BioEnredados

Uniendo Ciencia y Vida

Third Season - Volume 1

A production of:

CIC bioGUNE

MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

EPISODES

4 BIOSENSORS: WHEN THE BODY SPEAKS AND SCIENCE LISTENS

We explore how biosensors are changing the way we understand and monitor our bodies, from detecting key biological signals to enabling more personalized healthcare. With **Gabriel Ortega**, emerging researcher from the Precision Medicine and Metabolism Group at CIC bioGUNE, we discover how these small devices can reveal what is happening inside us in real time, their potential for disease prevention, and the future of personalized medicine.

8 THE METABOLIC COST OF OBESITY

We delve into how metabolic changes such as obesity and fatty liver disease are reshaping our understanding of liver cancer. With **Amaia Navarro**, postdoctoral researcher at CIC bioGUNE, we discover how science is uncovering early biomarkers and new strategies to detect and prevent hepatocellular carcinoma.

9 MICROBIOTA AND THE IMMUNE SYSTEM

We examine how the microbiota shapes immune memory and its potential role in fighting infections and antimicrobial resistance. With **Aize Pellón**, postdoctoral researcher from the Inflammation and Macrophage Plasticity Lab at CIC bioGUNE, we explore how innate immunity could open new paths for future therapies and vaccines.

10 PROSTATE CANCER AND THE IMMUNE SYSTEM

We dig into how the immune system and tumor environment shape prostate cancer progression, from metastasis to treatment resistance. With **Jaione Auzmendi**, postdoctoral researcher from the Cancer Cell Signaling And Metabolism Lab at CIC bioGUNE, we explore how this knowledge could lead to new therapeutic strategies.

12 EMERGING VIRUSES AND PUBLIC HEALTH: HOW SCIENCE PREPARES US

We look at how emerging viruses spread across humans, animals, and the environment, and how science prepares us for future outbreaks. With **Nicola GA Abrescia**, Ikerbasque Research Professor and leader of the Virus Structure and Cell Biology Laboratory at CIC bioGUNE, we explore how immunity, vaccines, and global health strategies can help prevent viral threats.

Welcome to our podcast BioEnredados: Uniendo Ciencia y Vida!

We are your gateway to the cutting-edge research in biosciences that is taking place at the heart of CIC bioGUNE.

In each episode, we will immerse you in an exciting journey through the most innovative scientific and technological advances that are transforming our understanding of the biosciences, from basic chemistry to biology and medicine.

Our mission is clear: to bring you science in an accessible and exciting way. We aim to ignite your curiosity and nurture your interest in cutting-edge bioscientific research.

Are you ready?

BIOSENSORS

WHEN THE BODY SPEAKS & SCIENCE LISTENS

When we think about smartwatches, we often picture devices that help us stay active, count our steps, monitor our heart rate, or keep us connected throughout the day. But what if these small devices could go beyond measuring our daily habits and reveal what is happening inside our bodies in real time?

Imagine a tiny sensor capable of detecting changes in glucose levels, hormones, oxygen, or even immune responses, providing valuable information about our health as it happens. This is the promise of biosensors: innovative tools that can "listen" to the signals produced by our bodies and transform them into meaningful data. By continuously monitoring biological processes, these technologies could help us detect changes earlier, understand our health in a more dynamic way, and move toward more personalized healthcare.

In this article, we explore the world of biosensors and how they are bringing biology and technology together. To help us understand their potential, we speak with Dr. **Gabriel Ortega**, emerging researcher in the Precision Medicine and Metabolism Group at CIC bioGUNE. Together, we discover how these biological "smartwatches" could transform the way we monitor our bodies and shape the future of personalized medicine.

What exactly are biosensors?

- A biosensor can be defined as a measurement device that combines two elements: a biological component and an electronic component. It is a kind of hybrid between biology and technology that allows us to measure molecules or chemical and physical parameters in the body that are relevant, for example, in medicine, sports, and many other applications.

How do these small devices work, and what types of signals can they provide about our health in real time?

- A sensor may look like a simple, tiny device, but inside it contains many microscopic components working together. Biosensors often use biological elements such as proteins, antibodies, or enzymes that recognize specific molecules and generate a measurable signal.

The role of researchers is to connect this natural recognition process with signals we can detect, such as changes in colour, light, or electrical current. In other words, they translate microscopic molecular interactions into clear and measurable information.

Many biosensors are inspired by nature. Scientists take mechanisms that already exist in living organisms and adapt them to create stronger, more easily detectable signals.

A well-known example is the glucose sensor, where an enzyme reacts with glucose and produces an electrical signal that can be measured.

Right: Magnific. Glucose biosensor by xb100

Another familiar example is COVID rapid tests, where antibodies recognize the virus and trigger a visible colour change through gold nanoparticles.

