

### **Notable Studies using Primates**

\*Polio—disease and vaccine

\*Split-brain experiments—mapping neocortical connections (right brain, left brain)

\*Vision experiments—macrocolumnar organization of vision, depth perception

\*Deep-brain stimulation—mapping over and underused portions of the brain

(Parkinson's)

\*AIDS—disease, treatments and vaccines

\*Treatment of anxiety and depression—pharmacological treatments

### **Medical research on primates**

Leprosy

HIV and AIDS

Asthma

Parkinson's disease

Alzheimer's

Depression, anxiety and psychosis

Rheumatoid arthritis

Malnutrition caused by food aversion following chemotherapy

Cyclospora, an intestinal illness

Cardiopulmonary hypertension

Kidney dialysis

Anti depressant and anti psychotic medications

Life support systems for premature babies

Medicine to control transplant rejection

Components of blood and plasma

Rh factor, blood-typing knowledge critical for safe blood transfusions

Anesthesia and neuromuscular blocking agents

Cancer chemotherapy

Therapeutic use of cortisone

Procedures to restore blood supply in the brain

Interaction between tumor viruses and genetic material

Corneal transplants

Congenital cataracts and "lazy eye" in children; normal retinal development

Effects of Lead toxicity

Effects of alcohol during pregnancy

Reproduction and genetic disorders

Parent to child lung transplants for cystic fibrosis

Diagnosing influenza

Maternal transmission of HIV/AIDS to fetuses and infants

Hepatitis B and C

Acute Respiratory Disease

Periodontal Disease

Effects of calorie reduction

Addictive disorders

### **Vaccines developed with Primates**

Polio

Diphtheria

Malaria

Anthrax

Hepatitis B

German measles

Yellow fever

Mumps, Measles, Rubella

14 potential HIV/AIDS vaccines

### **Top proscribed drugs developed on Primates:**

Simvastatin for cholesterol control

Omeprazole for stomach acid control

Levothyroxine Sodium, a thyroxine replacement

Ramipril for hypertension

Amlodipine for hypertension and angina

Paracetamol for pain relief

Atorvastatin for cholesterol control

Salbutamol for asthma

Lansoprazole for stomach acid control

Metformin Hydrochloride, an anti diabetic

Cholecalciferol, vitamin D

Bendroflumethiazide, a diuretic

### **History of Medical uses of Primates**

#### **1900**

\*Components of blood and plasma discovered. Treatment of pellagra.

#### **1920s**

\*Ability to diagnose and treat typhoid fever.

#### **1930s**

\*Modern anesthesia and neuromuscular blocking agents. Mumps virus discovered.

#### **1940s**

\*Treatment of rheumatoid arthritis.

\*Discovery of the Rh factor, blood-typing knowledge critical for safe blood transfusions.

#### **1950s**

\*Development of polio vaccine.

\*Chlorpromazine and its tranquilizing derivatives.

\*Cancer chemotherapy.

\*Development of yellow fever vaccine.

#### **1960s**

\*Mapping of the heart's connections to arteries.

\*Development of German measles vaccine.

\*Therapeutic use of cortisone.

\*Corneal transplants.

#### **1970s**

\*Treatment of leprosy.

- \*Procedures to restore blood supply in the brain.
- \*Interaction between tumor viruses and genetic material.
- \*Understanding of slow viruses, which linger in the nervous system.

### **1980s**

- \*Development of cyclosporine and anti-rejection drugs.
- \*Processing of visual information by the brain.
- \*Identification of psycho-physiological co-factors in depression, anxiety, and phobias.
- \*Treatment of malnutrition caused by food aversion following chemotherapy.
- \*Treatment of congenital cataracts and "lazy eye" in children.
- \*First animal model for research on Parkinson's Disease, enabling doctors to more accurately research human Parkinson's Disease.
- \*Heart and lung transplant to treat cardiopulmonary hypertension.
- \*First Hepatitis B vaccine.
- \*Rhesus monkey model for AIDS used to establish the effectiveness of early administration of AZT in cases of diagnosed infection.
- \*Addition of taurine to infant formulas. An amino acid in breast milk, taurine is necessary for normal retinal development.

### **1990s**

- \*Estrogen discovered to control an enzyme key to making serotonin, the brain chemical that regulates mood. Represents first step to providing effective medications for depression at the end of the menstrual cycle, and postpartum and postmenopausal depression. Lead toxicity studies help U.S. fight childhood lead exposure.
- \*Ongoing development of a one-dose transplant drug to prevent organ rejection.
- \*First controlled study to reveal that even moderate levels of alcohol are dangerous in pregnancy.
- \*Breakthroughs in understanding the mechanisms of puberty and disorders of puberty.
- \*Primate embryonic stem cells studied extensively for the first time, advancing efforts to better understand reproduction and genetic disorders. Control of intimal hyperplasia. Parent to child lung transplants for cystic fibrosis.
- \*Monkey model developed for curing diabetes.

