A-Muse-ing Cells

By: Banoo Rafiqzada

It starts with a banana.

Not the whole thing—just the peel. But that's enough to send you crashing to the ground. You might end up with a few bruises, a sore wrist, or a twisted ankle. Still, your body can handle it. With a bit of time, the swelling goes down, the pain fades, and your cells quietly get to work repairing the damage.

But what if they didn't?

Not all injuries are as simple as banana peel falls. Traumas like spinal cord injuries, heart attacks, and strokes plunge your cells into a hostile environment[1]. Cut off from blood flow and starved of oxygen levels, it becomes a place no cell wants to be. Under overwhelming stress, they begin to shut down and die[1]. And just like that, the body's ability to heal becomes far more complex.

But your body isn't ready to give up!

Amid the chaos, a special group of cells steps up—not only surviving the stress , but thriving in it. These resilient cells push through low oxygen levels, heavy inflammation, and harsh biochemical signals. They migrate toward the site of damage and begin to the process of repair[6]. These are called Muse cells—short for *multilineage differentiating stress-enduring cells*—and they represent one of the body's most promising tools for healing and regeneration.

Regenerative medicine has long been driven by the potential of stem cells to to repair and replace damaged tissues. Two major players have dominated the field: embryonic stem cells (ESCs) and induced pluripotent stem cells (iPSCs).

ESCs are derived from early-stage embryos and are *pluripotent*—meaning they can develop into *any* cell type in the body[4]! Whether it's skin, heart, muscle, or bone, ESCs have the capacity to form it. That versatility makes them a perfect candidate for regenerative therapies.

However, ESCs have long been entangled in ethical and political debates. As a result, , access to ESCs has been limited, slowing progress in the field[4].

To get around this, scientists developed iPSCs—adult cells that are reprogramed in the lab to return to a pluripotent state. With the right combination of factors, ordinary skin or blood cels can be turned into cells capable of becoming virtually any tissue—without the use of embryos[4].

But despite their promise, iPSCs come with their own challenges. Reprogramming is complex, and the resulting cells don't always behave as expected. Both ESCs and iPSCs also carry a risk of forming teratomas—unusual tumors made up of various tissue types[5].

So, while iPSCs offer a less controversial path forward, the search continued for a safer, more reliable alternative.

Fig. 1: Muse cells to the rescue!

That's where Muse cells come in.

With an exciting and groundbreaking discovery in 2010, Dr. Mari Dezawa and her team at Tohoku University in Japan introduced Muse cells to the world of regenerative medicine[2]. Unlike iPSCs and ESCs, Muse cells aren't created in a lab, and they don't come from embryos. They've been inside us all along.

Naturally residing in tissues like bone marrow, fat, skin, and blood, Muse cells act like the body's quiet emergency responders—lying in wait until they're needed for repair and regeneration[5,6] (Figure 1).

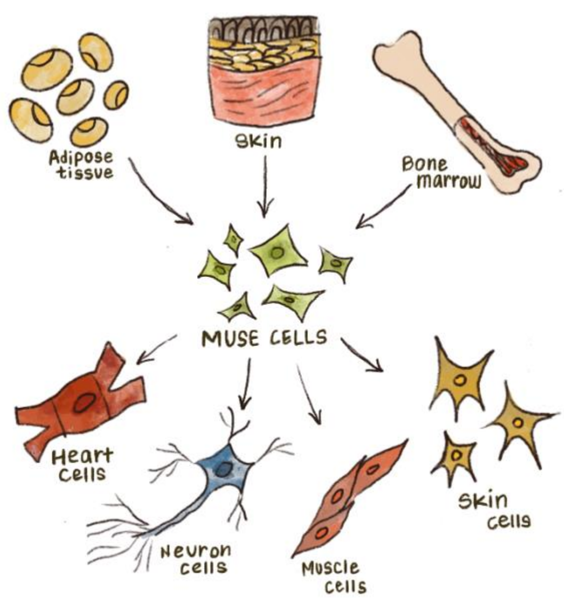

Fig. 2: Muse cells can form lots of cells.

As such, their location makes Muse cells relatively easy to collect. They can be found in fat tissue obtained through liposuction—a procedure that is generally safe and minimally invasive[5]. What's more, because Muse cells originate from your own body, they come equipped with immune suppressive properties, helping to avoid the complications of immune rejection during transplantation[5,6].

Like other stem cells, Muse cells are pluripotent—they are capable of forming any cell type the body needs (Figure 2)[6]. But what truly sets them apart from ESCs and iPSCs is their non-tumorigenic nature. Muse cells do not form tumors, making them a significantly safer option for regenerative therapies.

That's a big deal.

Unlike other pluripotent cells, which carry the risk of uncontrolled growth and teratoma formation, Muse cells don't have this problem. In fact, across 450 clinical trials involving Muse cells, there have been no reported cases of tumor formation to date[3]. This makes them extremely safe for clinical use!

Right now, scientists around the world are investigating the use of Muse cells in a multitude of treatments and therapies. And so far, what they've found is seriously impressive! Many current studies are exploring how Muse cells can regenerate heart cells to keep our hearts beating strong after heart attacks[6]. Others are looking into how Muse cells can transform into neurons to help restore brain function after traumatic strokes[3].

Because Muse cells can become nearly any cell type, the therapeutic possibilities are vast!

So, when your injuries go far beyond a simple fall from a banana peel, Muse cells may be there to help! For decades, scientists have relied on breakthroughs in reprogramming or reengineering pluripotent cells to help regenerate tissue. Yet Muse cells remind us that sometimes, the solution isn't about creating something new—it's about uncovering what's been within us all along.

And if that's not a little a-Muse-ing, I don't know what is!

REFERENCES

1. Akamatsu, Y., & Hanafy, K. A. (2020). Cell Death and Recovery in Traumatic Brain Injury. Neurotherapeutics, 17(2), 446–456. https://doi.org/10.1007/s13311-020-00840-7
2. Kuroda, Y., Kitada, M., Wakao, S., Nishikawa, K., Tanimura, Y., Makinoshima, H., Goda, M., Akashi, H., Inutsuka, A., Niwa, A., Shigemoto, T., Nabeshima, Y., Nakahata, T., Nabeshima, Y., Fujiyoshi, Y., & Dezawa, M. (2010). Unique multipotent cells in adult human mesenchymal cell populations. Proceedings of the National Academy of Sciences, 107(19), 8639–8643. https://doi.org/10.1073/pnas.0911647107
3. Li, H., Wei, J., Liu, X., Zhang, P., & Lin, J. (2022). Muse cells: Ushering in a new era of stem cell-based therapy for stroke. Stem Cell Research & Therapy, 13(1), 421. https://doi.org/10.1186/s13287-022-03126-1
4. Liang, G., & Zhang, Y. (2013). Embryonic stem cell and induced pluripotent stem cell: