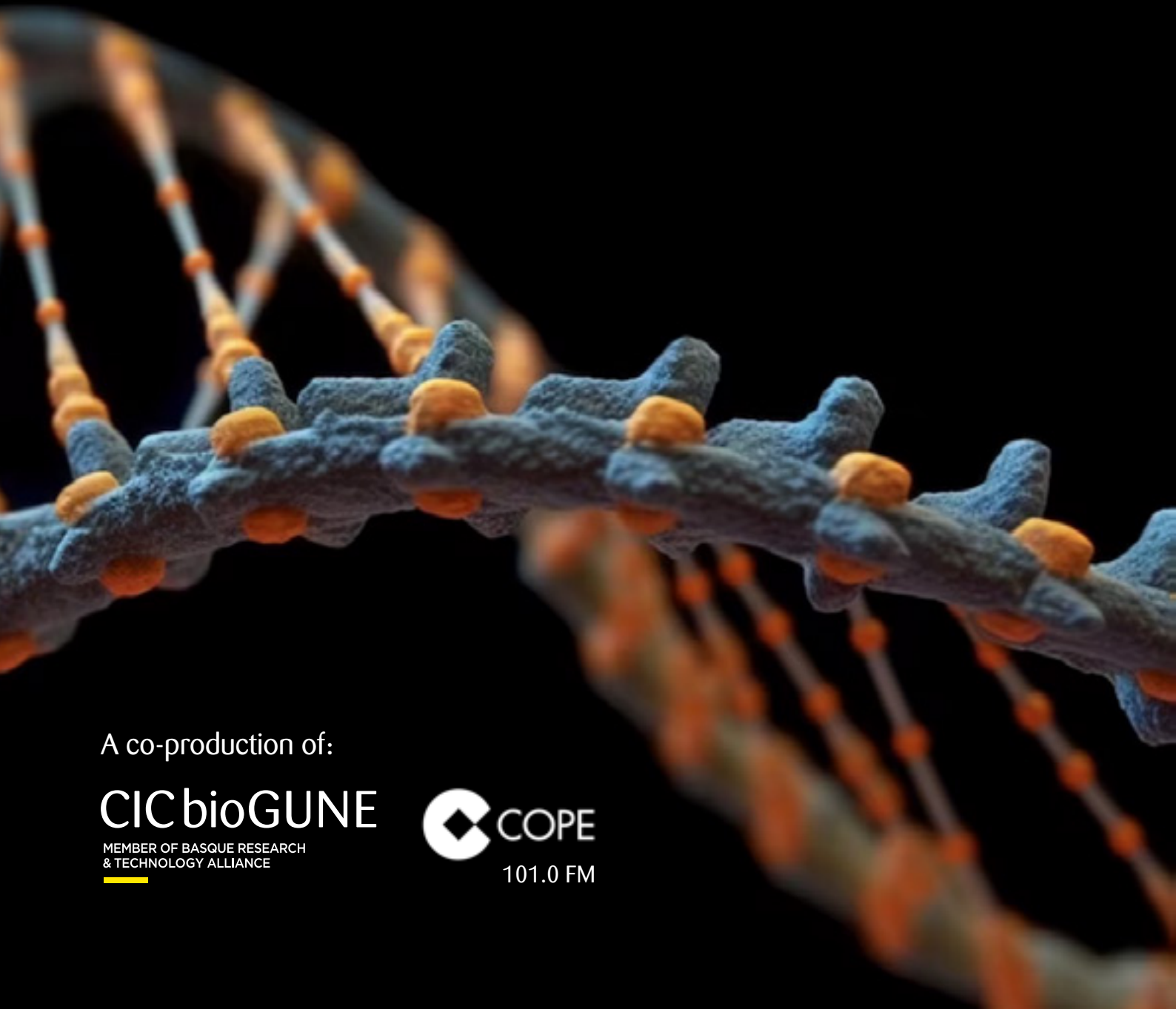
BioEnredados

Uniendo Ciencia y Vida

First Season - Volume 1



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EPISODES

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?

SCIENCE OR SCIENCE FICTION

AI ON THE SCIENTIFIC HORIZON

At the threshold of a new horizon, a world in constant evolution unfolds before us, a scenario where the boundaries between science and fiction blur ever more. We find ourselves amidst a revolution, where artificial intelligence stands as the undisputed protagonist, transforming disciplines such as biology, chemistry, and medicine on its path towards a promising future.

Artificial intelligence, a branch of computer science, focuses on developing machines or programs capable of simulating or imitating human intelligence to solve problems efficiently and automatically. Based on algorithms and mathematical models, AI allows machines to learn from data, adapt to the environment, and improve their performance as they gain more experience. In a moment marked by the debate on the ethics and security of this technology, artificial intelligence has been positioning itself imperceptibly in our daily lives, turning science fiction into a tangible reality.

