	1.741252	0.245615	6.32E-14	1.29E-11	SLC12A1
ENSG00000125618	36.75181	1.73868	0.524265	2.85E-05	0.00111	PAX8
ENSG00000198734	215.6007	1.67048	0.194419	7.28E-19	2.73E-16	F5
ENSG00000160712	70.69187	1.658494	0.411129	1.62E-06	9.16E-05	IL6R
ENSG00000250273	23.70306	1.584532	1.075776	0.001348	0.026124	PSMC1P5
ENSG00000124208	146.8774	1.558451	0.271779	3.30E-10	4.15E-08	TMEM189-UBE2V1
ENSG00000164972	48.67723	1.557692	0.430608	1.10E-05	0.000478	C9orf24
ENSG00000164619	28.54851	1.494197	0.640745	0.000504	0.012347	BMPER
ENSG00000135218	133.291	1.455898	0.259236	7.65E-10	8.93E-08	CD36
ENSG00000145244	251.8052	1.394978	0.185725	2.65E-15	6.28E-13	CORIN
ENSG00000108950	32.23199	1.358788	0.627946	0.00067	0.015395	FAM20A
ENSG00000182732	122.1529	1.337888	0.286857	1.17E-07	8.55E-06	RGS6
ENSG00000188803	537.0906	1.32986	0.121458	3.08E-29	3.31E-26	SHISA6
ENSG00000172137	51.1587	1.295019	0.428389	8.81E-05	0.002861	CALB2
ENSG00000183631	39.36058	1.249127	0.512672	0.000423	0.01084	PRR32
ENSG00000175899	145.5523	1.244468	0.271871	1.78E-07	1.26E-05	A2M
ENSG00000284431	30.59085	1.231623	0.689587	0.001555	0.028977	NA
ENSG00000154330	54.02707	1.226512	0.422122	0.000122	0.003716	PGM5
ENSG00000044524	1549.422	1.198752	0.074567	1.86E-59	4.99E-56	EPHA3
ENSG00000125810	41.18496	1.188155	0.518152	0.000568	0.013585	CD93
ENSG00000007129	115.9785	1.164146	0.282661	1.43E-06	8.28E-05	CEACAM21
ENSG00000108684	317.0688	1.127467	0.162887	1.91E-13	3.57E-11	ASIC2
ENSG00000151655	86.43641	1.11579	0.321603	2.03E-05	0.000823	ITIH2
ENSG00000090104	30.33757	1.081204	0.71022	0.002464	0.041142	RGS1

ENSG00000125089	47.72176	1.055939	0.468055	0.000675	0.015458	SH3TC1
ENSG00000272410	49.71654	1.045088	0.881999	0.001935	0.034312	RP11-438J1.1
ENSG00000181649	116.0026	1.03633	0.32477	4.24E-05	0.001534	PHLDA2
ENSG00000105479	83.13028	1.033783	0.326489	5.55E-05	0.001921	CCDC114
ENSG00000111432	85.01367	0.991773	0.334871	0.000103	0.00328	FZD10
ENSG00000172164	236.9085	0.991715	0.185878	4.40E-09	4.38E-07	SNTB1
ENSG00000134215	755.6642	0.983005	0.103279	8.97E-23	4.74E-20	VAV3
ENSG00000273184	42.2666	0.982758	0.595173	0.001921	0.03419	RP11-212P7.3
ENSG00000187122	12180.55	0.977697	0.040586	7.96E-130	1.28E-125	SLIT1
ENSG00000269113	255.7326	0.929332	0.185801	2.65E-08	2.21E-06	TRABD2B
ENSG00000174640	491.3589	0.898514	0.130572	2.87E-13	5.25E-11	SLCO2A1
ENSG00000069535	1154.378	0.897886	0.082702	9.02E-29	9.08E-26	MAOB
ENSG00000108231	299.602	0.894894	0.167008	3.83E-09	3.93E-07	LGI1
ENSG00000034239	169.93	0.888188	0.221152	2.95E-06	0.000154	EFCAB1
ENSG00000077943	92.81062	0.883718	0.338725	0.000277	0.007617	ITGA8
ENSG00000112769	1374.206	0.873282	0.088605	3.19E-24	2.14E-21	LAMA4
ENSG00000187800	73.83669	0.863186	0.38744	0.00072	0.016119	PEAR1
