

DAFTAR ISI

| | |
|--|------|
| HALAMAN JUDUL | i |
| HALAMAN PENGESAHAN | ii |
| SURAT PERNYATAAN | iii |
| PRAKATA..... | iv |
| DAFTAR ISI..... | v |
| DAFTAR SINGKATAN | ix |
| DAFTAR TABEL..... | xi |
| DAFTAR GAMBAR | xii |
| DAFTAR LAMPIRAN..... | xiii |
| INTISARI | xiv |
| BAB I PENDAHULUAN..... | 1 |
| 1.1. Latar Belakang | 1 |
| 1.2. Rumusan Masalah | 4 |
| 1.3. Tujuan Penelitian..... | 4 |
| 1.3.1. Tujuan Umum | 4 |
| 1.3.2. Tujuan Khusus | 4 |
| 1.4. Manfaat..... | 4 |
| 1.4.1. Manfaat Teoritis..... | 4 |
| 1.4.2. Manfaat Praktis | 5 |
| BAB II TINJAUAN PUSTAKA..... | 6 |
| 2.1. <i>Transforming Growth Factor-Beta</i> (TGF- β)..... | 6 |
| 2.1.1. Definisi TGF- β | 6 |
| 2.1.2. Pembentukan TGF- β | 7 |
| 2.1.3. Aktivasi TGF- β | 9 |
| 2.1.4. Peran TGF- β | 10 |
| 2.2. <i>Stem Cell</i> | 16 |
| 2.2.1. Definisi <i>Stem Cell</i> | 16 |
| 2.2.2. Sifat <i>Stem Cell</i> | 18 |
| 2.2.3. Klasifikasi <i>Stem Cell</i> | 20 |

| | |
|--|-----------|
| 2.3. <i>Mesenchymal Stem Cells</i> (MSCs) | 27 |
| 2.3.1. Definisi MSCs | 27 |
| 2.3.2. Sifat MSCs | 29 |
| 2.3.3. Kultur MSCs..... | 30 |
| 2.3.4. Mobilisasi MSCs | 30 |
| 2.3.5. Peran MSCs..... | 32 |
| 2.3.6. Potensi Diferensiasi dan Kontrol MSCs | 32 |
| 2.4. <i>Tumor Nekrosis Faktor-Alpha</i> (TNF- α)..... | 33 |
| 2.4.1. Definisi TNF- α | 33 |
| 2.4.2. Peran TNF- α | 35 |
| 2.5. Hubungan TNF- α dengan TGF- β | 37 |
| 2.6. Kerangka Teori..... | 39 |
| 2.7. Kerangka Konsep | 39 |
| 2.8. Hipotesis..... | 39 |
| BAB III METODE PENELITIAN | 40 |
| 3.1. Jenis Penelitian | 40 |
| 3.2. Variabel | 40 |
| 3.3. Definisi Operasional..... | 40 |
| 3.3.1. TNF- α | 40 |
| 3.3.2. TGF- β | 41 |
| 3.4. Subjek Penelitian | 41 |
| 3.5. Alat dan Bahan | 42 |
| 3.5.1. Alat | 42 |
| 3.5.2. Bahan | 43 |
| 3.6. Prosedur Penelitian..... | 43 |
| 3.6.1. Teknik Isolasi <i>Mesenchymal Stem Cells</i> dari <i>Umbilical Cord</i> | 43 |
| 3.6.2. Kultur Sel | 45 |
| 3.6.3. Proses Pemanenan Sel..... | 45 |
| 3.6.4. Proses Penghitungan Sel | 46 |
| 3.6.5. Proses Pengenceran TNF- α | 46 |

| | |
|---|----|
| 3.6.6. Pembuatan Medium TGF- β | 47 |
| 3.6.7. Pembacaan TGF- β dengan ELISA..... | 47 |
| 3.7. Tempat dan Waktu Penelitian | 48 |
| 3.7.1. Tempat Penelitian..... | 48 |
| 3.7.2. Waktu Penelitian | 48 |
| 3.8. Analisa Hasil | 48 |
| 3.9. Alur Penelitian..... | 49 |
| BAB IV HASIL DAN PEMBAHASAN | 50 |
| 4.1. Hasil Penelitian | 50 |
| 4.2. Pembahasan Penelitian | 53 |
| BAB V KESIMPULAN DAN SARAN | 56 |
| 5.1. Kesimpulan..... | 56 |
| 5.2. Saran..... | 57 |
| DAFTAR PUSTAKA | 58 |
| LAMPIRAN..... | 62 |