In this journey into the unknown, we delve into a universe where artificial intelligence and scientific research converge, challenging the limits of what is possible and opening new horizons of knowledge. What are the milestones marking this path towards the future? How is artificial intelligence revolutionizing our way of investigating and addressing the most pressing challenges of our society? And above all, what consequences will this technological revolution have on the development of innovative therapies and medications?

To delve into this thrilling territory, we are joined by **Gonzalo Jiménez-Osés**, Ikerbasque Professor and leader of the Computational Chemistry group at CIC bioGUNE. From his privileged perspective, Dr. Jiménez-Osés invites us to explore the latest advances and the challenges that still persist in this exciting field, offering us a unique insight into how artificial intelligence is transforming the face of contemporary science.

Could you give us a little overview of how artificial intelligence is being integrated into science?

- The integration of artificial intelligence is happening quickly and somewhat on the fly because its progress has been rapid and has caught many of us off guard. Especially in the scientific world, it's something we hadn't experienced much before, but the developments have mainly been carried out in software and communication companies. So, it's been a bit surprising that the most prominent developments, like AlphaFold or ChatGPT-3, have appeared almost overnight, in a broader context.

So, we're adapting on the fly. From my personal experience, I can say that this integration has been extremely fast, simple, and effective. In my field, there's a steep learning curve for the physics-based methods we used to determine molecular

Right: Pexels image bank.

molecular properties, which has been a barrier for students. Paradoxically, the adoption of these technologies has been rapid and straightforward, perhaps because they are quite opaque in their internal workings.

In our group, we're incorporating these technologies into our developments on a week-to-week basis. This marks a significant change because we no longer have to wait years for a new version of a program or an update, but literally every week or month, improved versions or competitors appear. Adaptation is virtually in real-time.

Could you tell us what your research is based on and how this technology has been applied in your field?

- Our research focuses on computer simulation of chemical and biological processes, ranging from basic chemistry to complex biological processes.

We utilize tools like AlphaFold, a groundbreaking neural network for predicting protein structures. This has enabled us to solve problems previously considered unsolvable in record time. Additionally, we explore neural networks like ProteinMPNN. By integrating these tools, we design new proteins with functions not found in nature, such as metal-based catalysts or blockers for certain proteins.

What used to take us years is now accomplished in a matter of weeks, thanks to the speed and precision of these AI-based tools. This has significantly accelerated our work, allowing us to progress towards laboratory experimentation much faster.

How do you envision artificial intelligence influencing, for example, the development of personalized medicines or therapies, now that it provides a speed that didn't exist before?

- Exponentially. There are two main areas in drug design: small molecules and protein-based molecules. Artificial intelligence is accelerating drug discovery, particularly in designing protein-based inhibitors, yielding remarkable results.

AlphaFold provides the structure of every protein in the genome, enabling drug design against previously unknown targets and creating entirely new drugs rapidly.

Google and other companies are creating spin-offs focused on drug development, indicating a significant shift in the industry. However, the challenge lies in standardizing data across various scientific fields to ensure the reliability of neural network predictions.

How do you think teaching in scientific fields should adapt to include understanding of this technology and its proper use?

- It's a necessity and a challenge, as the field is constantly changing. For example, technologies like ChatGPT or AlphaFold, based on architectures like the transformer developed by Google, are constantly evolving. It's difficult for chemists, physicists, doctors, and biologists to understand these technologies, but we can use them.

I believe education should progress at two speeds. From the early years of training, it's essential to incorporate programming, especially in Python, which is the primary language in the development of these technologies. Additionally, solid knowledge of neural network architectures and data processing is required. All scientific students should have this knowledge in a cross-sectional manner.

How do you envision this collaboration evolving in the future and how do you think it could influence our society?

- I don't dare to make predictions because reality always surprises us. Everyone talks about technologies like ChatGPT-3, Diffusion, or Dalí, which allow you to do things in real-time with exquisite quality, and this has caught us by surprise.

What I do know is that we must not be afraid and face this technology with an open mind, knowing that not every prediction from artificial intelligence is correct or valid. Critical thinking is essential. We'll see how everything unfolds, but I believe changes will happen quickly, and job profiles will transform.

"What I do know is that we must not be afraid and face this technology with an open mind, knowing that not every prediction from artificial intelligence is correct or valid."

Right, up: Gonzalo Jiménez-Osés, below: podcast episode cover.

LIVER ALERT!

THE SECRETS OF THE LIVER

The liver, that amazing and vital organ that often goes unnoticed, is the true protagonist in the complex scenario of our digestive system. Did you know it's the largest organ in this wonderful machinery that is our human body? Larger than the heart and almost as heavy as a soccer ball, the liver arouses fascination for its ability to perform such a crucial task for our health.