ENSG00000187783	75.65855	0.857253	0.425024	0.001094	0.022107	TMEM72
ENSG00000107562	810.1285	0.856336	0.102074	2.48E-18	8.32E-16	CXCL12
ENSG00000257767	169.8295	0.853011	0.28193	8.04E-05	0.002642	RP11-162P23.2
ENSG00000185215	291.1757	0.825789	0.224787	8.62E-06	0.000393	TNFAIP2
ENSG00000128283	378.2594	0.820312	0.151704	3.14E-09	3.31E-07	CDC42EP1
ENSG00000153162	989.0393	0.797564	0.089544	2.40E-20	9.68E-18	BMP6
ENSG00000169851	990.3388	0.79733	0.094256	1.35E-18	4.82E-16	PCDH7
ENSG00000125968	197.0893	0.791849	0.209646	6.54E-06	0.000312	ID1
ENSG00000144596	265.8701	0.78967	0.190624	1.39E-06	8.10E-05	GRIP2
ENSG00000163735	333.496	0.784136	0.163998	7.67E-08	5.86E-06	CXCL5
ENSG00000177374	218.6803	0.780477	0.191443	1.98E-06	0.000109	HIC1
ENSG00000077327	728.7609	0.778351	0.109603	5.82E-14	1.20E-11	SPAG6
ENSG00000183454	389.1964	0.777736	0.147405	6.02E-09	5.63E-07	GRIN2A
ENSG00000188931	313.1346	0.772245	0.163797	1.08E-07	7.98E-06	CFAP126
ENSG00000182601	261.0027	0.768825	0.183111	1.41E-06	8.18E-05	HS3ST4
ENSG00000107099	58.79933	0.766787	0.457886	0.002102	0.036369	DOCK8
ENSG00000112379	1275.345	0.761609	0.079493	5.01E-23	2.78E-20	ARFGEF3
ENSG00000100678	400.056	0.761289	0.143868	5.58E-09	5.45E-07	SLC8A3
ENSG00000133636	302.1336	0.759908	0.173906	5.63E-07	3.57E-05	NTS
ENSG00000107611	787.0891	0.757506	0.105649	3.65E-14	7.73E-12	CUBN
ENSG00000115252	272.7472	0.754692	0.197429	5.28E-06	0.00026	PDE1A
ENSG00000116016	168.4094	0.751449	0.236278	5.38E-05	0.001875	EPAS1

ENSG00000187678	1928.609	0.745738	0.079471	2.90E-22	1.34E-19	SPRY4
ENSG00000179921	100.7889	0.743604	0.307967	0.000501	0.012321	GPBAR1
ENSG00000120262	84.37424	0.741924	0.362285	0.001082	0.021961	CCDC170
ENSG00000166016	682.1276	0.735169	0.110011	1.11E-12	1.97E-10	ABTB2
ENSG00000221818	163.7312	0.731601	0.228859	5.31E-05	0.001861	EBF2
ENSG00000164741	1037.052	0.726122	0.097156	3.85E-15	8.86E-13	DLC1
ENSG00000038295	175.9855	0.718925	0.225401	5.39E-05	0.001875	TLL1
ENSG00000198729	497.8926	0.710432	0.138334	9.40E-09	8.45E-07	PPP1R14C
ENSG00000152760	465.9713	0.701985	0.132662	5.79E-09	5.49E-07	TCTEX1D1
ENSG00000142694	170.3532	0.696283	0.232865	0.000103	0.00328	EVA1B
ENSG00000184347	1128.247	0.692125	0.088402	2.49E-16	7.10E-14	SLIT3
ENSG00000213085	265.8908	0.691059	0.192798	1.36E-05	0.00058	CFAP45
ENSG00000168421	518.4892	0.690589	0.141481	4.51E-08	3.60E-06	RHOH
ENSG00000166596	147.3812	0.688814	0.257143	0.000248	0.00691	CFAP52
ENSG00000181234	1296.867	0.686537	0.08062	9.16E-19	3.35E-16	TMEM132C
ENSG00000109625	137.508	0.686374	0.287842	0.000509	0.01243	CPZ
ENSG00000078549	814.7668	0.685557	0.103598	1.85E-12	3.02E-10	ADCYAP1R1
ENSG00000138434	4839.154	0.682833	0.04706	1.01E-49	2.04E-46	SSFA2
