Finding: Following a stroke, individuals with a higher content of circulating stem cells recover better than individuals with fewer circulating stem cells.

In a study from the University Hospital Pasteur, 25 patients who incurred a stroke were divided into 2 groups. The first (left side in graph) had a higher number of circulating stem cells after the stroke, the second had a lower number (right side in graph). On the y-axis is severity of the stroke’s effects. One and three months after the stroke, the patients with higher amounts of circulating stem cells had a more profound neurological recovery as compared to patients who had lower stem cell counts.


Finding: Smokers have impaired circulating stem cells, which increase with cessation and decrease with resumption of smoking.

The effects of chronic smoking and subsequent termination were examined on circulating EPC levels. Participants included 14 nonsmokers and 15 smokers; all of the smokers quit smoking. It was found that circulating PCs and EPCs increased promptly after cessation and decreased again following resumption of smoking (resembling a level similar to pre-termination). Recovery of EPCs was found to be greater in light smokers than in heavy smokers. The graph on the left illustrates the levels of circulating progenitor cells corresponding to various time frames following smoking cessation and resumption.


Finding: Circulating stem cells correlate with vascular health and cardiac risk factors.

In a study published in the New England Journal of Medicine, it was hypothesized that EPCs had a significant role in continuing endothelial repair, where decreased or damaged mobilization would contribute to endothelial dysfunction and cardiovascular disease progression. They measured the amount of circulating EPCs that were able to form colonies (colony-forming units) in blood samples of 45 men who had differing degrees of cardiac risk factors but had never suffered cardiovascular disease. It was shown that a strong correlation existed between the number of circulating EPCs and the subject’s Framingham Risk Score — a measure of risk for cardiovascular disease (see graph to the right). Significant correlations also existed between the amount of progenitor cells and the participant’s endothelial function; levels of circulating EPCs were actually a better predictor of vascular reactivity than the existence or nonexistence of cardiac risk factors.


Finding: Injured tissue mobilizes or “calls in” stem cells.

Authors of this study sought to see if EPCs and CD34+ cells were mobilized in peripheral blood (PB) following acute myocardial infarction. Participants included 16 people who had just suffered an acute myocardial infarction and 8 control subjects who had no evidence of any cardiac ischemia (but suffered from abnormal chest pain). Flow cytometry analysis demonstrated that circulating CD34+ counts significantly increased following onset of myocardial infarction, reaching a peak at day 7 (see graph on the left), where control groups had no change. Furthermore, induced culture of a sample of these cells from the patients with acute myocardial infarction developed higher levels of cell clusters and EPCs from PB obtained from day 7 than day 1. This shows not only that levels of EPCs and CD34+ increase in response to an injury, but their capabilities to mobilize and colonize also increase (demonstrating their importance in response to injury).

**Finding:** Increasing the number of circulating stem cells with G-CSF leads to a therapeutic effect in cardiac regeneration.

Granulocyte colony-stimulating factor (G-CSF) is a drug that mobilizes EPCs, a type of circulating stem cell. This study shows the effectiveness of having increased circulating stem cells in regards to cardiac regeneration (following acute myocardial infarction). The current study took 41 patients with large anterior wall acute myocardial infarction who were at increased risk of unfavorable cardiac remodeling, randomizing them into a control group and a treatment group. After a follow-up of 5 months, patients treated with G-CSF showed a substantially higher LV ejection fraction (left ventricular ejection fraction — the heart’s pumping ability) than those treated by conventional methods. Using G-CSF (a means of increasing circulating EPCs) prevented unfavorable cardiac remodeling and improved LV function significantly (see graph to the right).

**Reference:** Leone et al. Usefulness of granulocyte colony-stimulating factor in patients with a large anterior wall acute myocardial infarction to prevent left ventricular remodeling (the rigenera study). Am J Cardiol 2007, 100:397-403.

**Finding:** Individuals with Alzheimer's have reduced levels of circulating stem cells and a correlation exists between the decreased number of circulating stem cells and the severity of the disease.

In a recent study, the authors sought to investigate the levels of various circulating stem cells involved in angiogenesis (such as EPCs) in patients with Alzheimer’s disease. Study participants included 55 who were newly diagnosed with Alzheimer’s (AD), 37 who had non-AD neurodegenerative diseases, and nondemented risk factor control subjects for both groups after matching for sex, age, and Framingham risk factor score. Results demonstrated that patients with AD had significantly lower amounts of CFU-EPC (colony-forming units) than the risk factor (RF) controls (see Figure 1). Furthermore, lower amounts of CFU-EPC in patients with AD were independently associated with either a higher Clinical Dementia Rating scale score or a lower Mini-Mental State Examination score (see Figure 2).


**Finding:** Patients with migraine headaches have decreased circulating stem cells.

Study authors investigated patients with migraines to see if irregularities in EPC amounts or abilities existed. A large sample was enlisted, including 166 total consecutive headache patients with varying degrees of severity (severity determined separation into three more groups). Peripheral blood samples were taken to determine CFU-EPCs in the patients; results indicated that those with migraines had significantly lower EPC levels (migraine with aura being lower than migraine without aura). EPCs from migraine patients demonstrated a decreased migratory capacity and increased cellular senescence compared to EPCs from normal subjects or those with tension-type headaches. These findings suggest that EPC numbers and functions may represent a link between migraines and cardiovascular risk factors.


**Finding:** Erectile and endothelial function correlate with circulating endothelial progenitor cell levels.

Endothelial dysfunction has been identified as a necessary connection with erectile dysfunction (ED). The objective of this study was to discover any potential trends in EPC levels of overweight men with and without ED. 30 overweight, yet healthy individuals with symptomatic ED for a period of at least 6 months were matched with 30 control subjects of same age and weight without ED. Erectile function was assessed and multiple subpopulations of circulating EPCs were measured through flow cytometry. It was found that certain EPCs were significantly reduced in overweight subjects with ED and were related to the severity of the disease.