What is its exact role in digestion and nutrient absorption? Well, this is where the magic of the liver truly shines. This little giant unfolds like an internal cleaning engine, tirelessly working to metabolize the substances we consume daily. Imagine it as an elaborate chemical laboratory inside our body, breaking down what we eat and drink to turn it into useful nutrients, while eliminating the waste and toxins our body doesn't need.

But, how does the liver accomplish this amazing task? That's a question that has puzzled scientists and curious minds for a long time. And it's because, essentially, the liver is a marvel of biology. From the food we eat to the air we breathe, everything passes through the liver's filter. Our daily diet has a direct impact on its functioning, and it's crucial to understand how our food choices can influence the health of this vital organ.

And here's where a serious topic comes into play: alcohol consumption. Did you know it can have serious consequences for the health of our liver? The liver, despite its amazing regenerative capacity, has its limits. Excessive alcohol can damage liver cells, leading to serious conditions such as liver cirrhosis.

To delve deeper into this topic, we have invited an expert in the field: **Malu Martínez-Chantar**, principal investigator of the Liver Diseases group at CIC bioGUNE. With her experience and knowledge, she will help us unravel all the secrets of the liver and understand how we can better care for it in our daily lives.

Could you give us a general overview of this organ and its functioning?

- The liver is one of the largest organs in the digestive system and plays a fundamental role every day. The liver will have a very important role, for example, in lipid metabolism. All the fats we ingest will be metabolized by the liver to prevent those lipids from staying in the liver and causing damage to the liver, our cells, and ending up with what we'll talk about later, a fatty liver.

For example, the liver will also play a very important role in the immune system. It will also have a very important function in the formation, for example, of bile acids which are responsible for generating that bile that will degrade that metabolism. And then, above all, it has a very, very essential role in maintaining constant glucose levels.

Glucose levels have to be kept constant throughout the day, okay? So that we don't have very significant drops or increases in

Right: Polina Tankilevitch, taken from Pexels image bank.

glucose. And the liver will be responsible for maintaining that glucose. And finally, the liver will metabolize all our toxins that we take every day.

We ingest medicines, we ingest alcohol, we ingest nutrients, we ingest fats and the liver will be responsible for metabolizing all those toxins and secreting them and eliminating them.

What role does the liver play in digestion and nutrient absorption, and how do our eating habits affect the liver?

- The liver, all of this is a balance between eating too much or too little and eating well, right? When we, for example, ingest a lot of fats, then the liver has to make an extra effort to metabolize those fats because, if those fats stay in the liver, they will produce damage to the cells. So, the liver tries in some way to metabolize, eliminate those fats so they don't stay in the liver.

If we take, for example, a diet very rich in carbohydrates or sugary drinks, what happens? We are ingesting a lot of glucose. That glucose, in the end, will also be converted into fats and then, again, the liver has to make an extra effort to remove and eliminate those fats and prevent damage to the liver from occurring. If we ingest alcohol, a very specific alcohol metabolism will occur and we know that deeply damages our cells.

The liver has a great capacity of regenerating itself. That means it is capable of forming more cells, okay? We cause damage and suddenly another healthy cell appears that occupies the place of that cell we have damaged. But there may come a time when the damage is excessive, the regenerative capacity of the liver is not enough to prevent all the damage we have done.

"By 2030 there will be countries with almost 35% of patients with fatty liver, so of course eating well and eating healthy. I think that's something that needs to be taught from schools, really."

And that's where liver disease begins. The most prevalent disease is fatty liver, which is associated with obesity, metabolic syndrome, it is estimated that 25% of the general population suffers from fatty liver. While it can be reversed with lifestyle changes, some patients progress to advanced stages, potentially leading to fibrosis, cirrhosis, and liver cancer.

What are the current scientific advancements in treating liver conditions?

- For instance, in fatty liver, you're probably aware of a medication many people are taking, especially for obesity and insulin resistance. This treatment has shown a significant impact on fatty liver by addressing these underlying conditions.

Additionally, while there's no specific treatment for alcohol, current approaches focus on managing associated health issues. Given the prevalence and mortality rates linked to liver pathologies, there's a pressing need for research to explore new therapeutic avenues.

What are the next steps in research and how could they impact prevention?

- Well, first of all, you know there's a huge effort towards personalized medicine. I think it's one of the key aspects that we need to highlight. Personalized medicine aims to tailor, as its name suggests, the treatment we give to patients in a very specific way to what we have in front of us. So, the first thing we need to do is to deeply understand the mechanisms underlying liver pathology.

That is, if we know very well what is happening to that patient, then we'll have much more chances of blocking or modulating the pathways that are altered in a much more efficient way than if we haven't characterized that pathology and we're just throwing bombs to see where we can hit. So, targeted therapy, well, with that, we save time, which is very important in this type of pathologies, and probably the likelihood of being effective and successful is much higher. So that's one side, personalized medicine, of course.