ENSG00000102554	233.4269	0.679076	0.207927	4.27E-05	0.001543	KLF5
ENSG00000122861	295.373	0.678609	0.198772	2.45E-05	0.000974	PLAU
ENSG00000136158	5060.008	0.6785	0.048125	1.18E-46	2.11E-43	SPRY2
ENSG00000091986	3394.952	0.666601	0.070468	1.69E-22	8.24E-20	CCDC80
ENSG00000135905	690.8613	0.6541	0.123725	5.73E-09	5.48E-07	DOCK10
ENSG00000118785	1323.134	0.652911	0.082296	1.22E-16	3.56E-14	SPP1
ENSG00000141668	321.0375	0.651119	0.173598	6.98E-06	0.00033	CBLN2
ENSG00000080493	838.1314	0.648905	0.097307	1.33E-12	2.24E-10	SLC4A4
ENSG00000198739	145.3181	0.648675	0.256524	0.000384	0.01003	LRRTM3
ENSG00000172985	132.3129	0.648497	0.280372	0.000623	0.014639	SH3RF3
ENSG00000187714	658.847	0.646699	0.110062	2.11E-10	2.77E-08	SLC18A3
ENSG00000167244	31123.93	0.646641	0.034069	1.28E-81	5.16E-78	IGF2
ENSG00000138185	183.4125	0.646149	0.284189	0.000635	0.014827	ENTPD1
ENSG00000099869	104.3963	0.644454	0.357013	0.001706	0.031198	IGF2-AS
ENSG00000178695	5856.782	0.641052	0.048963	1.76E-40	2.58E-37	KCTD12
ENSG00000078725	772.8169	0.640304	0.10701	9.98E-11	1.36E-08	BRINP1
ENSG00000164056	3104.514	0.639113	0.053397	2.71E-34	3.64E-31	SPRY1
ENSG00000164929	604.5985	0.635712	0.119998	5.86E-09	5.52E-07	BAALC
ENSG00000144619	1517.275	0.634665	0.082093	6.16E-16	1.60E-13	CNTN4
ENSG00000101222	184.6453	0.633854	0.219932	0.000147	0.004359	SPEF1
ENSG00000149090	277.0437	0.632522	0.173429	1.17E-05	0.00051	PAMR1
ENSG00000154856	2051.108	0.629559	0.089456	8.63E-14	1.72E-11	APCDD1

ENSG00000154127	822.9059	0.627406	0.100077	1.94E-11	2.92E-09	UBASH3B
ENSG00000100427	103.9381	0.627023	0.336121	0.001543	0.028901	MLC1
ENSG00000136286	133.8157	0.625628	0.278369	0.000753	0.016705	MYO1G
ENSG00000159713	845.0526	0.608419	0.101354	9.46E-11	1.30E-08	TPPP3
ENSG00000276386	138.2324	0.606966	0.277394	0.000865	0.018608	CNTNAP3P2
ENSG00000106714	1594.954	0.604632	0.074296	1.97E-17	6.09E-15	CNTNAP3
ENSG00000244405	2535.474	0.603236	0.060006	5.90E-25	4.32E-22	ETV5
ENSG00000004838	384.1246	0.589109	0.148293	3.26E-06	0.000169	ZMYND10
ENSG00000176601	145.6949	0.587654	0.276567	0.001079	0.021961	MAP3K19
ENSG00000167711	143.1948	0.585099	0.28729	0.001195	0.023807	SERPINF2
ENSG00000154080	113.8952	-0.58588	0.34417	0.002128	0.03662	CHST9
ENSG00000196277	90.00304	-0.59387	0.368341	0.002436	0.040873	GRM7
ENSG00000163637	492.8375	-0.59492	0.150527	3.58E-06	0.000183	PRICKLE2
ENSG00000137501	313.4755	-0.5952	0.184637	4.98E-05	0.001755	SYTL2
ENSG00000197747	872.4758	-0.60391	0.0974	3.31E-11	4.89E-09	S100A10
ENSG00000132849	242.9018	-0.60985	0.196424	6.42E-05	0.002191	PATJ
ENSG00000172572	1989.736	-0.61453	0.067589	5.10E-21	2.16E-18	PDE3A
ENSG00000075223	978.4148	-0.62114	0.108048	4.70E-10	5.74E-08	SEMA3C