Nature already provides many of the tools needed for these technologies. Researchers study and adapt these biological mechanisms, ncluding light-producing systems found in some organisms, to develop new biosensors for health and biotechnology applications.

From your research group at CIC bioGUNE, what projects or studies are you currently working on involving biosensors, and how could they be applied in real-life situations?

- Our main focus is developing biosensors for continuous measurements. Unlike COVID or pregnancy tests, which provide a single answer at one moment, continuous biosensors track how molecules change over time.

- This type of monitoring is important for molecules such as hormones, which naturally fluctuate throughout the day or during specific biological processes. For example, tracking fertility-related hormones or cortisol levels can provide valuable information about how the body responds to different conditions or treatments.

The challenge is creating devices that can measure these changes directly in the body, outside a hospital, while people continue with their normal activities. This requires transforming complex laboratory processes into small, autonomous devices that continuously collect and transmit data.

Glucose sensors are the best-known example of this technology, but many other molecules are much harder to detect. Researchers are therefore developing new biological mechanisms that can recognize specific molecules and convert that recognition into measurable signals.

One approach involves engineering proteins or DNA-based receptors, such as aptamers, that change their shape when they interact with specific molecules. These molecular changes can be converted into electrical signals, allowing real-time monitoring of drug levels inside the body. This could enable more personalized treatments by helping maintain the right dose, reducing side effects, and adapting therapies to each patient's changing conditions.

The main challenge is developing versatile biological signalling systems that can be applied to different targets and provide reliable, continuous information from inside the body.

Looking ahead, what role could biosensors play in personalized medicine, and what challenges still need to be overcome for them to become truly useful?

- One of the main challenges is developing new molecular detection and signalling mechanisms, which requires continued advances in biology and biochemistry.

However, technology alone is not enough. Healthcare systems and society will also need to adapt to a new approach: moving from occasional measurements to continuous, real-time monitoring of health.

Accessibility will be essential to ensure these technologies benefit everyone, not only those with access to advanced healthcare resources.

Artificial intelligence will also play a major role. It can help design new molecular tools and analyze the large amounts of data generated by continuous biosensors. With millions of people using these devices, AI could identify abnormal patterns, predict health risks, enable earlier interventions, and provide a real-time view of population health.

The future of biosensors will depend on combining advances in molecular biology, technology, and artificial intelligence to create systems that connect biological signals with meaningful health information.

"The main challenge is developing versatile biological signalling systems that can detect different targets and provide reliable, continuous information from inside the body."

Right, up: Gabriel Ortega, below: podcast episode cover.

METABOLIC PRICE OF OBESITY

FATTY LIVER DISEASE

The liver is one of the most essential and versatile organs in our body. It regulates metabolism, removes harmful substances, and performs hundreds of functions that keep us healthy. Yet, this complex organ is increasingly affected by a global health challenge: obesity and metabolic syndrome, which impact millions of people worldwide and are linked to a growing number of chronic diseases.

For decades, alcohol and viral infections were considered the main causes of liver cancer. Today, obesity, metabolic dysfunction, and certain medication-related factors are becoming increasingly important. These conditions can lead to metabolic dysfunction-associated steatotic liver disease (MASLD), where fat accumulates in the liver and can trigger inflammation, fibrosis, and, in some cases, hepatocellular carcinoma, the most common type of liver cancer in adults.

One of the biggest challenges is that MASLD often develops silently. Detecting the earliest changes in the liver and identifying new biomarkers are therefore key to preventing disease progression and improving treatment.

To explore this field, we spoke with Dr. **Amaia Navarro**, postdoctoral researcher at CIC bioGUNE. Together, we'll discover how researchers are uncovering the mechanisms behind liver disease and searching for new ways to diagnose and treat it.

Why do obesity and metabolic syndrome have such a strong impact on the liver and how can they lead to cancer?

- The most intuitive way to understand the liver is to think of it as the body's main filter and processing factory. Everything we consume, from food to medications, passes through the liver, making it one of the hardest-working organs in our body.

For many years, we considered alcohol and viral infections the main threats to liver health. They remain important, but we now know that other silent factors are becoming increasingly relevant, especially obesity and the excessive use of certain medications, such as paracetamol.

Obesity creates a constant overload of nutrients: the liver receives more fat and sugar than it can properly process. Medications, on the other hand, are broken down by liver enzymes, and some compounds can generate toxic by-products that, when they accumulate, cause liver damage.

When this metabolic and chemical stress continues for years, the liver can enter a state of chronic inflammation. This persistent inflammatory environment damages cells and increases the risk of genetic changes that can lead to tumour development.

This is why hepatocellular carcinoma associated with metabolic dysfunction and obesity is becoming an increasingly important cause of liver cancer worldwide.