Prevention is very important. Especially, as I mentioned, if we're dealing with fatty liver with a prevalence of 25%, it's expected that by 2030 there will be countries with almost 35% of patients with fatty liver, so of course eating well and eating healthy. I think that's something that needs to be taught from schools, really.

Right, up: Malu Martínez-Chantar, below: podcast episode cover.

DNA REVEALED:

DECIPHERING OUR HERITAGE

In the fascinating world of future medicine, we delve into a territory as vast as it is mysterious: that of our own genes. Have you ever wondered how they influence our health and predisposition to diseases? Would you like to discover how science is revolutionizing medicine by designing personalized treatments for each individual?

We immerse ourselves in the depths of integrative genomics, a discipline that allows us to understand how our genes and our lifestyle interact to influence our health. From the very roots of diseases to the ability to predict our risk of developing them, we embark on a journey of discovery.

Imagine being able to unveil the most intimate secrets of our biology, understanding the subtle connections between our genes and our way of life. Here, we explore how integrative genomics allows us to piece together the complex genetic puzzle, thus revealing the secrets encoded in our DNA.

Are you ready to explore how science can shape a future where medicine adapts to each of us? What impact will decoding the genetic code have on our quality of life and longevity?

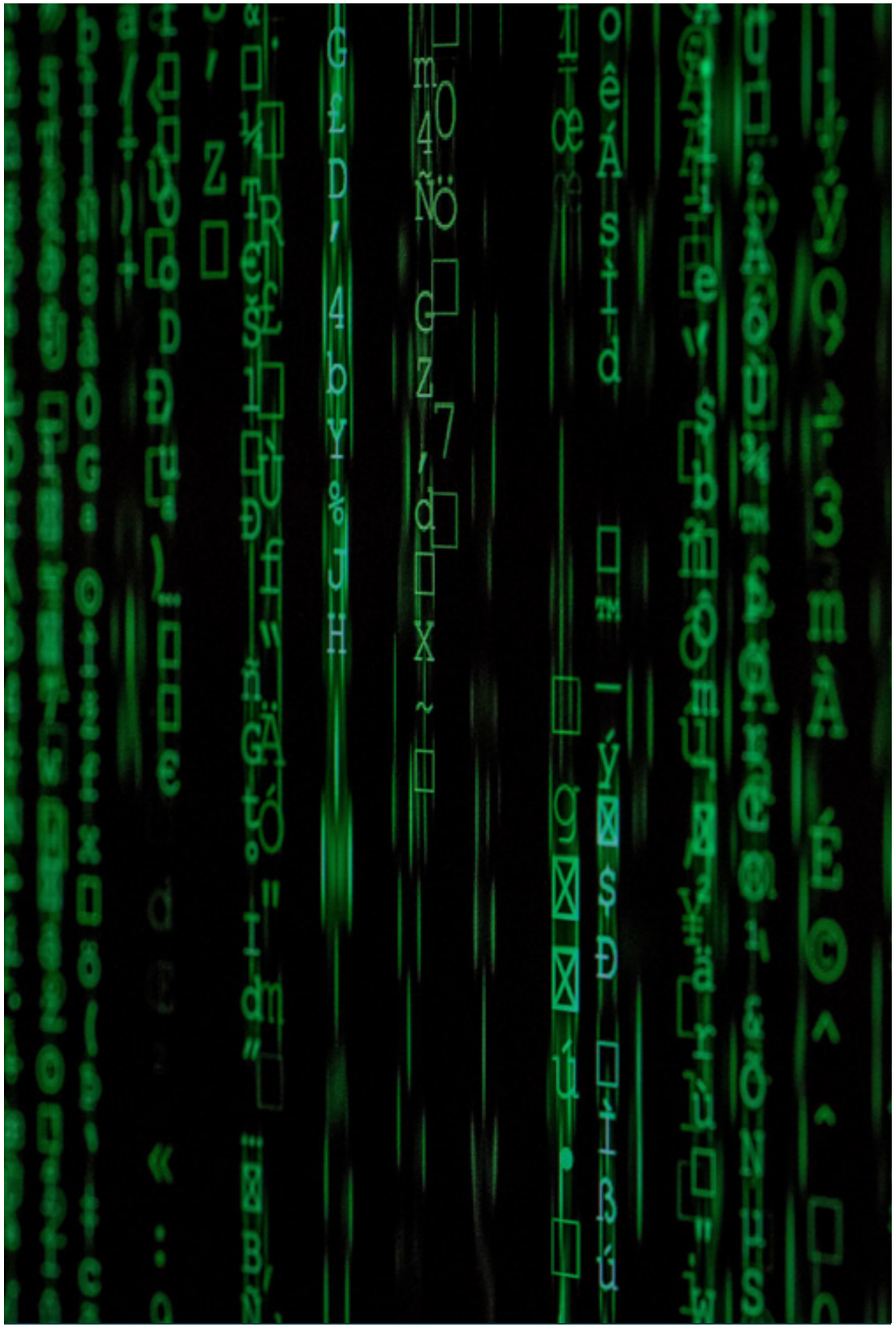
To delve into this fascinating topic, we have the expertise of **Urko Martínez Marigorta**, Ikerbasque Research Professor of Integrative Genomics at CIC bioGUNE. Join us on this journey to the frontiers of tomorrow's medicine.

