

**Table S1** List of cell cycle related genes.

| Diseases or Functions Annotation                | p-value  | Activation z-score | Molecules                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------|----------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Senescence of cells                             | 5.1E-05  | -0.53              | ADD3,AIMP2,AR,ATM,ATR,BLM,BTG3,DYRK1A,EIF4E,GATA4,GPATCH8,HMGA2,ID1,MAP2K1,MAPKAPK5,ME2,MITF,NBN,PBRM1,PPP1R13B,TAF1C,TCF3,TGFBR2,UIMC1,ZEB2                                                                                                                                                                                                                    |
| G2 phase                                        | 0.00025  | -1.51              | AR,ATM,ATR,BLM,CCNY,EEF2K,EIF2AK2,EP400,HAUS7,HMGA2,MAP2K1,MAPRE1,MXI1,NBN,OFD1,PRKAR2B,RBBP6,SPHK2,TAF6,TAOK2,TGFBR2,TTI1,UIMC1,YWHAE,ZEB2                                                                                                                                                                                                                     |
| Interphase                                      | 0.00034  | -0.25              | AFAP1L2,AR,ATM,ATR,BCAT1,BLM,BTG3,CCL3,CCNY,CDC6,DAB2,DYRK1A,EEF2K,EIF2AK2,EIF4E,EP400,FZR1,HAUS7,HMGA2,ID1,KIT,LBH,MAP2K1,MAPRE1,MAX,MCM2,MINDY3,MXI1,NBN,OFD1,PFKFB3,PLAG1,PPP1R26,PRKAR2B,RBBP6,RXRA,SPHK2,SPRY2,TAF6,TAOK2,TCF3,TFCP2,TGFBR2,TTI1,UIMC1,USP36,YWHAE,ZEB2                                                                                    |
| Replicative senescence of fibroblast cell lines | 0.00042  | -0.82              | ADD3,ATM,GPATCH8,NBN,PBRM1,TAF1C                                                                                                                                                                                                                                                                                                                                |
| Senescence of fibroblast cell lines             | 0.00048  | -0.67              | ADD3,AIMP2,ATM,BTG3,DYRK1A,GATA4,GPATCH8,ID1,ME2,NBN,PBRM1,TAF1C,TCF3                                                                                                                                                                                                                                                                                           |
| Mitosis                                         | 0.00050  | -0.54              | AFAP1L2,AR,ATM,ATR,AZI2,BLM,BTG3,CDC6,ELOC,FER,FOXC1,GNA13,GNAI3,HAUS7,IL2RB,ITGAL,KIT,MAP2K1,MAX,MITF,NBN,NTRK1,PBRM1,PEBP1,PKN2,SASS6,SPHK2,SPRY2,TAF6,TGFBR2,THBS1,TUBB3,YWHAE                                                                                                                                                                               |
| G2/M phase                                      | 0.000592 | -1.70              | AR,ATM,ATR,BLM,CCNY,EIF2AK2,EP400,HAUS7,HMGA2,MAPRE1,MXI1,NBN,OFD1,PRKAR2B,RBBP6,SPHK2,TAOK2,TGFBR2,TTI1,UIMC1,YWHAE                                                                                                                                                                                                                                            |
| Cell cycle progression                          | 0.00061  | -1.20              | AFAP1L2,AMER1,AR,ARHGAP32,ATM,ATR,AZI2,BLM,BTG3,CCL3,CDC6,EIF2AK2,EIF4E,ELOC,FER,FOXC1,FZR1,GAS7,GATA4,GNA13,GNAI3,HAUS7,ID1,IL2RB,IRF9,ITGAL,KIT,LBH,MAP2K1,MAX,MIR17HG,MITF,MXI1,NBN,NR4A3,NTRK1,PBRM1,PEBP1,PES1,PHC1,PHF6,PKN2,PLAG1,PPP1R13B,PPP2R3A,PRKAR2B,RARG,SASS6,SETD7,SOC3,SPHK2,SPRY2,TAF6,TCF3,TFCP2,TGFBR2,THBS1,THRA,TNFSF10,TUBB3,UHRF2,YWHAE |
| Replicative senescence of cells                 | 0.00083  | -0.82              | ADD3,ATM,ATR,GPATCH8,MAPKAPK5,NBN,PBRM1,TAF1C,UIMC1                                                                                                                                                                                                                                                                                                             |