Right: Magnific. Adipometer.

What happens inside the liver when fat starts to accumulate? How can something so common become the starting point of such a serious disease?

- I like to describe fatty liver as a small domestic problem that, over time, can turn into a biological fire. At first, when there is an excess of nutrients, hepatocytes, the most abundant cells in the liver, try to protect the body by storing the extra fat in small droplets inside the cell. It is like keeping boxes from an uncollected delivery: manageable at first, and even protective.

The problem begins when this situation persists. As these fat droplets continue to accumulate, the cell becomes overlooded and its metabolism starts to fail. The mitochondria, which act as the cell's energy factories, become less efficient and produce harmful molecules called free radicals. These can damage proteins, lipids, and DNA.

At this point, another key process comes into play: epigenetics. In simple terms, epigenetics works like a system of molecular switches that controls which genes are turned on or off. It does not change the DNA itself, but it changes how the information stored in DNA is read.

When the liver is exposed to constant fat overload, inflammation, and cellular stress, these switches can become disrupted. Genes that should remain inactive may become activated, while protective mechanisms may stop working properly. It is as if the liver's instruction manual becomes disorganized.

This combination of epigenetic changes, inflammation, and oxidative stress can push some cells toward uncontrolled growth, which is one of the first steps in cancer development. So, something that may seem as simple as fat accumulation can, over time, become the starting point of a much more serious disease.

"Liver cancer is often detected too late, but identifying early metabolic and epigenetic changes could enable blood tests and other tools to detect disease before it progresses."

In your research group at CIC bioGUNE, you study these mechanisms in detail. What does your project involve, and how are you investigating their role in obesity-associated liver cancer?

- We are trying to answer a key question: what early metabolic and epigenetic changes indicate that a fatty liver is starting to progress toward cancer? My project, supported by an MSCA Marie Curie fellowship, focuses on understanding how nutrients and metabolic changes can influence the way cells read their DNA. After six years of research in the United States studying the connection between metabolism and epigenetic regulation, I am now applying this knowledge to liver disease.

Using experimental models of obesity and liver damage, together with advanced technologies, we analyze how liver cells change at the metabolic and molecular levels, and how these changes affect genes involved in inflammation, fibrosis, and cancer.

The goal is to create a molecular map of liver disease progression, from simple fat accumulation to liver cancer. By identifying early warning signals, such as specific molecules in blood or epigenetic patterns, we hope to develop new biomarkers that can detect disease before irreversible damage occurs.

Looking ahead, do you think this type of research could help us detect liver cancer earlier or even prevent it?

- Yes, that is exactly why I work in this field. The dream of cancer research is to understand the disease early enough to prevent it.

Today, liver cancer is often detected too late. If we can identify the metabolic and epigenetic changes that occur years before a tumor develops, we could create early warning tools, such as blood tests, to detect when the liver starts to change.

Understanding these mechanisms could also open the door to prevention, through earlier interventions, targeted treatments, or personalized strategies for people at higher risk.

It is a long-term challenge, but we are closer than ever. Our goal is to listen to the signals the liver gives us before disease appears and transform that knowledge into better diagnosis, prevention, and treatment.

Right, up: Amaia Navarro, below: podcast episode cover.

MICROBIOTA & IMMUNOLOGY

ALLIES AGAINST ANTIMICROBIAL RESISTANCE

Our body is not just a collection of human cells, it is a living ecosystem where billions of microorganisms and our own biology are in constant conversation. At the heart of this relationship is the microbiota, a vast community of microbes that inhabits our body and influences essential processes, from digestion and metabolism to the way our immune system responds to the world around us.

For decades, immune memory was thought to belong exclusively to the adaptive immune system, the branch responsible for producing antibodies and the long-lasting protection behind vaccines. However, recent discoveries have revealed a surprising ability of our innate immune system: cells such as macrophages and neutrophils can also “remember” previous encounters and respond more efficiently in the future. This phenomenon, known as trained immunity, has changed our understanding of how the body prepares itself against future threats.

This discovery has changed the way we understand our defenses and opened new possibilities for fighting infectious diseases. The microbiota appears to play a key role in shaping this immune training, helping regulate how our body reacts to pathogens and inflammation. Understanding this connection could provide new strategies to address one of the greatest health challenges of our time: antimicrobial resistance.

To delve into this fascinating topic, we have the expertise of Dr. **Aize Pellón**, Marie Skłodowska-Curie postdoctoral researcher in the Inflammation and Macrophage Plasticity group at CIC bioGUNE.