Could you explain in simple terms what this study of the genetic basis of diseases entails and how you are approaching these investigations?

- I believe that in order to understand what we are doing in genomics research, it's good to distinguish between two types of diseases. Typically, we have what we call hereditary diseases, which are the classic diseases where we notice certain families have an accumulation of people with the disease, such as hereditary breast cancer or, here in the Basque Country, clinical fibrosis. In the case of these diseases, what we greatly benefit from is being able to study the entire genome, take a snapshot, and try to learn which mutation causes this disease and which gene justifies why these cases are necessary to activate genetic counseling.

So in these cases, we study the entire genome because we know we will have a mutation in a gene that explains these hereditary diseases. And then, in the other major branch of genomics, the research we are doing today, are the diseases called multifactorial, they are complex diseases with many genes associated with them. We have environmental factors, for example, diabetes, schizophrenia or asthma, which are much more complex.

And in the case of these diseases, what we are doing, also benefiting from the increase in the capacity to sequence the genome, is conducting studies of large cohorts,



Right: Taken from Pexels image bank.

where we have many people with disease and many people without disease, and we are comparing position by position of the genome, which is different between them, to try to learn which genes regulate these diseases.

So, I think it's good to make this distinction, because on one hand we have diseases, which is the classic genetics where we think that if we look at the genome we will discover a mutation, because it's very deterministic. And then we have studies or ways of investigating diseases that are more complex, where we already have to think about a genetics that is probabilistic.

What we need to understand is which positions in the genome give more or less risk of having a disease, even though not everyone with a mutation will end up developing those diseases like asthma or diabetes.

And one of the long-term goals is to advance towards precision medicine, right, adapting health treatments to individual profiles. This approach focuses on predicting the risk of diseases at an individual level.

Could you tell us how genomics is being used to develop tools that assess this risk and what challenges are faced on this path towards personalized medicine?

- Science takes time. We already have evidence that things are working and that it's being useful for studying people.

For purely genetic and deterministic diseases, like some found in newborns in the USA, doctors compare the genomes of sick infants and their parents to identify mutations.

This method has helped diagnose and treat conditions in about one-third to one-half of cases, allowing tailored treatments that can save lives.

For complex diseases, we are moving towards precision medicine, which is challenging. Instead of deterministic risks, genetics often gives a probability of developing a disease. By analyzing a person's genome, we can calculate the likelihood of diseases like diabetes or asthma and make better-informed medical decisions. Although there are promising examples, like optimizing cholesterol treatments based on genetic risk, there are non-established programs yet to fully utilize this genetic information.

What is the role of lifestyle, and what data or methods do you use to investigate these gene-environment interactions, aside from our own genetics?

- From a geneticist's perspective, while lifestyle factors are very important, genetic differences between individuals also play a significant role. This means lifestyle affects each person differently. Besides genetics, we now consider the "exposome", which includes all environmental and lifestyle factors that influence disease development. Unlike genetics, where we've made significant technological advances, we lack the same capability to measure lifestyle systematically. Devices like the Apple Watch are starting to change this, allowing us to systematically measure an individual's environment.

Over the past two decades, genomics hasn't fully incorporated the role of lifestyle despite its importance. Once we can systematically generate lifestyle data, we'll better understand how genetic variants interact with lifestyle, driving the increase in multifactorial diseases.

What advances are expected in the coming years, and how could they impact medicine and public health?

- It's like with all technologies, such as the internet: in three to five years, nothing seems to change, but after 20 years, you realize it has completely transformed your life. I believe genomics will follow a similar path. In the next two decades, we will see significant changes, especially in how we diagnose diseases. We're in a limbo where research shows great promise, but implementation is still uncertain, despite clear examples of its potential usefulness.

"And one of the long-term goals is to advance towards precision medicine, adapting health treatments to individual profiles, predicting the risk of diseases at an individual level."

Right, up: Urko Martínez Marigorta, below: podcast episode cover.

FROM GENES TO MAPS:

CARTOGRAPHY OF CANCER

Cancer, an adversary that confronts millions globally, remains one of the most challenging medical puzzles of our time. But what truly lies at the heart of this complex disease? To fathom its depths, we must navigate through its multifaceted layers, peering into the inner workings that govern its existence.