| Ploidy of cells                                 | 0.0033   | -1.14              | AKT3,ATM,DYRK2,IRAK4,MAP2K1,RGPD4,ROCK1,SPRY2,SUDS3,TCIRG1,TGFBR2                                                                                                                                                                                                                                                                                               |
| S phase checkpoint control                      | 0.0034   | -1.09              | ATM,EIF4E,NBN,TTI1                                                                                                                                                                                                                                                                                                                                              |
| G1 phase of fibroblast cell lines               | 0.0063   | 0                  | CDC6,DYRK1A,EP400,FZR1,MAP2K1,MCM2,TCF3                                                                                                                                                                                                                                                                                                                         |
| G1/S phase transition                           | 0.0068   | 1.13               | BCAT1,BTG3,CDC6,EIF2AK2,EIF4E,FZR1,KIT,MAP2K1,MAX,MCM2,PLAG1,PPP1R26,SPRY2,TCF3,TFCP2,ZEB2                                                                                                                                                                                                                                                                      |
| Checkpoint control                              | 0.0075   | -1.67              | ATM,ATR,CDC6,CSNK1G1,EIF4E,NBN,TTI1,UIMC1                                                                                                                                                                                                                                                                                                                       |
| Interphase of cancer cells                      | 0.0076   | -1                 | ATM,ATR,CDC6,TGFBR2                                                                                                                                                                                                                                                                                                                                             |
| S phase                                         | 0.0085   | 0.26               | AR,ATM,ATR,BLM,CCL3,CDC6,EP400,FZR1,ID1,LBH,MAP2K1,MAX,MXI1,NBN,PFKFB3,TGFBR2,TTI1                                                                                                                                                                                                                                                                              |
| Modification of chromatin                       | 0.0092   | 0.45               | ATM,BAZ2B,GATA4,HDAC11,PBRM1,SUPT16H,TBX21,ZBTB7A                                                                                                                                                                                                                                                                                                               |
| Ploidy                                          | 0.0093   | -1.39              | AKT3,ATM,DYRK2,EP400,IRAK4,MAP2K1,RGPD4,ROCK1,SPRY2,SUDS3,TCIRG1,TGFBR2                                                                                                                                                                                                                                                                                         |