ENSG00000129151	233.6159	-0.62154	0.192866	5.10E-05	0.00179	BBOX1
ENSG00000147437	83.83388	-0.63459	0.379168	0.002116	0.036577	GNRH1
ENSG00000145721	655.9064	-0.64058	0.119943	3.52E-09	3.64E-07	LIX1
ENSG00000165376	396.3021	-0.65838	0.148707	4.22E-07	2.77E-05	CLDN2
ENSG00000021645	403.4302	-0.69222	0.143164	6.09E-08	4.72E-06	NRXN3
ENSG00000143858	178.7474	-0.69381	0.245054	0.000162	0.004757	SYT2
ENSG00000152689	213.7669	-0.70994	0.246174	0.000142	0.004256	RASGRP3
ENSG00000124749	1052.756	-0.714	0.095377	3.50E-15	8.17E-13	COL21A1
ENSG00000156535	226.431	-0.71657	0.195722	9.58E-06	0.000431	CD109
ENSG00000166106	1867.276	-0.71805	0.077178	6.65E-22	2.97E-19	ADAMTS15
ENSG00000115414	33626.06	-0.72172	0.03148	1.30E-117	1.04E-113	FN1
ENSG00000169436	1037.296	-0.73462	0.095281	6.15E-16	1.60E-13	COL22A1
ENSG00000154027	495.1722	-0.73836	0.15502	7.68E-08	5.86E-06	AK5
ENSG00000145708	134.7128	-0.73989	0.331366	0.000787	0.017284	CRHBP
ENSG00000143248	1905.923	-0.76864	0.090187	5.98E-19	2.29E-16	RGS5
ENSG00000115232	575.0555	-0.77941	0.138689	8.39E-10	9.73E-08	ITGA4
ENSG00000125378	234.8834	-0.79411	0.19975	2.92E-06	0.000153	BMP4
ENSG00000177459	146.2749	-0.79738	0.250426	5.39E-05	0.001875	ERICH5
ENSG00000143768	113.5148	-0.8035	0.297635	0.000226	0.006378	LEFTY2
ENSG00000187098	217.0607	-0.80761	0.214099	6.38E-06	0.000306	MITF
ENSG00000144285	137.9672	-0.8492	0.28998	0.000115	0.003544	SCN1A

ENSG00000108821	16084.3	-0.86553	0.040781	1.36E-100	7.29E-97	COL1A1
ENSG00000078098	87.90229	-0.91471	0.332667	0.000189	0.005455	FAP
ENSG00000113805	331.8	-0.93774	0.174569	3.28E-09	3.43E-07	CNTN3
ENSG00000168743	50.91675	-0.98879	0.478676	0.000969	0.020238	NPNT
ENSG00000183145	451.5226	-1.01527	0.136948	5.67E-15	1.27E-12	RIPPLY3
ENSG00000178568	93.40963	-1.06706	0.388354	0.000185	0.00534	ERBB4
ENSG00000047457	672.7094	-1.07489	0.113198	9.42E-23	4.74E-20	CP
ENSG00000167306	360.9299	-1.17427	0.156212	2.30E-15	5.60E-13	MYO5B
ENSG00000245112	108.8179	-1.2822	0.318217	1.75E-06	9.81E-05	SMARCA5-AS1
ENSG00000249307	45.27171	-1.38792	0.503317	0.000182	0.005277	LINC01088
ENSG00000213886	98.94692	-1.44704	0.355736	1.98E-06	0.000109	UBD
ENSG00000204531	108.2005	-1.46529	0.298986	3.54E-08	2.91E-06	POU5F1
ENSG00000184697	88.82106	-1.53365	0.329485	1.24E-07	9.00E-06	CLDN6
ENSG00000041353	128.6722	-1.54224	0.278986	1.35E-09	1.51E-07	RAB27B
ENSG00000167600	25.60487	-1.61805	0.672568	0.0004	0.01039	CYP2S1
ENSG00000102755	53.57856	-1.75994	0.431463	1.51E-06	8.63E-05	FLT1
ENSG00000112782	35.13461	-1.85181	0.551054	2.97E-05	0.001144	CLIC5
ENSG00000265992	119.8317	-1.88208	0.268741	1.08E-13	2.12E-11	ESRG
ENSG00000198796	54.03718	-2.16171	0.462274	1.11E-07	8.14E-06	ALPK2
ENSG00000241186	49.46296	-2.28873	0.464355	3.29E-08	2.72E-06	TDGF1