Imagine our cells as elaborate manuscripts, each one containing the blueprint of life encoded within its DNA. Over the course of our existence, this genetic code undergoes subtle alterations known as mutations. While some are benign and a natural consequence of aging, others hold the potential to unleash a cascade of events, ultimately culminating in cancer.

But amid this genetic variability, why do only certain mutations trigger the development of cancer? What interplay of factors dictates this outcome? And how do researchers navigate this intricate landscape of cellular complexity?

Join us on a journey as we embark on an exploration of cancer's enigmatic depths. We'll unravel its secrets, guided by the expertise of **Isabel Mendizabal**, Ikerbasque Emerging Leader in the Cancer Cell Signaling And Metabolism research group at CIC bioGUNE. Through her work, we aim not only to comprehend cancer's molecular intricacies but also to pave the way for innovative treatments and preventative measures.

Most likely, we've all heard about cancer, a disease that is estimated to impact 1 in 2 men and 1 in 3 women today. But Isabel, could you please explain to us what cancer actually is?

- Well, cancer, rather than being just one disease, we could say that cancer is a group of diseases that share in common abnormal and uncontrolled growth of some cells in our bodies.

Our tissues are made up of millions of cells, and under normal conditions, these cells follow a fairly orderly life cycle. They are born, they divide, and then they move in a way that is already programmed. However, in cancer, what happens is that this process is disrupted, and the cells continue to divide and grow without any kind of control.

As a result, these cells end up forming masses of tissue that we call tumors. And in the case of cancer, which are malignant tumors, what we mean by this is that these cells are also capable of invading adjacent tissues or even spreading throughout the body through the bloodstream or lymphatic system. This is what we call metastasis.

And as for the causes, as mentioned in the introduction, we have known for decades now that cancer originates due to alterations in DNA, in the genetic material, which we normally call the genome, which is the set of genes in our cells. And these alterations, these mutations, can have three different origins.

Right: Taken from Pexels image bank.

On one hand, we know that exposure to mutagens, to agents that cause mutations, can change our DNA.

For example, we know about the case of tobacco smoke, for instance, in the case of lung cancer, or ultraviolet rays from the sun, which we have also heard about many times, affecting the incidence of skin cancer. But mutations can also be inherited; a predisposition to cancer can be inherited, or simply, as mentioned earlier, it can be due to inevitable errors in our cells that accumulate as we grow older. So, it is for this main reason that cancer appears mainly in older ages.

And from the perspective of cancer research, Isabel, how are the challenges in understanding this highly prevalent disease being addressed? What is currently being done?

- At CIC bioGUNE, we specialize in omics techniques, which have revolutionized biology and medicine. These methodologies allow us to study thousands of molecules simultaneously and systematically, providing comprehensive insights into tumors.

Recent advancements enable us to not only analyze the entire tumor but also profile each individual cell within it. This reveals the remarkable heterogeneity of tumors and sheds light on why some develop resistance to therapies.

Moreover, studying cells from healthy tissues has unveiled that mutations once thought exclusive to tumors are also present in healthy tissues. This challenges our understanding of cancer's origins and necessitates a broader perspective on its development.

Understanding the diverse cellular composition within tumors, including immune and vascular cells, is key. It elucidates how cancer cells manipulate antitumor responses, offering valuable insights for developing more effective therapies.

This innovative research approach generates a vast amount of data that must be analyzed to draw conclusions. What are the highlighted advantages of this methodology?

- There has been a huge revolution in biology, which has given rise to a new discipline: bioinformatics. Now we need researchers with knowledge of biology, but also capable of analyzing large volumes of data and applying advanced statistics, programming, and computing to turn that data into interpretable information. However, one of the current challenges in biology is the gap between data generation and its transformation into useful information. This not only represents an analytical challenge but has also changed the way science is designed and conducted.

Previously, in biology, work was based on working hypotheses based on what was known or on previous research. Now, with bioinformatics, science is more data-driven, generating hypotheses as data is analyzed. This allows us to overcome biases in knowledge and discover completely new processes that were not previously considered possible.

"In cancer research, omic techniques are already being used in clinical practice, which could improve early diagnosis and develop more personalized therapies."

From your perspective, where do you believe research is heading, and how might it impact cancer prevention and treatment?

- In cancer research, omic techniques are already being used in clinical practice, which could improve early diagnosis and develop more personalized therapies. Furthermore, integrating these techniques with artificial intelligence and imaging could be key to detecting cancer at more treatable stages.

Regarding treatments, the discovery that tumors have multiple identities suggests that therapies may become more complex, possibly requiring combined approaches. Immunotherapy is also a promising area, harnessing the body's mechanisms to fight cancer. Although there is still much to understand, these advances promise to significantly transform cancer prevention and treatment in the coming years.

Right, up: Isabel Mendizabal, below: podcast episode cover.