Table S1

**Table S2 List of cell proliferation related genes.**

| Diseases or Functions Annotation              | p-value | Activation z-score | Molecules                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------|---------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Production of lymphocytes                     | 0.00012 | -0.87              | ADA,IL2RB,ITGA4,KIT,SOCS3,TBX21,TCF3,THRA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Growth of yeast                               | 0.0003  | 1.06               | BLM,DHX15,DUSP12,EIF2AK2,MAP2K1,MAPRE1,PIGN,RCL1,RGPD4 (includes others),SLC25A14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Production of cells                           | 0.00056 | -1.11              | ADA,ATM,CCL3,IL2RB,INHBB,ITGA4,KIT,MAP2K1,SOCS3,TBX21,TCF3,TGFB2,THRA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Proliferation of connective tissue cells      | 0.00059 | -1.18              | AKT3,AR,ARHGAP32,ATM,ATR,BLM,BMX,CDC6,EIF2AK2,EMD,EP400,FNDC3B,FOXC1,GOLPH3,HMGA2,HUWE1,INHBB,LIMA1,MAP2K1,NAB1,NAB2,NBN,PFKFB3,PHF14,PRKAR2B,RARG,RXRA,SDC4,SETDB1,SOCS3,SP2,SPHK2,SPRY2,TACC1,TCIRG1,TGFB2,THRA,TNFSF10,UIMC1                                                                                                                                                                                                                                                                                                                                               |
| Production of T lymphocytes                   | 0.00075 | 0.22               | ADA,ITGA4,KIT,SOCS3,THRA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Cell proliferation of melanoma cell lines     | 0.00098 | 1.23               | AKIRIN2,AKT3,ATM,EIF4E,GOLPH3,KIDINS220,KIT,MAP2K1,MITF,PEAK1,PEBP1,THBS1,TLR3,TNFSF10,ZEB2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Cell proliferation of tumor cell lines        | 0.0017  | 0.72               | ACSL4,ADAM10,AKIRIN2,AKT3,AR,ARCN1,ASPH,ATM,ATP2A2,ATP6AP1,ATR,BMX,BTG3,CASZ1,CCL3,DAB2,DPF2,EED,EEF2K,EIF4E,ELOVL7,ENAH,FDXR,FOXC1,FZR1,GATA4,GNG4,GOLPH3,HMGA2,HOTAIRM1,HTATIP2,HUWE1,ID1,IL2RB,ILF3,KIDINS220,KIT,LIMA1,MAP2K1,MAPRE1,MAX,MC2,MINDY3,MIR17HG,MITF,MXI1,NAB2,NR2C2,NTRK1,OSBPL5,PBRM1,PEAK1,PEBP1,PFKFB3,PHC1,PHF6,PLAG1,PPP1R13B,PRKAR2B,PRRC2C,PTPN14,PTPRR,RARG,RBBP6,RBM17,RFX1,RXRA,SDC4,SETD7,SETDB1,SLC36A1,SOCS3,SPHK2,SPRY2,SRSF5,SUDS3,SUFU,TAF6,TCF3,TCIRG1,TGFB2,THBS1,THRA,TLR3,TNFSF10,TNIF,TRA2A,TUBB3,USP36,VAMP2,ZBTB7A,ZEB2,ZNF451,ZSCAN1 |
| Formation of thymocytes                       | 0.0017  | -0.45              | ADAM10,EED,IL2RB,ITGAL,ITK,KIT,MAP2K1,NAB1,RPL22,TCF3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Development of hematopoietic progenitor cells | 0.008   | -0.65              | ADAM10,EED,EIF2AK2,HIST1H4C,HMGA2,IL2RB,ITGAL,ITK,KIT,MAP2K1,NAB1,NR4A3,RPL22,TCF3,THBS1,TNRC6A,ZEB2,ZFPM1                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Proliferation of prostate cell lines          | 0.0085  | -0.22              | AR,ATP2A2,DAB2,TGFB2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Proliferation of neuroblastoma cell lines     | 0.0092  | -0.40              | CASZ1,FZR1,HMGA2,MXI1,NTRK1,RARG,RFX1,TNFSF10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| T cell development                            | 0.0094  | -1.85              | ADA,ADAM10,ATM,BLM,CCL3,EED,GATA4,ID1,IL10RA,IL2RB,ITGA4,ITGAL,ITK,KIT,MAP2K1,MIR17HG,NAB1,NBN,ORAI1,PKNOX1,POLM,RPL22,SOCS3,TBX21,TCF3,TCIRG1,TGFB2,THRA,TLR3,TNFSF10,ZFPM1                                                                                                                                                                                                                                                                                                                                                                                                  |

Table S2

**Table S3 List of peptides identified in the LC-MS/MS analysis.**

| <b>Name</b>                                                  | <b>Score</b> |
|--------------------------------------------------------------|--------------|
| <b>Annexin A2 isoform 1</b>                                  | <b>248</b>   |
| <b>Triosephosphate isomerase 1</b>                           | <b>245</b>   |
| <b>Alpha-enolase</b>                                         | <b>194</b>   |
| <b>Neuroblast differentiation-associated protein AHNAK</b>   | <b>147</b>   |
| <b>Thioredoxin</b>                                           | <b>121</b>   |
| <b>Isoform A of Lamin-A/C</b>                                | <b>114</b>   |
| <b>Calpain-1 catalytic subunit</b>                           | <b>112</b>   |
| <b>Gamma-glutamylcyclotransferase</b>                        | <b>104</b>   |
| <b>Cathepsin D</b>                                           | <b>97</b>    |
| <b>Glutathione S-transferase P</b>                           | <b>96</b>    |
| <b>Heat-shock protein beta-1</b>                             | <b>86</b>    |
| <b>Histone H4</b>                                            | <b>77</b>    |
| <b>Collagen alpha-2(1) chain</b>                             | <b>73</b>    |
| <b>Isoform 1 of Plectin-1</b>                                | <b>68</b>    |
| <b>Endoplasmic reticulum lipid raft-associated protein 2</b> | <b>65</b>    |
| <b>Alpha-2-glycoprotein 1</b>                                | <b>62</b>    |
| <b>Heat-shock protein 90Bb</b>                               | <b>62</b>    |
| <b>L-lactate dehydrogenase C chain</b>                       | <b>61</b>    |
| <b>Transaldolase</b>                                         | <b>56</b>    |
| <b>Ras-related protein Rab-30</b>                            | <b>54</b>    |

