

# Index

- A**
- Acetylated low-density lipoprotein (Ac-LDL), 68
  - Adipogenic lineage, 146
  - Adult stem cells, 190–191
  - Advanced therapy medicinal products (ATMPs), 192
  - Air-handling system, 222
  - Allogeneic stem cells, 222
  - Alpha smooth muscle actin (ASMA), 46
  - Alzheimer's disease (AD), 49
  - Amnioblasts, 5
  - Amniotic epithelial cells (AECs), 25, 83, 140
  - Amniotic fluid mesenchymal stem cells (AF-MSCs), 30–31
  - Amniotic fluid stem cells (AFSCs), 173–184
    - cardiovascular system, 179
    - future basic science, 182
    - limitations and challenges, 183
    - modeling of human genetic diseases, 180–181
    - musculoskeletal system, 176, 177
    - neural system, 177–178
    - respiratory system, 180
    - skin, 180
    - urinary system, 178–179
    - in utero therapy of congenital disorders, 181, 182
  - Amniotic membrane (AM), 25, 26, 83, 88, 138, 139, 141, 142, 144
    - biological skin dressing, 93
    - decellularization of human, 86–88
    - derived stem cells, 83–84
    - properties, 81
  - Amniotic membrane mesenchymal stem cells (AMSCs), 25–30, 83
    - biosafety, 143–144
    - defined biomarkers for characterization, 141–142
    - immunomodulatory features, 151–155
    - location, 139
    - preclinical studies, 155–160
    - proliferation potential, 139–140
    - studies on regeneration ability, 156–158
    - transdifferentiation predisposition, 144–150
  - Amniotic membrane transplantation (AMT), 90
  - Amyotrophic lateral sclerosis (ALS), 155
  - Angioblasts, 66–68
  - Angiogenesis, 67
  - Angiogenic property, 84
  - Angio-vasculogenic effect, 159
  - Antiaging medicine, 231
  - Antibacterial activity, 85–86
  - Antibacterial activity for bacterial standard strains (ATCC), 96
  - Antigen-presenting cells (APCs), 32
  - Anti-inflammatory therapy, 53
  - Antiscarring effects, 84
  - Aorta-gonadal mesonephros (AGM), 109
  - Aseptic processing, 217, 219, 220, 222, 225
  - Astasia, 54
  - Autism Spectrum Disorders (ASD), 55
  - Autologous chondrocyte, 51
  - Autologous skin grafting, 92
- B**
- B7 homolog 1 (B7-H1), 28
  - Basement membrane, 82

Basic fibroblast growth factor (bFGF), 31, 83, 84, 95, 149

Beta amyloid peptide ( $A\beta$ ), 49

Biopolymers, 93

Blood vessels, 65, 71

Bone marrow (BM), 66, 74, 137, 138, 152

Bone marrow mesenchymal stem cells (BMSCs), 52, 141, 142, 160, 173, 178

Bone regeneration using stem cells, 176

Brain-derived neurotrophic factor (BDNF), 144

Burn wounds, 94–96

**C**

Carcino-embryonic antigen (CEA), 118

Cardiomyogenic lineage, 148

Cardiovascular disease (CVD), 75

Cell adhesion property, 84–85

Cell culture techniques, 43

Cell therapy, 48, 51, 83, 142, 150, 160, 161, 215–220, 225, 226

Cell–cell contact, 47

Cerebellar ataxia, 54–55

Chemokine receptor type 4 (CXCR4), 28

Chondrogenic lineage, 145

Chorion-derived mesenchymal stem cells (CMSCs), 31–33

Chronic wounds, 51

Circulating ECFC from cord blood (CB-ECFC), 72

Cleanroom, 216–220, 222–225
 

- classification based on GMP guidelines, 217
- cleanliness cascade, 223
- design, 219
- garments, 225
- monitoring, 222

