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BARR BODY
A MYSTERY IN THE ORIGIN,
IGNORANCE IN THE FUNCTION

Barr body is omnipresent in the human female somatic cells. Since its discovery by Murray Barr in 1949, the Barr body rests the most mysterious secret of the human cell. For a long time, its origin and its function have alimented the academic debates. Since, any of the related hypothesis has not gotten the unanimity. Therefore, I tried to dive deep into the cell and find out what could be the reality. Astonishingly, in the passage, many other secrets have turned out. Hereafter, you will find out the entire story.

Barr Body

I do believe in the common origin of both sexes from one stem cell; I named it the Mother Stem Cell (MSC); figure (1). The ***MSC*** contained in its nucleus 22 pairs of autosomal chromosomes specific to the human space, in addition to the precursor of the sexual chromosomes (i.e. the origin of the chromosomes XX and the chromosomes XY). I suppose it should be the chromosome pXX with the prefix (p) to differentiate it from the female sexual chromosomes XX, which is a little bit different, as we will see later.

During the ***asexual reproduction (mitosis)*** of the ***MSC***, its chromatin storage had been duplicated in preparation to its supposed-equal distribution between the two supposed-identical daughter cells***. Mistakenly, as mitosis was going on to distribute the chromatin matter into the two daughter cells; a segment of one X of the pXX had been avulsed from one daughter cell in profit to the other daughter cell.*** The looser daughter cell became with the sexual chromosomes X and Y, whereas the winner daughter cell became with the sexual chromosomes X and X***; figure (2).***

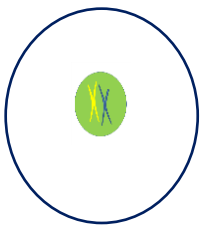

Figure (1)
The Mother Stem Cell (MSC)
It contains 22 pairs of autosomal chromosomes,
in addition to the precursor of both sexual chromosomes XX & XY.

Figure (2-a)
The Mother Stem Cell (MSC)

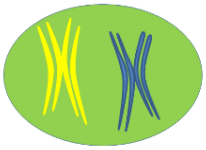

Figure (2-b)

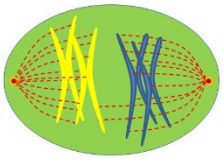

Figure (2-c)

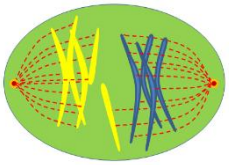

Figure (2-c)

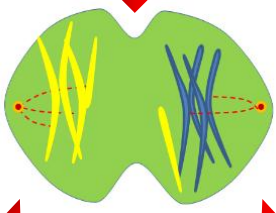

Figure (2-c)

Figure (2-d)

The first man

The first woman

Figure (2):

(N.B. You can see a related animation in this link)

Figure (2-a): The Mother Stem Cell (MSC) contains 22 pairs of autosomal chromosomes and the precursor of both sexual chromosomes (pXX). For more simplicity, the pXX only is represented here.
(pXX= the precursor of both sexual chromosomes XX and XY)
Figure (2-b): During the asexual reproduction (mitosis), the chromatin storage of the MSC, represented here by the pXX, was duplicated in order to be equally distributed between the two daughter cells.
Figure (2-c): During the anaphase and the telophase of mitosis, a segment of the chromosome X is stolen from one daughter cell in profit to the other daughter cell.
Figure (2-d) The looser daughter cell became the male cell (in right) with the sexual chromosomes X and Y… The winner daughter cell (in the left) became the female cell with the sexual chromosomes X and X, in addition to the new element that was stolen from the other daughter cell.
(Yellow segment = the stolen segment)

The stolen segment and Barr body

The stolen segment is supposed to be in the nucleus of the recipient cell. I suggest three forms of its existence there:

1- It might be integrated within the structure of the sexual chromosome X itself rendering it bigger (i.e. of a higher molecular weight) than its homologue the other chromosome X of the same cell. This dissimilarity between the two sexual chromosomes X and X is crucial concerning the formation of ***Barr body*** in the descending ***female somatic cells.*** Early, the heavier one ***(the giant chromosome X)*** will form ***Barr body*** in each ***female somatic cell; figure (3- a)***.
2- It might also be attached to the sexual chromosome X by a microtubule, which is a vestige of the spindle apparatus, forming together a new structure of two distinguishable components***; figure (3- b).*** Similarly, the new structure ***(chromosome X + stolen segment)*** is of a higher molecular weight than the other chromosome X of the same cell, and it could be ***Barr body***.
3- It may rest free in the nucleus of the recipient cell forming an independent body; ***figure (3-c).*** This body will be omnipresent in all female somatic cells, and is called ***Barr body***.