**Table S4 List of antibodies for ICC and flow cytometry.**

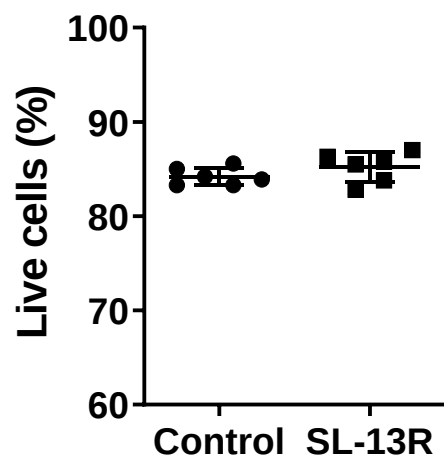
| <b>Target</b>  | <b>Company</b>        | <b>Catalog number</b>     |
|----------------|-----------------------|---------------------------|
| <b>AHNAK</b>   | <b>sigma</b>          | <b>HPA019070</b>          |
| <b>ANXA2</b>   | <b>CST</b>            | <b>8235</b>               |
| <b>ERLN2</b>   | <b>abcam</b>          | <b>ab129207</b>           |
| <b>HIST4H4</b> | <b>CST</b>            | <b>13919</b>              |
| <b>HSPB1</b>   | <b>CAT</b>            | <b>50353</b>              |
| <b>PLEC</b>    | <b>abcam</b>          | <b>ab83497</b>            |
| <b>RAB30</b>   | <b>CUSABIO</b>        | <b>CSB-PA613602LA01HU</b> |
| <b>CD34</b>    | <b>eBioscience</b>    | <b>12-0349-42</b>         |
| <b>CD38</b>    | <b>BioLegend</b>      | <b>356608</b>             |
| <b>CD45RA</b>  | <b>BioLegend</b>      | <b>304128</b>             |
| <b>CD90</b>    | <b>BD Biosciences</b> | <b>555595</b>             |
| <b>CD49f</b>   | <b>BioLegend</b>      | <b>313616</b>             |
| <b>CD45</b>    | <b>BD Biosciences</b> | <b>555483</b>             |

**Table S5 List of siRNA.**

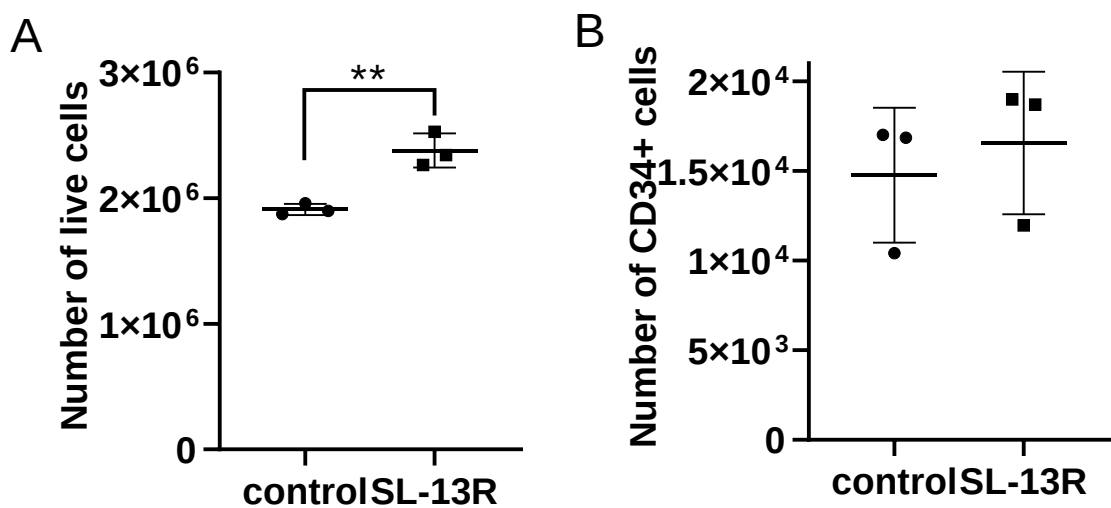
| Target        |                               | Mean of Knock down effect (%) |
|---------------|-------------------------------|-------------------------------|
| <b>AHNAK</b>  | Hs_AHNAK_2903 Mission siRNA   | 37.5                          |
| <b>ANXA2</b>  | Hs_ANXA2_7107 Mission siRNA   | 61.2                          |
| <b>ERLN2</b>  | Hs_ERLIN2_7582 Mission siRNA  | 21.6                          |
| <b>HIST4T</b> | Hs_HIST4H4_4969 Mission siRNA | 35.1                          |
| <b>PLEC</b>   | Hs_PLEC1_2666 Mission siRNA   | 30.5                          |