DAFTAR SINGKATAN

| | |
|---------------|---|
| α -MEM | : <i>α-Modified Essential Medium</i> |
| AT | : <i>Adipose Tissue</i> |
| BM | : <i>Bone Marrow</i> |
| BMP | : <i>Bone Morphogenic Proteins</i> |
| BMP-1 | : <i>Bone Morphogenic Proteins-1</i> |
| CD | : <i>Cluster of Differentiation</i> |
| CSC | : <i>Cancer Stem Cell</i> |
| CXCR4 | : <i>Chemokine Receptors-4</i> |
| ELISA | : <i>Enzyme-Linked Immunosorbent Assay</i> |
| EPO | : <i>Erythropoietin</i> |
| FBS | : <i>Fetal Bovine Serum</i> |
| FGF | : <i>Fibroblast Growth Factor</i> |
| G-CSF | : <i>Granulocyte-Colony Stimulating Factor</i> |
| GM-CSF | : <i>Granulocyte Macrophage-Colony Stimulating Factor</i> |
| hEGCs | : <i>Human Embryonic Germ Cells</i> |
| HLA-DR | : <i>Human Leukocyte Antigen-DR</i> |
| HRP | : <i>Horseradish Peroxidase</i> |
| HSC | : <i>Hematopoietic Stem Cell</i> |
| IL | : <i>Interleucin</i> |
| IL-2 | : <i>Interleucin type 2</i> |

| | |
|----------------|---|
| IGF | : <i>Insulin-like Growth Factor</i> |
| LTBP | : <i>Latent TGF-β Binding Protein</i> |
| MHC | : <i>Major Histocompatibility Complex</i> |
| MSCs | : <i>Mesenchymal Stem Cells</i> |
| PBS | : <i>Phosphate Buffer Solution</i> |
| PDGF | : <i>Platelet Derived Growth Factor</i> |
| PIGF | : <i>Placental Growth Factor</i> |
| SCF | : <i>Stem Cell Factor</i> |
| SDF-1 | : <i>Stromal-cell Derived Factor-1</i> |
| SHH | : <i>Sonic Hedgehog</i> |
| TGF | : <i>Transforming Growth Factor</i> |
| TGF- β | : <i>Transforming Growth Factor-β</i> |
| TGF- β 1 | : <i>Transforming Growth Factor-β tipe I</i> |
| TGF- β 2 | : <i>Transforming Growth Factor-β tipe II</i> |
| TGF- β 3 | : <i>Transforming Growth Factor-β tipe III</i> |
| TNF | : <i>Tumor Necrosis Factor</i> |
| TNF- α | : <i>Tumor Necrosis Factor-Alpha</i> |
| VEGF | : <i>Vascular Endothelial Growth Factor</i> |

DAFTAR TABEL

| | |
|---|----|
| Tabel 4.1. Hasil Uji Normalitas Kelompok..... | 51 |
| Tabel 4.2. Hasil Uji Homogenitas Kelompok..... | 52 |
| Tabel 4.3. Hasil Uji <i>One Way Anova</i> | 52 |
| Tabel 4.4. Hasil Uji <i>Post Hoc</i> Antar Kelompok | 52 |

DAFTAR GAMBAR

| | |
|---|----|
| Gambar 2. 1. Proses pembentukan <i>Transforming Growth Factor-Beta</i> (Rifai, 2013) | 8 |
| Gambar 2. 2. Jalur aktivasi TGF- β (Wu et al., 2016)..... | 10 |
| Gambar 2. 3. Peran dari TGF- β (Rosemary, 2016) | 13 |
| Gambar 2. 4. Peran TGF- β dalam pembentukan sel osteosit (Simon, 2013) | 13 |
| Gambar 2. 5. Model pembelahan <i>stem cell</i> (Putra, 2014)..... | 18 |
| Gambar 2. 6. Diferensiasi <i>stem cell</i> (<i>The National Academies. Understanding Stem Cells</i> , 2014). | 19 |
| Gambar 2. 7. Sifat <i>tissue niche</i> pada <i>stem cell</i> (Yamashita, 2010)..... | 20 |
| Gambar 2. 8. <i>Mesenchymal Stem Cells</i> marker (Hocking, 2015) | 29 |
| Gambar 2. 9. Peran TNF- α (Emanuela, 2016)..... | 37 |
| Gambar 4. 1. Rerata kadar <i>Transforming Growth Factor Beta</i> (TGF- β) antara kelompok K (25,99 \pm 1,25 pg/mL), kelompok P1 (60,06 \pm 1,87 pg/mL), kelompok P2 (64,09 \pm 2,25 pg/mL) dan kelompok P3 (61,41 \pm 1,38 pg/mL). | 51 |

DAFTAR LAMPIRAN

| | | |
|-------------|---|----|
| Lampiran 1. | Hasil Uji Deskriptif Data Kadar TGF- β | 62 |
| Lampiran 2. | Hasil Uji Normalitas dan Homogenitas Kadar TGF- β | 64 |
| Lampiran 3. | Hasil Uji Perbedaan Antar Kelompok Dengan <i>One Way Anova</i> dan Uji <i>Post Hoc</i> | 65 |
| Lampiran 4. | Dokumentasi Penelitian | 66 |
| Lampiran 5. | <i>Ethical Clearance</i> | 68 |
| Lampiran 6. | Surat Keterangan Melakukan Penelitian..... | 69 |
| Lampiran 7. | Surat Keterangan Melakukan Pembacaan ELISA | 70 |
| Lampiran 8. | Surat Keterangan Hasil Penelitian Pembacaan ELISA | 71 |