Closed-circuit television cameras (CCTVs), 223

Colony formation assay (CFU), 68

Conditioned medium (CM), 152

Contract manufacturing organizations (CMOs), 226

Corticosteroids, 54

Cotransplantation, 73

Cotyledons, 71

Curative therapy, 52

Cyclooxygenase-2 (COX-2), 23

Cystic fibrosis transmembrane conductance regulator (CFTR), 8

Cytokines, 30, 31, 161

Cytotrophoblast cells, 70

**D**

Decellularization, 86–88

Dendritic cells (DCs), 23, 24, 154, 155

Dermis, 92

Diabetes mellitus (DM), 56, 158

Diabetic foot ulcers (DFU), 96, 97

Diabetic ulcers, 96–97

Diabetic wounds, 51

Dimethylsulfoxide (DMSO), 197, 202

Dulbecco's modified eagle's medium (DMEM), 192

**E**

Embryonic stem cells (ESCs), 42, 107, 113–115, 119, 142, 143, 229, 232

Endothelial cells (EC), 65, 68

Endothelial colony-forming cells (ECFC), 69, 75

Endothelial lineage, 146

Endothelial outgrowth cells (EOC), 69

Endothelial progenitor cells (EPC), 70, 72
 

- application, 73–75
- characteristics, 68–70
- defined, 66
- placenta, 72–73

Enhanced green fluorescence protein (EGFP), 155

Epidermal growth factor (EGF), 22, 26, 83, 84, 95

Epidermis, 92

Epithelial cells, 92

Epithelial growth factor (EGF), 31

Epithelial layer, 82

*Escherichia coli*, 95

Ethical judgment criteria, 230

European Medicines Agency (EMA), 216

Explant method, 43

Extracellular matrix (ECM), 144, 150

**F**

Fetal bovine serum (FBS), 26, 43, 44, 192, 194, 197, 202

Fetal membrane, 139, 140, 151, 161

Fetal stem cells (FSCs), 107

Fibroblast growth factor (FGF), 51

Fibroblast growth factor receptor 2 (FGFR2), 48

Fluorescence in situ hybridization (FISH), 73

**G**

Germ layers, 42

Glial fibrillary acidic protein (GFAP), 46, 150

Glycosaminoglycan (GAG), 50, 51  
 Good manufacturing practice (GMP), 43, 216–225  
   compliant cell manufacturing facility, 199  
   compliant stem cells, 190, 192, 202  
   facility and staff training, 198–200  
   facility design, 218–224  
   facility maintenance and operations, 224–225  
   grade raw materials, 192–196  
   phases  
     commissioning phase, 223  
     construction phase, 222, 223  
     design phase, 220–222  
     planning phase, 219, 220  
     qualification phase, 224  
 Graft-versus-host disease (GVHD), 52–53, 57, 108, 120, 122  
 Granulocyte chemotactic protein (GCP-2), 144  
 Granulocyte macrophage colony-stimulating factor (GM-CSF), 144

**H**

HEALING-II registry, 74  
 Hemangiogenic stem cells, 71  
 Hematopoietic stem cell transplantation (HSCT), 52  
 Hematopoietic stem cells (HSC), 66, 67, 72  
 Hemogenic endothelium (HE), 66  
 Hepatic growth factor (HGF), 29, 83  
 Hepatic stellate cell (HSC), 53  
 Hepatitis B virus (HBV), 53  
 Hepatocyte growth factor (HGF), 22, 45, 50, 153  
 Hepatocyte growth factor receptor (HGFR), 174  
 Hepatocyte nuclear factor-3 $\beta$  (HNF-3 $\beta$ ), 142  
 Hepatogenic lineage, 148  
 High efficiency particulate air (HEPA) filtration system, 199  
 High proliferative potential (HPP), 72  
 Highly proliferative population (HPP), 69  
 Hind limb ischemia (HLI), 73  
 Human amniotic epithelial cells (hAEC), 6–9, 26  
 Human amniotic membrane (HAM), 82–91, 93–97  
 Human chorionic gonadotropin (hCG), 70  
 Human embryonic stem cells (ESCs), 173, 174, 181, 184, 190, 191  
 Human leukocyte antigen (HLA), 21, 108, 111–113, 116–118, 120  
 Human leukocyte antigen class I (HLA-I), 142  
 Human leukocyte antigen-G (HLA-G), 22, 28, 29, 32, 46, 47, 152, 154

Human perinatal stem cell, 4  
 Human placental lactogen (hPL), 70  
 Human platelet lysates (HPL), 43, 44, 194  
 Human umbilical cord mesenchymal stem cells (hUCMSCs), 23  
 Human Umbilical Cord Perivascular Cells (HUCPVCs), 111  
 Human vascular development, 66–68  
 HVAC system, 220, 224