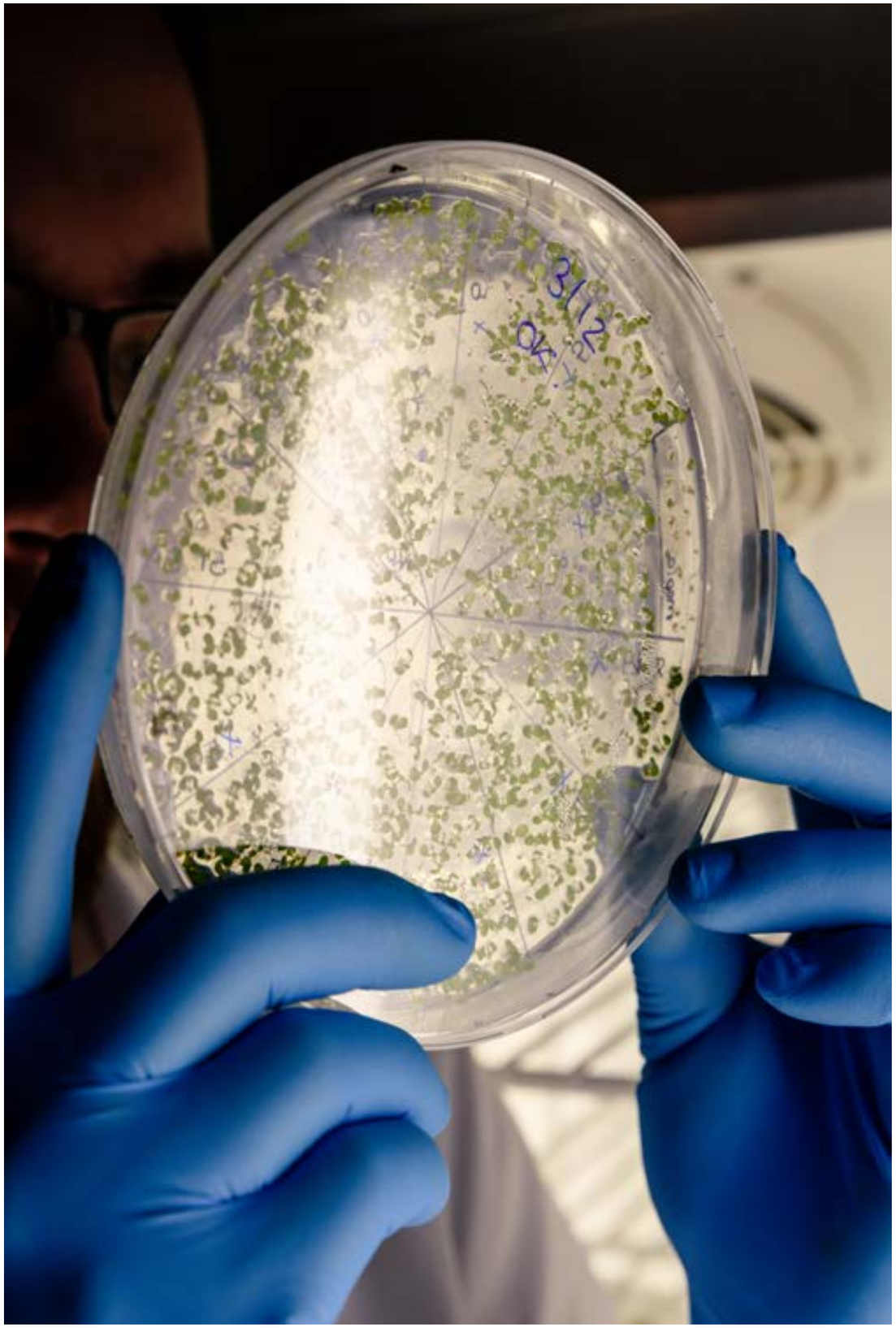
To start with the basics… what exactly is the microbiota, and why is it so important for our health?

- In simple terms, the microbiota is the community of microorganisms that live in a particular ecosystem. In our case, we are interested in the human microbiota: the microorganisms that inhabit different parts of our body.

Although we often associate microbes with disease, most microorganisms are not harmful. Many are beneficial or simply coexist with us, helping maintain a healthy balance.

Because our body contains different environments, we have different microbiotas, from the skin and mouth to the lungs and intestine. The gut microbiota is the one we know the most about because it is the largest and closely linked to our health.

Researchers have found associations between changes in gut bacteria and different diseases, but early studies were mostly descriptive. The main challenge now is understanding these interactions: whether microbiota changes contribute to disease, result from it, or involve a combination of both.



Right: Magnific. Examinating a Petri dish by wirestock.

How does the microbiota interact with our immune system? How do these two biological "worlds" communicate with each other?

- The immune system is one of the main ways our body communicates with the microbiota. Rather than simply defending us against harmful microbes, it is constantly interacting with the beneficial bacteria, fungi, and viruses that naturally live in and on our body. Understanding this dialogue is a major focus of our research.