According to the first two hypothesis, the two sexual chromosomes X and X, which are identifying the female cells, are not identical as was thought for a long time. One of them is heavier than its homologue. The heavier sexual chromosome X should be ***Barr body***; ***figures (3-a) & (3-b)***. Whereas, in the third hypothesis, the stolen segment forms per se ***Barr body***; ***figure (3-c)***.

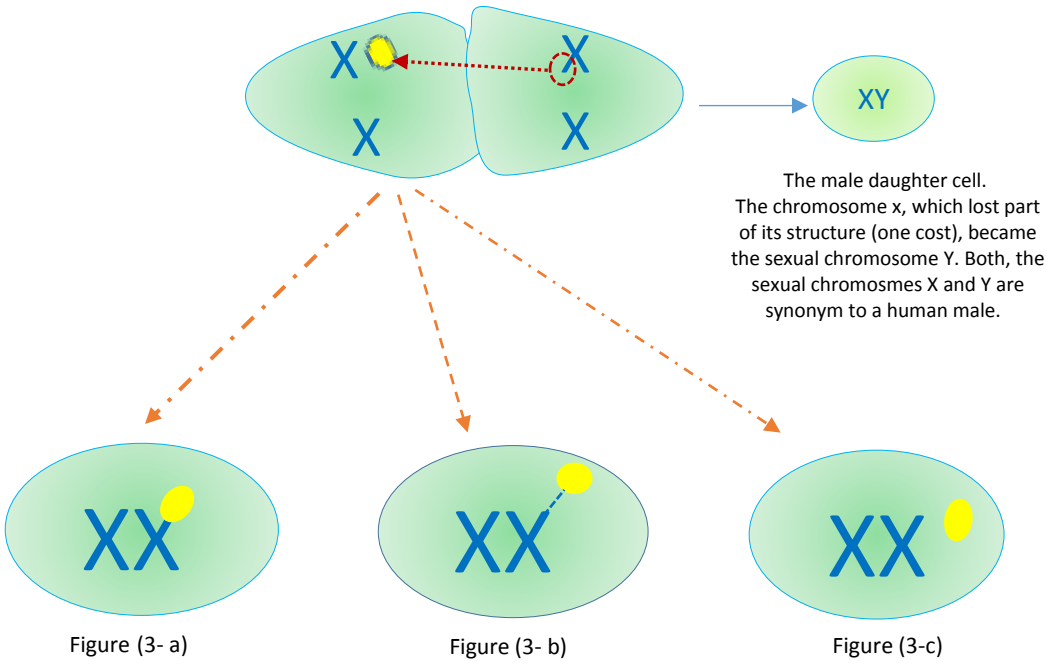

Figure (3):
During the asexual reproduction (mitosis) of the Mother Stem Cell,
a segment of the chromosome X (in red dashed circle) was avulsed in profit to the chromosome X in the other daughter cell.
Figure (3-a): The avulsed segment (yellow circle) is quite integrated in the structure of the chromosome X rendering it bigger (i.e. of higher molecular weight) than its homologue, the second chromosome X.
The giant chromosome X could be the future Barr body found in all female somatic cells.
Figure (3-b): The avulsed segment (yellow circle) is attached, by a micro band (dashed blue line), to the chromosome X forming together one structure of two distinguishable components. The bi-component structure is of a higher molecular weight than the other chromosome X,
and is the progenitor of the Barr body.
The micro band is a remnant of the spindle apparatus.
Figure (3-c): The avulsed segment (yellow circle) could stay independent in the nucleus of the recepient cell.
This free body might be the origin of the Barr body.

To view an animated demonstration concerning Barr Body, click on this link.