\*Naturally regenerative mechanism discovered in the mature primate brain, spurring new research toward curing Alzheimer's, other degenerative brain disorders.

\*Wild primate species help characterize emerging infectious diseases.

\*Rhesus and cynomolgus monkey kidneys developed for use in diagnosing influenza.

\*Development of anthrax vaccine.

## **2000s**

\*Gene that boosts dopamine production and strengthens brain cells used to successfully treat monkeys showing symptoms of Parkinson's Disease, a neurodegenerative disorder.

\*Monkey model developed to study the effects of malaria in pregnant women and their offspring.

\*Cyclospora, a food-borne pathogen, is characterized in primates. Dietary restriction without malnutrition provides major health benefits and may extend maximum lifespan.

\*Rhesus monkeys are now prime model for development of human immunodeficiency virus (HIV) treatments and potential vaccines. There are 14 licensed anti-viral drugs for treatment of HIV infection alone. Human embryonic stem cell work based on research in monkeys makes dramatic advances. Acquired Immune Deficiency Syndrome (AIDS) Researchers depend heavily on monkeys for the development of promising strategies to protect people from this disease. Vaccines containing various strains of a simian immunodeficiency virus (SIV), a closely related virus that follows a disease course similar to HIV, or a hybrid human/simian immunodeficiency virus (SHIV) are being tested in macaque monkeys, and several research groups have successfully vaccinated monkeys with viral preparations that reduce viral load and halt disease progression. If these results can be generalized to humans, the vaccines may be used to treat HIV-infected humans. Due to primate studies, significant strides have been made, especially in maternal transmission of HIV/AIDS to fetuses and infants.

\*Hepatitis B and C Research with chimpanzees has virtually eradicated Hepatitis B and C infections acquired through blood transfusions. Commercially available Hepatitis B vaccines have prevented the development of cirrhosis and liver cancer in millions of people. Because no vaccine for hepatitis C infections is yet available, scientists continue to study the pathogenesis of this disease in chimpanzees to gain a better understanding of the infection process.

\*Malaria Researchers are beginning to overcome some of the enormous obstacles in developing a vaccine against malaria, a disease that affects millions of people annually. New World monkeys and chimpanzees are the only species suitable for vaccine evaluation because they are susceptible to the same strains of the parasites that cause human malaria. A number of promising vaccines are being tested and have successfully stimulated protective responses in animals and may soon be ready for human trials.

\*Acute Respiratory Disease Respiratory syncytial virus (RSV) can cause life-threatening respiratory infections in infants, young children, and the elderly. Since there is no effective therapy, a vaccine is a high medical priority in the U.S. Vaccines are being tested for their ability to protect chimpanzees, the animal that is naturally infected by RSV and develops an illness with symptoms similar to those seen in humans.

\*Periodontal Disease This infection of the tissue supporting the teeth is the most common cause of bone and tooth loss in humans and may be an important risk factor for cardiovascular disease. It is also a health problem for captive primates, making these species excellent models for studying the connection between chronic oral infections and systemic disease. Several groups of researchers have shown that immunizing monkeys with a vaccine containing a killed oral bacterium can stop the progress of infection and suppress bone loss.

\*Aging and Nutrition Scientists are currently studying the effects of long-term calorie restriction (CR) on the biology of aging in macaque monkeys. They have learned that a reduction in calories over a period of several years lowers body temperature, slows metabolism, lessens the risk of cardiovascular disease, and reduces predisposition toward diabetes. Long-term studies of CR have increased the life span of monkeys.

\*Brain Biology Because nonhuman primates share many of the same features of brain biology and structure with humans, they are extremely valuable models for studying normal brain function and brain-related diseases, including mental, neurological, and addictive disorders.

\*Alzheimer's Disease The decline of memory and other mental functions in patients with Alzheimer's Disease is associated with the loss of or damage to cholinergic nerve cells that use the chemical acetylcholine to transmit messages to other cells in the brain.

Scientists have shown that grafting genetically modified cells to produce nerve growth

factors directly into the brains of macaque monkeys is a safe procedure that enhances the survival and function of the cholinergic nerve cells. Such studies are now being extended to humans in an attempt to slow the loss of memory in patients with this disease.

\*Parkinson's Disease Parkinson's Disease is a slow progressive disease generally found in the aged. Recently, scientists have found a new method to deliver the gene that produces GLNF (a factor that protects brain cells) directly in the brains of monkeys. The treatments successfully prevented the progression and reversed the symptoms of the disease. Clinical testing to forestall human disease is under consideration.