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DO STEM CELLS DIFFERENTIATE TO BACTERIA?

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ABSTRACT

Cumulative evidence suggests that some human endogenous infections may derive from bacteria produced by human cells. This study offers evidence to suggest that human stem cells are capable to produce microorganisms and represent the most likely candidates to generate microbes. The twin discoveries of A: The fetus is not sterile and harbors bacteria that are not contaminants and B: The Christensenellaceae bacteria are heritable and human genetics shape the gut microbiome, suggest some bacteria are produced by human cells. Human stem cells are capable to differentiate to epithelial and cancer cells and have the essentials to produce microbes. Human stem cells- consistent with their unique properties of multi-potency and self renewal - represent the most likely candidates to produce endogenous microorganisms, although this novel observation needs future experimental validation. Human cells represent a constant major source of new bacteria.

KEYWORDS: Stem cells; Bacteria; endogenous infections; Christensenellaceae; Fetal bacteria.

Do stem cells differentiate to bacteria?

This past decade witnessed multiple studies- substantiated by scientific evidence of mathematical certainty - suggesting that some human endogenous infections may derive from biological processes that let human cells or tissues produce microorganisms.[1,2,3,4,5]

To date, neither the precise pathways of endogenous production of microorganisms nor the specific cells that produce microbes has been established.

This study offers evidence to suggest that, human stem cells are capable to produce microorganisms and represent the most likely candidates to generate microbes.

The hypotheses of bacterial production by human stem cells may have clinical and therapeutic implications for opportunistic, nosocomial and burn wound infections that have been attributed to foreign invading microorganisms from the environment.

I will first review the evidence of endogenous microorganisms before discussing why human stem cells are the most likely candidates to generate microbes.

Endogenous microorganisms not imported from the environment

In the last decade diverse molecular observations have revealed the existence of endogenous microorganisms in several body parts which had previously been thought to be sterile.[6,7,8] For instance it has been shown that breast milk[6] breast tissue,[7] umbilical cord blood[8] placenta,[9,10] amniotic fluid,[10,11] meconium[12] harbor bacterial communities .Of significance, there has been no evidence to suggest that fetal microorganisms are contaminants from the environment. Also, the composition of the bacterial communities is unique for each habitat suggesting of their local origin.[13]

The most compelling evidence to suggest that human cells may produce microorganisms is the observation of a genetic link between humans cells and the Christensenellaceae (a family in the phylum Firmicutes).[1] There is also evidence that Malassezia furfur yeasts are heritable[14] and they have coevolved with humans dating back to 56,000 years ago when modern humans emerged in East Africa.[15] Further evidence consistent with their endogenous origin is the observation that they are not culturable from the environment[14] and host to host transmission is very rare or nonexistent.[14]

In summary, several independent observations including a genetic link between human cells and bacteria, the fetus harboring endogenous microorganisms which are locally produced, Malassezia furfur yeasts are not culturable from the environment, suggest human cells may produce endogenous microorganisms.

Multi potency of stem cells

In multicellular organisms, stem cells are the earliest type of cell in a cell lineage and can differentiate into various types of cells and proliferate indefinitely to

produce more of the same stem cell.[16] Epithelial tissues line the outer and inner surfaces of organs throughout the body and harbor stem cells that differentiate to epithelial cells.[16]

It has been observed that, perhaps the most important and useful property of stem cells is that of self-renewal.[16] Cancer cells may often originate from the transformation of normal stem cells and cancer cells may include 'cancer stem cells' — rare cells with indefinite potential for self-renewal that drive tumori-genesis.[17] Stem cells contain a nucleus whereas bacteria has a nucleoid.[18] Using long-term lineage tracing, Lopez-Garcia et al. showed that the loss of a stem cell was compensated by the multiplication of a neighbor cell.[19] The rate of stem-cell loss was equivalent to the rate of cell division, indicating that symmetric cell division was the rule for gut stem cells.[19]

Is it reasonable to consider that human stem cells which are capable to differentiate to epithelial and cancer cells and have the essentials to produce microbes are the most likely candidates to produce microorganisms?

Of importance, both gastrointestinal tract and skin harbor stem cells that constantly generate epithelial cells and may also convert to malignant growth. In essence, stem cells are wired to differentiate to more complex cells or to produce cancer cells.

What happens to an epithelial or a stem cell that falls off the surface of organs throughout the body? Is it possible that a stem or epithelial cell fallen off the epithelial surface may transform to a bacterium?

What is the difference between a stem cell and a bacterium?

A stem cell contains a nucleus versus a bacterium has a nucleoid. Hence, any transformation of human cells to bacteria may represent transformation of nucleus to nucleoid.

DISCUSSION

Diverse genetic molecular observations suggest that some human infections are endogenous and produced by human cells. The twin discoveries of A: The fetus is not sterile and harbors bacteria that are not contaminants and B: Some bacteria are heritable, suggest some bacteria are produced by human cells. Evidence consistent with the observation that some endogenous bacteria are produced by human cells prompts a basic question: which human cells produce bacteria? In essence the central question is no longer whether human cells produce bacteria but rather which cells are the most likely candidates to produce bacteria.

Human stem cells- consistent with their unique properties of multi-potency and self renewal - represent the most likely candidates to produce endogenous microorganisms. This novel observation which needs further experimental validationthat may also suggest that stem cells may contribute to human nosocomial and opportunistic infections.

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