The Barr body, its functions

Barr body is omnipresent in the woman's somatic cells, and has probably two essential functions:

1- The additional genes that are provided by ***Barr body,*** direct and dictate the cell development (differentiation) in a feminine direction.
2- ***Barr body*** offers two different types of genetically asymmetric ***oocytes; the male oocyte and the female oocyte.*** The presence of ***Barr body*** is synonym to a ***female oocyte (FO).*** A ***female oocyte*** does not give but a ***female embryo***.

For more details concerning the last idea, one could read my related article on this link:
Who decides the sex of coming baby?
the mother or the father?

Conclusion

Since its discovery in 1949, ***Barr body*** has received great attention. The scientists agreed on the existence of ***Barr body*** in the nucleus of the ***female cell (XX*),*** and agreed on its absence in the nucleus of the ***normal male cell (XY).*** However, the origin and the function of ***Barr body*** rest vague and rest at the core of a large controversy. Finally, they arrived to a certain conclusion, which is the hypothesis of ***Mary Lyon*** in 1961.

The ***Lyonisation Hypothesis*** suggests that one of the ***chromosomes X*** in the nucleus of the ***female cell (XX*)*** should be deactivated in order to control the over dose of the sexual genes carried on both ***sexual chromosomes X***. This process is termed ***Dosage Compensation***. The ***deactivated chromosome X*** will form the ***Barr body*** inside the nucleus of the ***female cell (XX*)***. The ***deactivated chromosome X*** may come from the father or the mother.

Mary Lyon claimed the presence of a certain ***Xist gene*** carried on one of the two ***chromosomes X,*** and the presence of a certain ***Tsix gene*** carried on the second ***chromosome X***. The ***Xist-bearing chromosome X*** will be the ***inactivated chromosome X***, which is the future ***Barr body***, early during embryonic development. Whereas, ***Tsix-bearing chromosome X*** will remain functional in the nucleus of the ***female somatic cell***.

Based on ***Lyon hypothesis***, the ***X-Xist*** and ***X-Tsix*** **chromosomes** continue to function effectively within the ***progenitor cell***. Next, the ***oocytes*** themselves will carry either the ***X-Xist chromosome*** or the ***X-Tsix chromosome***.

Similarly, in the man, the ***X- spermatozoid***, will be either carrier of the ***Xist gene*** or porter of the ***Tsix gene***. Now, give the ***X-Xist spermatozoid*** fertilized the ***X-Xist oocyte***, or the ***X-Tsix spermatozoid*** fertilized the ***X-Tsix oocyte***. What to do then? Which ***chromosome X*** will be functional, and which one would be deactivated? This is undoubtedly a great deficiency in ***Lyon hypothesis***.

Secondly, in ***sex-related hereditary diseases***, how could the woman be a disease-carrier with one functional ***chromosome X*** in the nucleus of her somatic cell?

Assuming the ***functional chromosome X*** carries the pathological gene of the hereditary disease, then the disease will clearly affect the woman. Now, on the contrary, assuming the ***non-functional chromosome X*** is the porter of the pathological gene of the hereditary disease, the disease will then totally disappear. There is no middle ground between this and that, as ***Lyon hypothesis*** requires. The woman is either affected by the sex-related hereditary disease or not. So, there is no woman who is a disease porter.

Thirdly, the coloration and the appearance of ***Barr body*** with the immune techniques and colorants that target ***chromosome X*** support the hypothesis of the

origin of ***Barr body*** from the ***chromosome X.*** Therefore, this argument strengthens both hypotheses; ***Lyon hypothesis*** and ***my innovated hypothesis***. The two hypotheses share the birth of ***Barr body*** from the ***sexual chromosome X***, although they differ in the mechanisms of occurrence.

Lyon hypothesis claims the excessive presence of sexual genes on the two ***chromosomes X***. To avoid an excessive supply of sexual genes, the ***female cell*** exempts one of the two existing ***chromosomes X*** from service and keeps the second active. So accordingly, ***Barr body*** must be the deactivated ***chromosome X***, and the other ***chromosome X*** should be the ***female functional chromosome***.

In contrast, my hypothesis considers Barr body to be the only sexual chromosome in the female cell. Actually, Barr body is the only functional chromosome X. While, the other chromosome X is just a porter chromosome, and a great doubt revolves around its sexuality.

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