BEYOND THE PLATE:

CANCER AND NUTRITION

In the expansive landscape of human health, cancer emerges as a multifaceted challenge, casting a shadow of uncertainty over our understanding and treatment capabilities. At its core lies the tumor microenvironment, a dynamic realm where cancer cells engage in intricate interactions and dialogue with a myriad of other cellular players within our body, including the vigilant defenders of the immune system.

Simultaneously, the impact of diet on our overall health has become a subject of growing interest and intensive investigation. Within this realm of contemplation, we embark on a journey to unravel the linkages between nutritional choices and our susceptibility to cancer. Moreover, we dare to venture into the realm of therapeutic strategies, exploring how the food we consume might wield influence over the course of cancer treatment.

Yet, amidst our pursuit of understanding, we encounter a tapestry of unresolved queries. How do cancer cells navigate their path towards malignancy? What intricate mechanisms govern their unbridled proliferation and invasive tendencies? And which specific dietary components hold the potential to sway these pivotal processes in cancer development and progression?

Guiding us through the maze of these compelling questions is **Arkaitz Carracedo**, Ikerbasque Professor and leader of the Cancer Cell Signaling and Metabolism group at CIC bioGUNE research center. With Dr. Carracedo's profound expertise and commitment to scientific excellence, we are poised to gain invaluable insights into the workings of cancer biology, illuminating pathways toward confronting this formidable adversary that impacts countless lives across the globe.

How does a cancer cell work and why is it so important to understand its functioning at the molecular and cellular level?

- Ultimately, our bodies and all living beings are composed of cells, these fundamental units. Since we are a single cell, we do nothing but divide and grow and grow in mass. We see it in little children, we see it when we get older. That entire process requires cells to copy its entire instruction book.

We have a copy of our father and a copy of our mother and although the cells do it very well, sometimes in that process of rewriting and making a new copy of the instruction book for the next cell, mistakes are made. When these mistakes are made, cells can change their functioning, they can stop understanding what their function is and acquire new functions. That's where cancer comes from, just as it comes from many other pathologies.

Right: Vanessa Loring, taken from Pexels image bank.

What elements of our diet can have an impact on the mechanisms of cancer development?

- As in the previous episode where you talked about the immune system and the entire microenvironment, here we must keep in mind that once we have a cell that begins to divide uncontrollably, with the aim of surviving, proliferating and generating more cells, everything around her can be used both to her benefit and to her detriment. Diet is our most direct interaction with the environment, therefore it will change the context in which that cancer cell is growing, for better or worse.

Therefore, it is an important factor because it is not only what we eat, but also how our body is balanced. People with diabetes not only eat more or less sugar, but also how they manage it.

The same thing happens with other types of diseases, therefore, it is something that is in our power and can be used, but it must also be used correctly. It is a double-edged sword. Many readers might be asking, "What is the diet we should follow?" Well, logically speaking, we have the Mediterranean diet at hand, right? And I think we all know a little bit about eating healthy, making it normal to eat healthy.

I'm not saying one day, because we eat something a little indulgent, but in general, we eat healthy. Yes. As we said before, just as diet is an important factor, the appearance of cancer is a process that occurs as a consequence of living.

Let's say that we simply live and grow old, we are going to have a certain chance of developing cancer. We're going to have, let me reiterate, we're going to bingo and we're going to have some cards.

Of course, depending on how we live and our lifestyle habits, we may have more cards or fewer cards.

But it will always be a matter of luck if it's our turn. What it means is that, if we smoke, if we do not protect ourselves from the sun, if our diet is not balanced, we are going to increase our chances. That does not mean that we are going to develop cancer, nor does it mean the opposite, that leading a super healthy life will keep us away from it.

It means that there are things that are under our control, and it is estimated that approximately a third of diagnosed cancers could be avoided by altering our lifestyle habits. And that includes tobacco, alcohol, sun exposure, certain viral infections, diet, etc. All of which can disrupt the environment we were talking about, leading to more complicated management of those cells.

And if we focus, for example, on treatment, how have these nutritional strategies been included in therapies against this disease?

Here we can speak at two levels. We can talk about how to use nutrition, our nutrition, in cancer treatment or we can talk about how you can use the nutrition of cancer cells, how cancer cells are fed to make better treatments. And it works in both directions.

In the context of our diet, studies are being done on how specific diets or some modes of fasting, for example, combined with treatment can increase the effectiveness of treatments. But all this, and this is very important, in the ideal application of these strategies would always be as part of the treatment. That means under medical supervision in the context of what treatment is used.

That's why I said that diet is a double-edged sword. If we are being treated with chemotherapy and we also go on an extreme diet that instead of strengthening us weakens us, it still makes the chemotherapy feel worse for us. So all this has to be very well coordinated from a medical point of view to use diet as a tool.

And at the other level, at the level of the tumor cells, knowing what mechanisms are used or how cancer cells are fed, we can translate that knowledge into drugs that allow us to better treat the disease.

"At the level of the tumor cells, knowing what mechanisms are used or how cancer cells are fed, we can translate that knowledge into drugs that allow us to better treat the disease."

Right, up: Arkaitz Carracedo, below: podcast episode cover.

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EXCELENCIA SEVERO OCHOA

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.

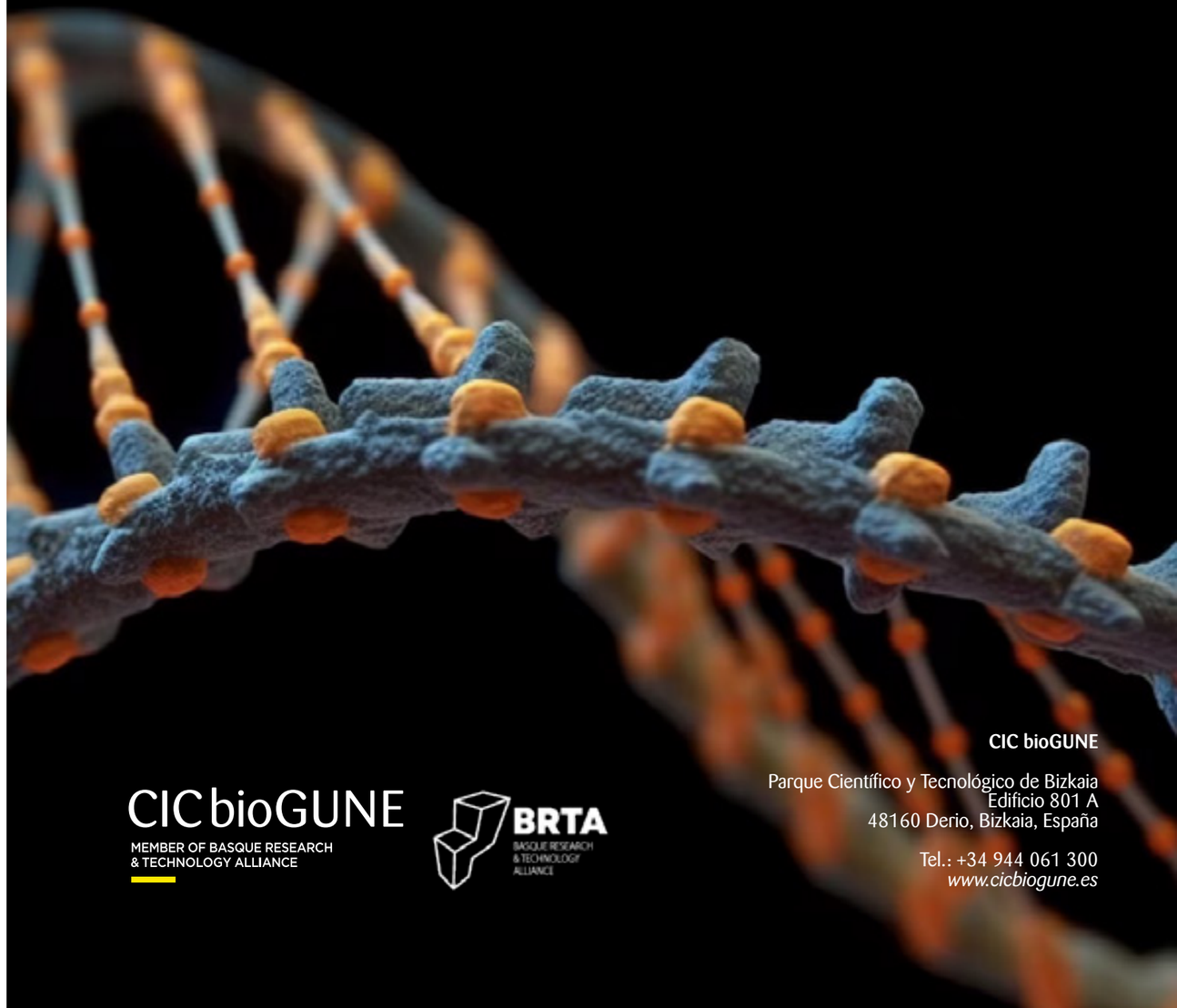
Recognized as a Severo Ochoa Center of Excellence, CIC bioGUNE leads cutting-edge research at the intersection of Biology, Chemistry, and Mathematics, focusing on Cancer, Rare Diseases, Infectious Diseases, and Metabolic Disorders. Our infrastructure includes advanced technological platforms that support scientific discovery and collaboration, positioning us among Europe's foremost research institutes.

We are committed to bridging the gap between complex scientific research and public understanding 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"



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