**I**

IFN- $\beta$ , 48, 49  
 IFN- $\gamma$ , 22, 23, 28, 32, 152, 153  
 Immune cells, 152  
 Immunoglobulin-like transcript receptors (ILTR), 8  
 Immunomodulatory properties  
   AF-Mscs, 30–31  
   AM-MSCs, 25–30  
   CMSCs, 31–33  
   UCB-MSCs, 23–25  
   WJ-MSCs, 21–23, 45–48  
 Immunophenotype analysis, 30  
 Immunoregulatory effects, 154  
 Indoleamine 2, 3-dioxygenase (IDO), 22, 27, 29, 31, 45, 153, 155  
 Induced pluripotent stem cells (iPSCs), 142, 198  
 Inflammatory cells, 92  
 Insulin growth factor-binding protein (IGFBP), 31  
 Insulin growth factors 1 and 2 (IGF1 and -2), 70  
 Intercellular adhesion molecule 1 (ICAM-1), 28, 149  
 Interferons (IFNs), 144  
 Interleukin-1 receptor antagonist (IL 1 RA), 91  
 Interleukin-6 (IL-6), 46, 84  
 Interleukin-8 (IL-8), 84  
 Interleukins (ILs), 144  
 Intermediate layer, 82  
 International Cooperative Ataxia Rating Scale (ICARS), 55  
 Ischemia model, 159  
 Ischemic disease, 75

**K**

Keratin layers, 94  
 Keratinocyte growth factor (KGF), 51

**L**

Large-scale expansion, 200–201  
 Leukemia inhibitory factor (LIF), 22

Leukocytes, 48  
 Limbal epithelial stem cells (LESCs), 89  
 Limbal stem cells (LSC), 89–91  
 Limbal stem cell deficiency (LSCD), 89  
 Liver cirrhosis, 53, 158  
 Liver diseases, 50  
 Liver transplantation, 53  
 Long storage and cryopreservation, 196–198  
 Lung fibrosis, 158, 160  
 Lupus nephritis, 54  
 Lymphocytes (LC), 86–88

## M

Macrophages (MQ), 88  
 Mammalian skin, 91  
 Matrix metalloproteases (MMPs), 28, 31, 53  
 MCAO model, 156  
 Mesenchymal stem cells (MSCs), 21–24,  
 26–28, 30–32, 41–43, 45, 47–51,  
 54–57, 71, 72, 82, 83, 85, 109, 111,  
 114, 116, 117, 137, 139, 141, 142,  
 145–148, 151–154, 173, 181, 190  
 Mesodermal cells, 67, 71  
 Methotrexate (MTX), 52  
 Methylprednisolone (MP), 159  
 Microchimerism studies, 72  
 Microvesicles (MV), 56–57  
 Migration inhibitory factor (MIF), 160  
 Mixed lymphocyte reaction (MLR), 22,  
 152, 153  
 Monocyte chemoattractant protein-1  
 (MCP-1), 160  
 Multidrug-resistant (MDR), 96  
 Multiple system atrophy-cerebellar type  
 (MSA-C), 54  
 Mycophenolatemofetil (MMF), 52  
 Myo D, 149  
 Myocardial infarction (MI), 50  
 Myogenic lineage, 146, 147

## N

Nascent vessels, 67  
 Natural killer (NK) cell, 24, 27, 29, 32, 47,  
 151, 154  
 Neovascularization, 93  
 Nestin (NES), 150  
 Neural cell adhesion molecule (NCAM),  
 150, 174  
 Neurogenic lineage, 147  
 Neuron-specific enolase (NSE), 150  
 Nitric oxide (NO), 45, 153

## O

Ocular surface, 89–91  
 Ocular surface diseases (OSD), 91  
 Oligodendrocytes, 51  
 Osteogenic lineage, 145

## P

Perinatal and fetal tissue-derived stem cells, 191  
 Perinatal stem cells, 1–6, 10, 233  
 Peripheral blood mononuclear cell (PBMC), 9,  
 152, 153  
 Phosphate-buffered saline (PBS), 159, 198  
 Placenta, 69–73  
 Placenta-derived stem cells, 2, 14  
 Placental growth factor (PIGF), 70  
 Placental tissue, 139  
 Placental-ECFCs (P-ECFC), 72  
 Plasma cells (PC), 88  
 Platelet lysate, 194  
 Platelet-derived growth factor (PDGF), 22,  
 51, 84  
 Pluripotency markers, 44  
 Pluripotent stem cells, 83  
 Poly Tetra Fluoro Ethylene (PTFE), 93  
 Polyglycolic acid (PGA), 50  
 Postnatal vasculogenesis, 68  
 Preclinical studies, 155–160  
 Programmed death-ligand 1 (PD-L1), 28  
 Prostaglandin E (PGE), 27  
 Prostaglandin E2 (PGE2), 22, 27, 29, 31, 45,  
 153, 155  
*Pseudomonas aeruginosa*, 95

## R

Regenerative medicine, 137, 138, 143, 155,  
 189, 229–233

## S

Secretory leukocyte proteinase inhibitor  
 (SLPI), 85  
 Semiallogeneic fetus, 151  
 Silver sulfadiazine (SSD), 95  
 Skin  
 autologous skin grafting, 92  
 damages, 92  
 grafts, 94  
 healing, 94  
 keratin layers, 94  
 mammalian, 91  
 overview, 91

tissue engineering, 93  
 xenotransplant, 92  
 Sodium dodecyl sulfate (SDS), 86  
 Spinal cord injuries (SCIs), 54  
 Spinocerebellar ataxia (SCA), 54  
 Split-thickness skin graft (STSG), 93  
 SSEA-4, 174  
*Staphylococcus aureus*, 95, 96  
 Stem cell, 21, 26, 30, 41, 42, 48, 51, 66, 72,  
 82–84, 107, 110, 137–139, 143, 155  
 Stem cell-derived exosomes, 56–57  
 Stem cells for cell therapy, 190–191  
 Stem cells manufacturing, 191, 192  
 Stem cell therapy, 1, 50, 51, 138  
 Stevens–Johnson Syndrome (SJS), 55  
 Stromal cell-derived factor-1 (SDF1), 48  
 Subendothelial layer cells, 117  
 Synaptophysin (SYN), 150  
 Systemic Lupus Erythematosus (SLE),  
 53–54, 57

## T

T cell, 22, 23, 27–29, 32, 47, 52, 151–155  
 T cell receptor (TCR), 152  
 T helper cell, 27  
 T lymphocyte, 27–29, 138  
 Temporomandibular joint (TMJ), 50  
 Tissue engineering (TE), 49, 50, 82, 89–97,  
 229–233  
 Transforming growth factor beta (TGF- $\beta$ ), 22,  
 24, 27–29, 31, 32, 144  
 Transforming growth factor beta receptor III  
 (TGFB $\beta$ 3), 48  
 Tregs, 23, 153, 154  
 Tris-buffered saline (TBS), 86  
 Trophoblast cells, 70  
 Tumor necrosis factor (TNF), 28, 83  
 Tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), 144  
 Tumorigenicity, 143

## U

UC lining (UCL), 117–118  
 UC perivascular stem cells (UCPVCs), 117  
 Umbilical cord (UC) tissue, 41–43  
 Umbilical cord blood, 23, 138  
 Umbilical cord mesenchymal stem cell,  
 23–25, 109–111, 116–118

advantages over embryonic and adult stem  
 cells, 113–115  
 and cardiovascular recovery, 122–123  
 clinical application, 118–127  
 clinical trial sorted by disease types, 120  
 clinical trials based on phase, 121  
 immune-modulatory and reconstitution  
 effect, 120–122  
 immunomodulatory properties, 111–113  
 isolation and characteristics features,  
 115–118  
 for liver and gastrointestinal disorders, 124  
 and malignant abnormalities, 126–127  
 and musculoskeletal regeneration, 126  
 neural tissue regeneration, 124–126  
 number of conducted clinical trials, 121  
 therapeutic effects on diabetes mellitus, 123

## V

Validation Master Plan (VMP), 220  
 Vascular cell adhesion molecule (VCAM),  
 28, 149  
 Vascular endothelial growth factor (VEGF),  
 31, 50, 51, 84, 146, 149  
 Vascularization, 65, 73  
 Vasculogenesis, 66, 67  
 von Willebrand factor (vWF), 93, 149

## W

Wharton's jelly (WJ), 21, 41, 108–110, 115, 116  
 Wharton's Jelly mesenchymal stem cells  
 (WJMSC), 1, 6, 10–14, 21–23, 43–49  
 antitumor activity, 48–49  
 cancer therapy, 57  
 characterization, 43–44  
 differentiation and clinical potential,  
 10–12  
 homing, 48  
 immune properties, 13–14  
 immunomodulatory properties, 45–48  
 isolation methods, 43  
 xeno-transplantation, 50  
 Wound healing process, 92

## X

Xenotransplant, 92