

# Mast Cells:

## Key regulators of the immune system

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Mast cells are a type of human immune cell. Though they are small in size, Mast cells have a wide range of functions and play a key role in creating an inflammatory response during infections, an essential role to protect against bacterial infection. However Mast cells are also responsible for the development of allergies and hay fever.

### What are Mast Cells?

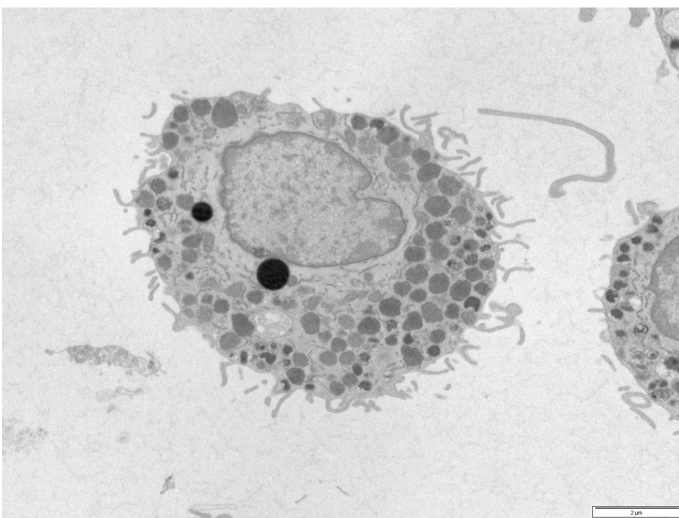
Mast cells are essential immune cells that guard the human body. They are found in all tissues of the body, providing a rapid response to invading pathogens. In 1878 German scientist Paul Ehrlich discovered Mast cells, due to their large granules he mistakenly thought they were responsible for nourishing the surrounding tissue. Ehrlich, named the cells mastzellen inspired by the German word mast which means “to fatten”. Since their discovery 140 years ago Mast cells have revealed remarkable roles in initiating our immune system response, however there are still many secrets of this cell yet to be revealed...

### Masters of the immune system?

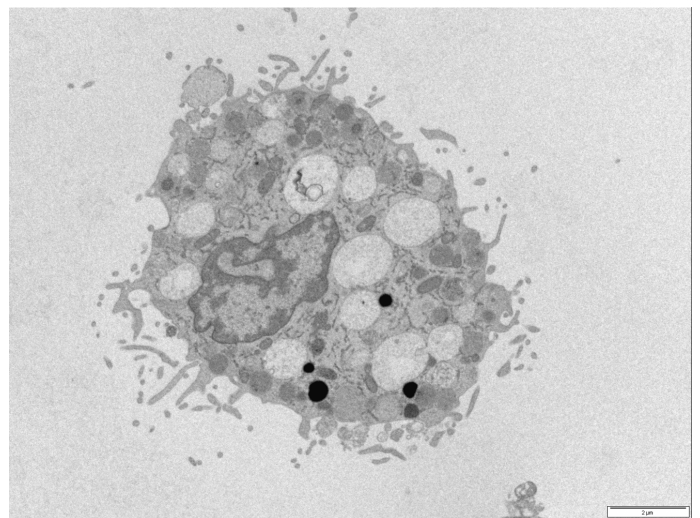
As the master cell of the immune system, mast cells are key to triggering inflammation at the site of infection. Mast cells contain many granules in their cytoplasm, which in normal conditions are kept inside the mast cell. However, when the immune system is under attack the mast cell activates and undergoes degranulation, each of the granules are filled with powerful inflammatory mediators, such as histamine, which are deployed to the extracellular environment in response to a specific stimulus.

**“Mast Cells are ‘first responders’ in an infectious attack”**

Most famously, Mast cells express antibody receptors, which allows them to recognise pathogens that you have previously been exposed to. This means Mast Cells are “first responders” in an infectious attack. However, this mechanism can backfire and cause disruption by creating an allergic response when it contacts pollen and other harmless environmental stimuli.