Both Juan Anguita, who leads our research group, and I began our careers studying how the immune system responds to infectious microorganisms, his work focused mainly on bacteria, while mine focused on fungal infections. Over the last few years, our research has shifted toward understanding how the microbiota shapes the immune system and how we can use this interaction to improve health.

This relationship extends far beyond infectious diseases. Because the immune system is involved in many biological processes, the microbiota can also influence metabolic, inflammatory, and even neurological disorders. It is a partnership shaped over millions of years, allowing us to live in balance with the microorganisms that inhabit our bodies.

This interaction begins at birth, when we acquire our first microbiota, which helps educate the immune system from the very beginning. Throughout life, our microbiota continues to evolve, and lifestyle plays a key role. A balanced diet, regular exercise, and healthy habits help maintain a diverse microbiota, while probiotics and fermented foods may further support both gut and immune health.

Your research group at CIC bioGUNE focuses on a relatively new concept known as trained immunity, or innate immune memory. What is innate immune memory, and why has it become such an exciting area of research in recent years?

- Trained immunity, or innate immune memory, is a relatively new concept that has attracted a lot of attention in recent years. For a long time, we believed that only the adaptive immune system could create memory, the part involving B cells, T cells, and antibodies that allows us to respond more efficiently to a pathogen we have seen before, which is also the basis of vaccines.

The innate immune system, with cells like macrophages and neutrophils, was thought to simply detect microbes and react without remembering. However, we now know that these cells can also develop a type of memory. They do not create new memory cells like the adaptive system, but the same cells can change their metabolism and gene activity, allowing them to respond differently when they encounter a new challenge.

This discovery has changed the way we understand immunity. Innate immune memory can either strengthen the response, a process called training, or reduce it through tolerance. Our group is studying how the microbiota influences these processes and how beneficial microbes, such as probiotics, can shape immune responses and potentially help maintain a healthier balance.

"By modulating these immune responses, we could improve vaccines and combine immune-based strategies with lower antibiotic doses, helping reduce resistance."

How could this knowledge help us develop new therapies and reduce our reliance on antibiotics?

- Yes, although these are still relatively new concepts and more research is needed, understanding the mechanisms behind trained immunity could open new therapeutic possibilities.

By learning how to modulate these immune responses, we could improve vaccines or combine immune-boosting approaches with lower doses of antibiotics, helping reduce their use and limiting the emergence of resistant microorganisms.

This could be especially valuable for infections that are difficult to treat, such as fungal infections, where treatment options are more limited. A better understanding of the interaction between the immune system and the microbiota could help us develop new strategies to strengthen our natural defenses and improve the way we fight infectious diseases.

Right, up: Aize Pellón, below: podcast episode cover.

BEYOND THE TUMOR

PROSTATE CANCER & THE IMMUNE SYSTEM

Cancer is much more than the uncontrolled growth of cells. Tumors develop within a complex ecosystem where cancer cells interact with their surroundings, undergo metabolic changes, and communicate with the immune system, the body's natural defense network that constantly monitors and responds to threats.

Prostate cancer is one of the most common cancers in men. Advances in early detection and treatment have allowed many patients to live with the disease for years while maintaining a good quality of life. However, prostate cancer is not a single disease: some tumors remain controlled, while others become more aggressive, resist treatment, and spread to other organs. In these advanced stages, the interaction between cancer cells and the immune system becomes a key factor in disease progression.

Understanding how tumors evolve, how they influence and evade immune responses, and how these mechanisms can be harnessed to develop new therapies are among the major challenges in prostate cancer research today.

To find out, we turn to Dr. **Jaione Auzmendi**, Juan de la Cierva postdoctoral researcher in the Cancer Cell Signaling and Metabolism Laboratory at CIC bioGUNE, who will help us uncover the complex relationship between prostate cancer and the immune system, and how it could shape the future of cancer treatment.

What is prostate cancer and how does it currently present in patients?

- Prostate cancer is one of the most common cancers in men, particularly among those over 50 or 60 years old. In many cases, it develops slowly and does not cause noticeable symptoms in its early stages. As it progresses, some patients may experience urinary problems, such as difficulty urinating or increased frequency, which can lead to further investigation.

Diagnosis usually begins with a blood test that measures PSA, the prostate-specific antigen. Prostate cells naturally produce this protein, but cancer cells often generate much higher levels, making PSA an important indicator of possible disease. A confirmed diagnosis requires combining different approaches, including physical examination, imaging techniques, and biopsy analysis.

Fortunately, many prostate cancers are detected while they are still localized, and treatments such as surgery or radiotherapy can lead to very good outcomes. However, some tumors become more aggressive, resist treatment, and spread to other organs through metastasis. In these advanced cases, therapies that block androgen pathways can help slow disease progression, but some patients eventually develop resistance, making it essential to better understand how these tumors evolve and find new treatment strategies.

Right: Magnific. Prostate cancer ribbon.

Now that we know more about prostate cancer, let's turn to the immune system: what are the main cells that make up our defenses, and how can they influence the development and progression of prostate cancer?

- For many years, cancer research focused mainly on mutations and changes in the DNA of tumor cells. However, we now know that cancer is much more than that: tumors are part of a complex ecosystem where they interact with their surroundings, including immune cells, fibroblasts, fat cells, and even factors such as our lifestyle and habits.

The immune system is one of the key players in this environment. Its role is to detect and eliminate things that do not belong in our body. For example, when bacteria enter through a wound, immune cells activate to remove them. Even with tattoos, immune cells called macrophages recognize the ink as something foreign and "eat" it, but they can become filled with pigment and remain there, allowing the tattoo to persist.

In theory, cancer cells should also be recognized as abnormal. The problem is that tumors are very good at hiding. They create a kind of "invisibility cloak" that allows them to escape immune attack. Immunotherapy aims to remove this cloak and help our defenses recognize and fight cancer again.

These treatments have transformed the way we approach some cancers by targeting immune "switches" such as PD-1 and CTLA-4. However, prostate cancer presents a particular challenge because these tumors often contain fewer T cells, the immune cells usually targeted by immunotherapy. This is why researchers are exploring other immune cells and new ways to strengthen the interaction between the immune system and the tumor.

"Our goal is to identify what makes these tumor-associated neutrophils different and find ways to target them without affecting the protective functions of normal neutrophils."

At CIC bioGUNE, your research focuses on the interaction between prostate cancer and the immune system. What are you studying, and why is this relationship so important for understanding the disease?

- Our research focuses on a group of prostate cancer patients who already have metastasis at diagnosis. Although they represent only around 10% of cases, they account for a large proportion of prostate cancer-related deaths. To study this aggressive form of the disease, we have developed an animal model with genetic alterations in key genes, such as PTEN and LKB1, which are also commonly mutated in patients.

This model helps us understand how tumors develop, spread, and interact with the immune system. When we analyzed the immune cells present in these tumors, we found a large number of neutrophils rather than the lymphocytes usually targeted by immunotherapies. This was particularly interesting because neutrophils can have different roles: while they normally protect us from infections, some tumor-associated neutrophils can actually support cancer progression.

Our goal is to identify what makes these tumor-associated neutrophils different and find ways to target them without affecting the protective functions of normal neutrophils. We are also studying a process called NETosis, where neutrophils release DNA structures that normally help fight infections but may also assist tumor cells in spreading and forming metastases.

Right, up: Jaione Auzmendi, below: podcast episode cover.

Looking ahead, how could understanding the immune system's role in prostate cancer help us develop better therapies, especially for patients with metastatic disease?

- The future of this research is to develop better therapies by understanding how prostate cancer interacts with the immune system. These tumors are often considered "immune cold," with fewer lymphocytes targeted by current immunotherapies. Instead, cancer cells can manipulate immune cells such as neutrophils and macrophages to support tumor growth.

Our goal is to target these tumor-promoting immune cells while preserving the protective functions of the immune system. Combining this approach with existing treatments, such as immunotherapy or androgen-blocking therapies, could open new strategies for patients with advanced prostate cancer.

EMERGING VIRUSES

PUBLIC HEALTH: HOW SCIENCE PREPARES US

Our world is constantly shaped by invisible biological agents: viruses. Although we tend to think of them only when they cause human disease, they are part of a much broader ecosystem involving animals, insect vectors, the environment, and people. Understanding how viruses emerge, evolve, and spread is essential for protecting health on a global scale.

In recent years, the world has experienced firsthand the profound impact that viral diseases can have on society. The COVID-19 pandemic demonstrated that infectious diseases know no borders and highlighted the importance of scientific preparedness and international collaboration. At the same time, outbreaks affecting livestock and wildlife have underscored that viruses are not only a human health concern, but also a major challenge for animal health, food security, and the economy.

Climate change, global travel, and the expansion of disease-carrying vectors such as mosquitoes are creating new opportunities for viruses to spread into previously unaffected regions.In the Basque Country, the recent detection of diseases such as lumpy skin disease and bluetongue virus, together with concerns over the potential arrival of African swine fever virus (ASFV), illustrate how closely interconnected animal and human health have become. Meanwhile, mosquito-borne flaviviruses, including dengue, Zika, and West Nile virus, continue to pose an increasing global threat, affecting millions of people every year.

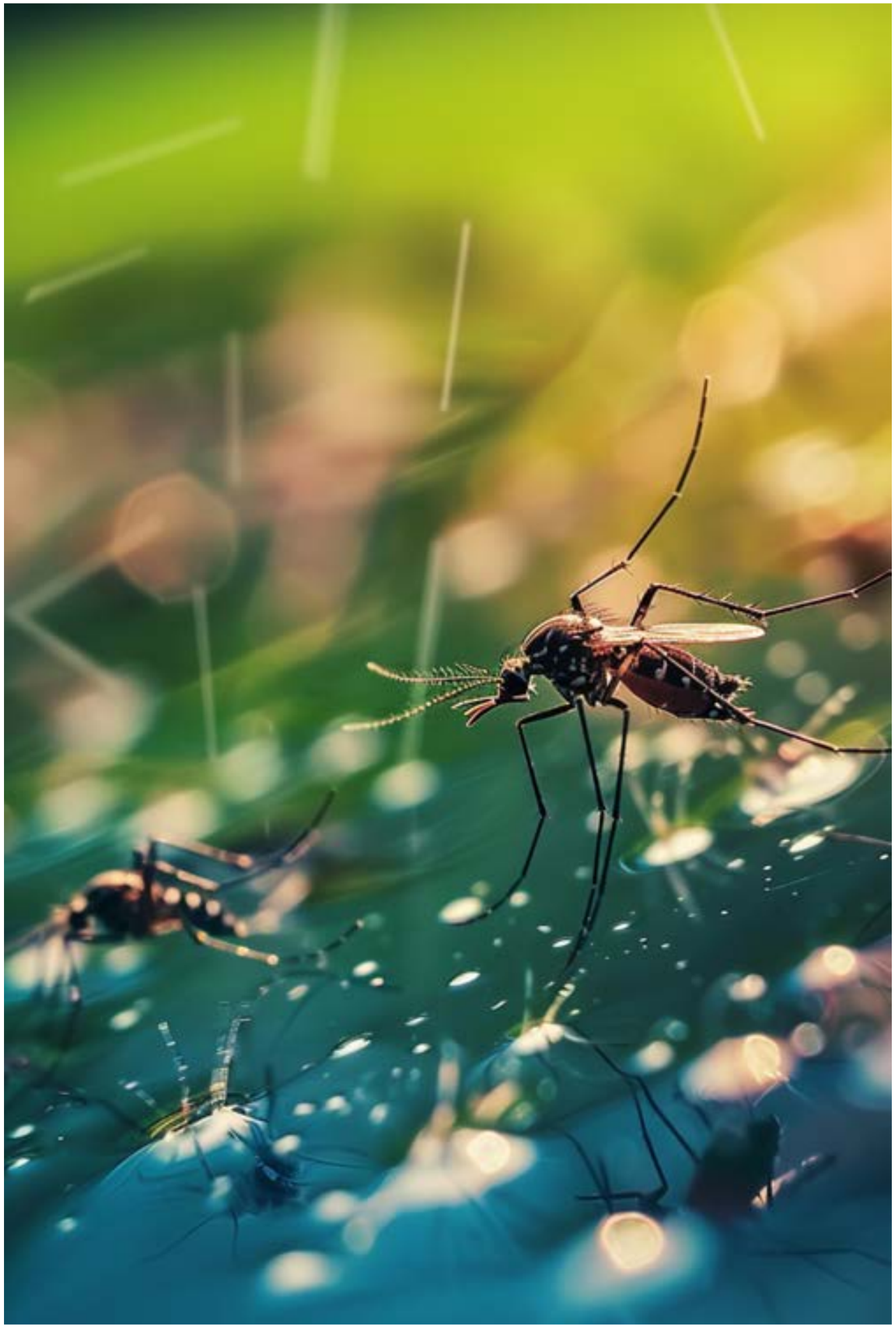
At the forefront of this research is Dr. **Nicola GA Abrescia**, head of the Structural and Cellular Biology of Viruses Laboratory at CIC bioGUNE. Through European projects such as InFlaMe and SPIDVAC, his team is advancing our understanding of viral infections and developing new strategies to improve epidemic preparedness and vaccines for both human and animal health.

From a global health perspective, why is it important to study viruses not only in humans, but also in animals and their environment?

- To put it simply, studying viruses is like having life insurance. We hope we will never need it, but when a crisis occurs, the knowledge and tools developed through research are essential.

Studying viruses that affect humans, animals, or even bacteria through bacteriophages provides knowledge that can be applied across different areas of health. For example, as antibiotic resistance becomes a growing concern, phage therapy is re-emerging as a promising strategy to combat bacterial infections.

The COVID-19 pandemic showed us the importance of being prepared, although we often forget these lessons quickly. Another example is human papillomavirus (HPV): vaccines developed through decades of research are now helping to prevent cervical cancer. This illustrates how closely basic



Right: Taken from Magnific image bank (AI-created).

research, prevention, and public health are connected.