**Table S6 List of primers for qRT-PCR.**

| Target   |            | Primer sequence(5'-3')   |
|----------|------------|--------------------------|
| ACTB     | sense      | catgtacggttgctatccaggc   |
|          | anti-sense | ctccttaatgtcacgcacgat    |
| AHNAK    | sense      | tgaagtcttcagctcctgcag    |
|          | anti-sense | ttccactccatcttccgacttc   |
| ANXA2    | sense      | gacttccgcaagacgatggt     |
|          | anti-sense | tggtatccccgagcatcttggt   |
| CAPN1    | sense      | caggcaacaacctcaacaagaa   |
|          | anti-sense | gcagcaaacgaaaaagtcaaagt  |
| COL1A2   | sense      | ccaactaagcctctcagaacatca |
|          | anti-sense | ccctctacaatgacagcctttttc |
| CTSD     | sense      | gctggatggaccacaactacaa   |
|          | anti-sense | gcgtgcccagagccatag       |
| ENO1     | sense      | tgctgctgctgaagactcgtatt  |
|          | anti-sense | ctcgagccccgctacct        |
| ERLIN2   | sense      | cattcaagggtgtgcgggtaa    |
|          | anti-sense | ggcggcaatgagaagggtt      |
| GGCT     | sense      | agagaggaaggacctgcgaaa    |
|          | anti-sense | acttgttttgccttgggatttg   |
| GSTP1    | sense      | ggcacttgaagccttttgaga    |
|          | anti-sense | caggttgtagtcagcgaaggagat |
| HIST4H4  | sense      | aacgccatttgtggtctcatc    |
|          | anti-sense | ttggcgtgctccgtgtaag      |
| HSP90AB1 | sense      | attcgcatgaccaatcctgatc   |
|          | anti-sense | agtgcccaatgatggagatgtc   |
| HSPB1    | sense      | gcgtgtcccaggatgtcaac     |
|          | anti-sense | gtgtatttccggcgtgaagca    |
| LDHC     | sense      | tcttaggagagtcacccagttt   |
|          | anti-sense | accattccgccccaaagac      |
| LMNA     | sense      | ccgcaagacccaagactca      |
|          | anti-sense | ttggtattgggcgctttca      |
| PLEC     | sense      | caacctgctgaactcctccaa    |
|          | anti-sense | ccatctcattcagccacattagc  |
| RAB30    | sense      | aatccttccgttgcccttct     |
|          | anti-sense | ctcctcaatcttgttgcccacta  |
| TALDO1   | sense      | aatcgatgagcccctggaaga    |
|          | anti-sense | gaggcggcgatgacaatg       |
| TP1      | sense      | tgtgtcggccattggtactc     |
|          | anti-sense | cgcacagagaccttggactt     |
| TXN      | sense      | cacatcctgagagtcacccacatt |
|          | anti-sense | gggccttgcagaatgatcaa     |



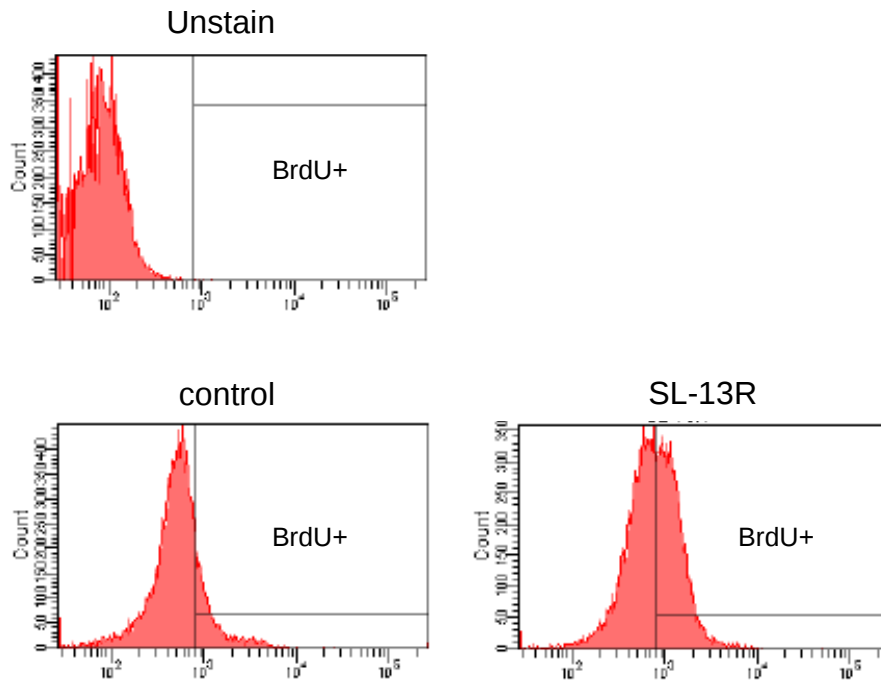
**Fig. S1. Ex vivo expansion of human PB HSPCs by SL-13R**  
UCB CD34<sup>+</sup> cells were cultured with or without SL-13R for 9 days and analyzed percentage of live cells. . n=6; 6 donor.



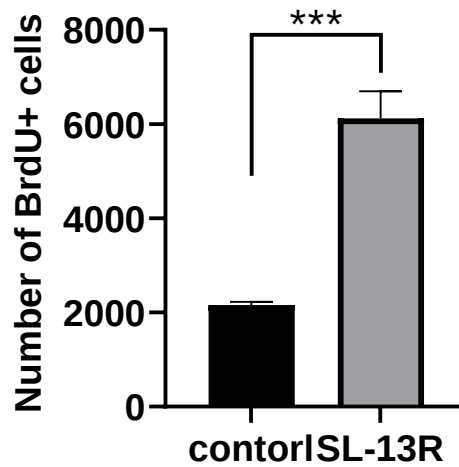
**Fig. S2. Ex vivo expansion of human PB HSPCs by SL-13R**

Human PB CD34<sup>+</sup> cells were cultured with or without SL-13R for 9 days. n=3; 3 donor (A) Number of live cells. (B) Number of CD34<sup>+</sup> cells. The control was PBS treatment. Student t test was used to test intergroup differences. \*\*p < 0.01.