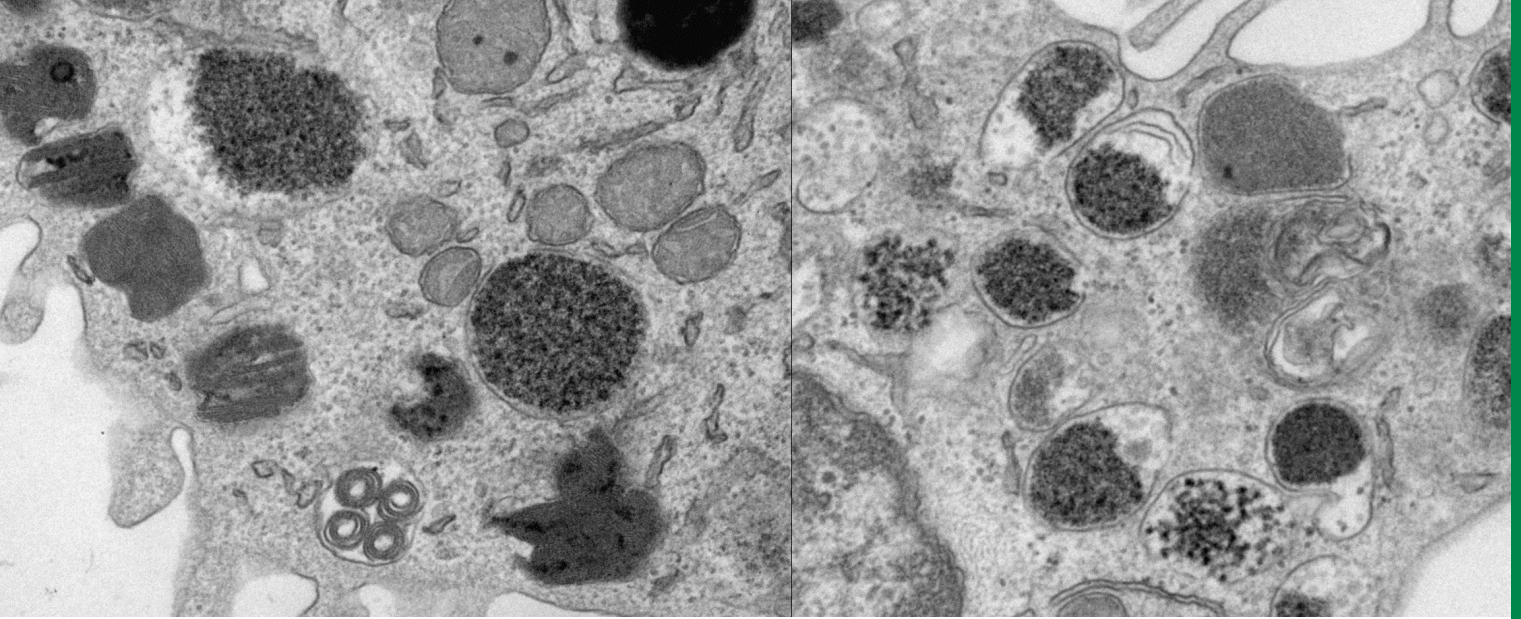
Mast cell from the human lung shown in “normal” conditions with lots of granules contained in the cytoplasm. Electron microscope image (1,000,000x).



Mast cell from the human lung “activated” form containing fewer granules due to secretion. Electron microscope image (1,000,000x).

Photo credit: Leicester University (EMF department)

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**Mast cell granules. Electron microscope image (1,000,000x).**

Photo credit: Leicester University (EMF department).

### **Mast Cell: Origin Story**

There is an ongoing debate about the origin of the Mast cell population. It is widely accepted that Mast cell precursors, “baby” Mast cells, develop in the bone marrow alongside white blood cells. These precursors are released into the bloodstream and migrate to all the different tissues in the body where they mature into “adult” Mast cells.

**“The more we understand about mast cell function the better we will be able to treat the various diseases caused by mast cells”**

The job of a Mast cell is to sit within the tissue and survey the local environment for evidence of attack from foreign bodies. When an invader is identified Mast cells rapidly release their granules which contain a wide range of inflammatory mediators and toxins, all within a minute! The toxins start attacking the dangerous pathogen, while the inflammatory mediators act as a signal to alert other immune cells to the invader so they can help join the fight! The signal acts like a beacon which attracts immune system cells to the site in a specific order.

For its next trick, the Mast cells produce mediators designed to attract the adaptive immune cells; T cells and B cells. This immune system team create the long-term memory of the immune system, storing the profiles of previous invaders so they can be recognised and dealt with more efficiently in the future.

### **Friend or foe?**

Mast cells are a double-edged sword. Even though Mast cells are crucial managers of our immune system, but they are also responsible for causing allergies. Infamously, Mast cells cause hay fever by creating an immune response to pollen. In addition, Mast cells are also responsible for a reaction to other allergens including dust, pets and peanuts.

Mast cells can also play a very damaging role in disease. For example, Mast cells create a life threatening, anaphylactic response to food and insect stings. Mast cells have an ongoing effect in chronic diseases such as Asthma. The Mast cell response to allergens inhaled into the lung causes wheezing by releasing inflammatory mediators like histamine and bradykinin which causes a contraction of the airway muscles making it difficult to breathe.

**“The more we understand about mast cell function the better we will be able to treat the various diseases caused by mast cells”**

Our research group at The University of Leicester discovered that in asthma patients the mast cells are found within the regions of airway smooth muscle in the lung (C, Brightling, 2002). Since then, different research groups have found similar outcomes, showing that mast cells can cause airway inflammation and mediating the airway's response to allergens. My involvement in Mast cell research aims to better understand the specific role of Mast cells in Asthma, by investigating the Mast cells and the airway smooth muscle relationship. Specifically, the communication between these two cells is poorly understood, so by co-culturing the two cells types I can show how one informs the other. The more we understand about mast cell function the better we will be able to treat the various diseases caused by mast cells, which is the ultimate goal of my research.