Viruses do not exist in isolation, and neither should our approach to studying them. Understanding viral biology today provides the tools we may need to protect human, animal, and environmental health in the future.

How does our body respond to emerging viruses, and which cells play a role in defending us against these infections?

- I'm not an immunologist myself, but one of the key factors determining how we respond to a virus is whether we have encountered it before. If we have, our immune system already has defenses, such as antibodies, prepared to recognize and fight it. If we are immunologically naïve, as happened with SARS-CoV-2 at the beginning of the COVID-19 pandemic, the response can be much more complex because our body lacks those specific defenses.

Vaccines work by creating this pre-existing immunity. They expose our immune system to specific viral components, or epitopes, allowing us to develop antibodies that can recognize and block the virus when we encounter it. Understanding which parts of a virus trigger this response is a key area of research for developing better vaccines.

In your research group, you study virus–host interactions at the molecular level. What exactly does your research involve, and why is it so important for understanding how these viruses spread?

- There are different ways to block a virus. One is preventing it from entering our cells, where antibodies play a key role. Another is stopping viral replication inside the cell using antivirals that target specific viral enzymes.

In our group, we study these interactions at the molecular level using structural biology techniques. Like a key fitting into a lock, understanding how antibodies recognize viruses allows us to identify the mechanisms of protection and design better vaccines and therapies.

This approach also applies to animal viruses. We have studied viruses affecting species such as horses, highlighting the importance of moving beyond a human-centered view of health. Animal diseases can have major consequences not only for animal welfare, but also for economies and communities. The COVID-19 pandemic showed us that human, animal, and environmental health are deeply interconnected.

Using this knowledge, we have developed a prototype vaccine for an equine virus by identifying the viral regions targeted by protective antibodies. We are applying similar strategies to human viruses such as dengue through the European project InFlaMe, combining structural biology with clinical research to improve prevention and treatment.

Looking ahead, how can this knowledge help us develop more effective vaccines and antivirals? Could it improve Europe's and the world's ability to prevent epidemics and pandemics?

- Absolutely. The more we understand about viruses, the better prepared we will be. Viruses are highly diverse, with different serotypes and genetic variations, so it is essential to study them to ensure that vaccines can provide broader and more effective protection.

This is the motivation behind initiatives such as InFlaMe: strengthening Europe's preparedness for future outbreaks. Studying antibodies from people who have overcome infections can reveal how the immune system responds and help us develop better vaccines and treatments.

Our work focuses on dengue, using advanced microscopy to study how antibodies interact with the virus. This is increasingly important as dengue transmission is no longer limited to imported cases, with local outbreaks emerging in parts of Europe due to the expansion of mosquito vectors and environmental changes.

This highlights the need to move beyond a human-centred view of health and adopt a One Health perspective, recognizing that viruses are shaped by the interactions between humans, animals, and the environment.

"We need to move beyond a human-centred view of health and adopt a One Health perspective, recognizing the connections between humans, animals, and the environment."

Right, up: Nicola GA Abrescia,
below: podcast episode cover.

CIC bioGUNE
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

EXCELENCIA SEVERO OCHOA

Fundación científica asociación española contra el cancer

EUSKO JAURLARITZA GOBIERNO VASCO

Established in 2004 under the auspices of the Basque Government, CIC bioGUNE is dedicated to advancing biomedical science. Its interdisciplinary team of over two hundred scientists and technicians delves into the molecular foundations and mechanisms of diseases, aiming to innovate in diagnostic methods and foster the advancement of innovative therapies.

Recognized as a Severo Ochoa Center of Excellence, CIC bioGUNE conducts pioneering multidisciplinary research integrating chemistry, structural, molecular and cellular biology, immunology and state-of-the-art omics technologies. Our infrastructure includes advanced technological platforms that support scientific discovery and collaboration, positioning us among Europe's foremost research institutes.

We are committed to bridging the gap between complex scientific through diverse outreach activities. By translating our research into accessible language and engaging the community in scientific advancements, we emphasize the importance of investing in research for societal progress and well-being. These efforts not only strengthen our connection with stakeholders but also promote broader appreciation and engagement with science for the benefit of society.

Transcriptions, editing and layout:

These podcast episodes have been transcribed, translated, edited, and formatted for this magazine by **Jana Sendra Viscarro**.

"Cutting-edge science advancing at the frontier between Chemistry, Structural, Molecular and Cellular Biology, aiming to develop a more Precise Medicine for the future"

CIC bioGUNE
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

BRTA
BASQUE RESEARCH & TECHNOLOGY ALLIANCE

CIC bioGUNE

Parque Científico y Tecnológico de Bizkaia
Edificio 801 A
48160 Derio, Bizkaia, España

Tel.: +34 944 061 300
www.cicbiogune.es