A

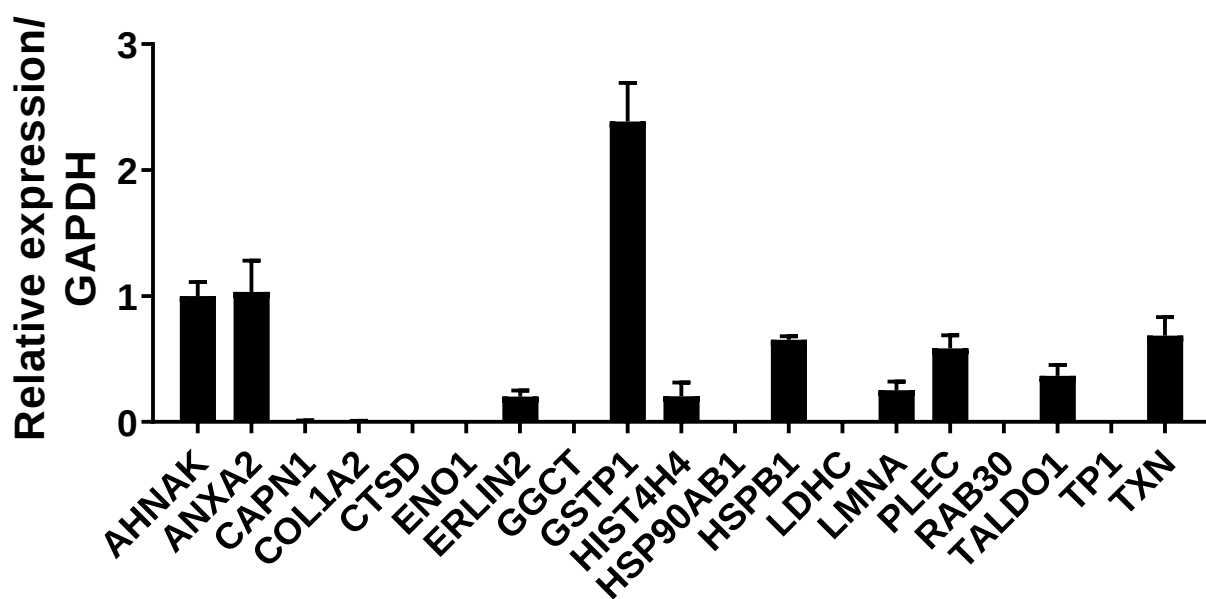


B

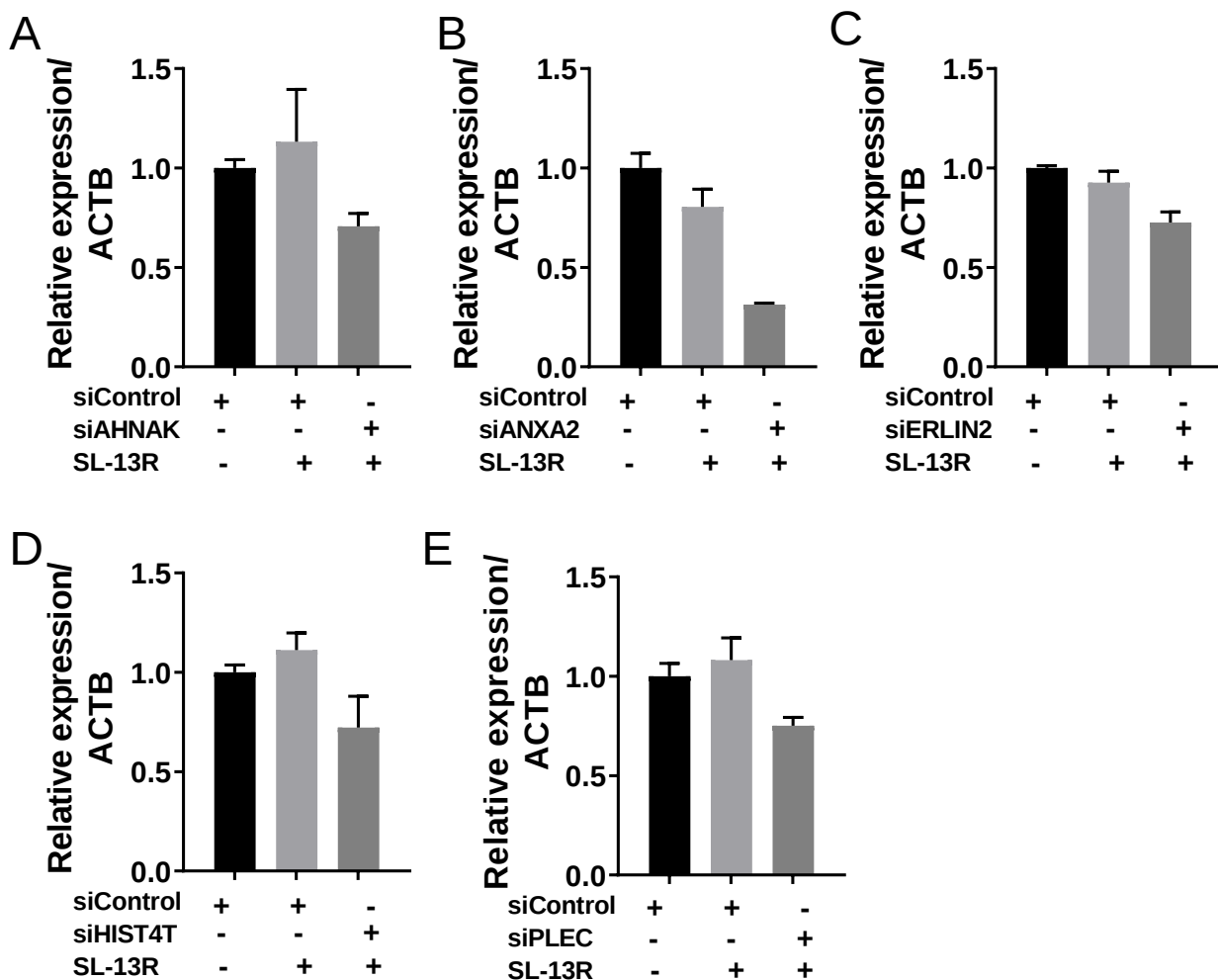


**Fig. S3. SL-13R treatment increase incorporation of BrdU**

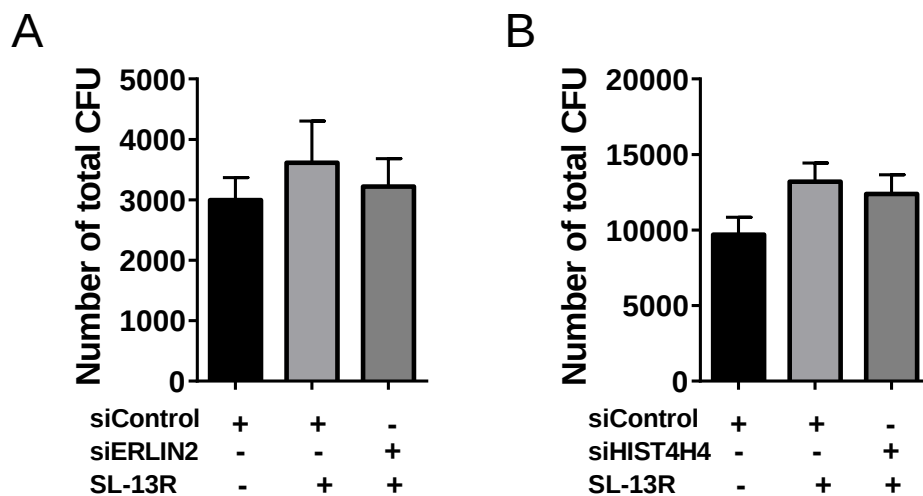
Human PB CD34<sup>+</sup> cells were cultured with or without SL-13R and added BrdU on day 3 and analyzed BrdU positive cells. (A) Histogram of BrdU positive cells cultured with or without SL-13R, (B) Number of BrdU positive cells cultured with or without SL-13R for 3 days. Student t test was used to test intergroup differences. n=3 \*\*\*p < 0.005.



**Fig. S4. Expression of candidate genes for SL-13R binding**  
Relative mRNA expression of candidate gene in PB CD34<sup>+</sup> cells.



**Fig. S5. Gene knockdown effects of siRNA for ERLN2, HIST4H4, HSPB1, and RAB30**  
 Human UCB CD34<sup>+</sup> cells were cultured with or without SL-13R and electroporation of siRNA for ERLN2, HIST4H4, HSPB1, and RAB30 for 24 kr and analyzed gene expression by qRT-PCR. (A) siRNA for AHNAK, (B) siRNA for ANXA2, (C) siRNA for ERLN2, (D) siRNA for HIST4T, (E) siRNA for PLEC.



**Fig. S6. Knockdown effects of ERLN2 and HIST4H4 on number of total CFU**

Human UCB CD34<sup>+</sup> cells were cultured with or without SL-13R and electroporation of siRNA for ERLN2 or HIST4H4 for 3 days and performed CFU assay. n=3 (A) siRNA for ERLN2, (B) siRNA for HIST4H4.