

Why menstruate?



Marilyn B. Renfree
BioEssays Editorial Board Member

Menstruation – the regular renewal of the lining of the uterus – is a curious phenomenon. Most mammals do not menstruate, so why do humans, higher primates, certain bats and the elephant shrew?

Menstruation evolved relatively recently in each of these three mammalian groups. There have been many hypotheses to explain it. Cyclical regression and renewal may be energetically less costly than maintaining the endometrium in a metabolically active state needed for implantation. Other theories suggested that menstruation evolved to prevent sperm-borne pathogens infecting the endometrium. However, in this issue of *BioEssays*, Emera et al. [1] present arguments that menstruation is an inevitable consequence of spontaneous decidualisation. Decidualisation, the development of a stromal reaction in the endometrium of the uterus that resembles an inflammatory tissue reaction, occurs during the luteal phase in anticipation of an invasive blastocyst. If fertilisation fails, progesterone drops and the differentiated stromal tissue is shed with bleeding – menstruation. Menstruation is therefore a consequence of the evolution of endometrial preparation that has become independent of any action of the embryo. It also may have co-evolved as a protective mechanism against maternal-foetal rejection. If these traits were advantageous, they may have been specifically selected and gradually incorporated into the organism.

In mammals, the secretion of progesterone plays a major role in controlling the inflammatory decidual reaction. In some, such as the mouse, the invasiveness of the trophoblast penetrates inside the wall of the endometrium. The stroma

responds under the influence of progesterone to undergo an implantation/decidual reaction [2]. Despite this, the mouse does not menstruate. Furthermore, not all mammals have a decidual reaction, but all nurture a fetus within the uterus.

One aspect of menstruation that is not widely recognised is its abnormal frequency. In hunter-gatherer societies, such as the !Kung of the Kalahari, a woman would spend around 15 years in lactational amenorrhea, because in her five lifetime pregnancies she normally breastfed each infant for an average of 2–3 years [3]. Thus, she would have had only around 4 years of menstrual cycles. These would have occurred initially during the period of adolescent infertility (between menarche and the first conception) and when fertility declines before the onset of menopause towards the end of her reproductive life [3]. In total, she would experience only about 50 cycles. Compare this to the modern contraceptive-using woman who experiences menarche at approximately 13 and menopause at around 50. This results in about 420 menstrual cycles if two pregnancies and lactational amenorrhea have intervened. It is our modern lifestyle that leads to these excessive numbers of cycles, which, with their repeated oestrogen surges and progesterone withdrawal are certainly not what we evolved to cope with. Is monthly menstruation an iatrogenic disorder of modern Western societies who practise contraception that leads to 'diseases of nulliparity' including breast cancer, endometrial cancer, ovarian cancer and endometriosis?

Hunter-gatherer societies reflect the same pattern of reproduction as our

closest relatives, the Great Apes. Chimpanzees, gorillas and orang-utan females all breastfeed their infants for around 3–4 years. But what is the advantage to those other menstruating mammals, namely certain bats and the elephant shrew? Like humans, these species have a decidual reaction even in the absence of an embryo [4]. In seasonal breeding species, the advantage may be to allow for rapid elimination of highly differentiated endometria to provide another opportunity to establish another pregnancy within the same season. Although the adaptive significance of menstruation remains a mystery, it may be, as Emera et al. [1] point out, simply an evolutionary trade-off.

References

1. Emera D, Romero R, Wagner G. 2012. The evolution of menstruation: A new model for genetic assimilation. *BioEssays* **34**: 26–35.
2. Finn CA. 1996. Why do women menstruate? Historical and evolutionary review. *Eur J Obstet Gynecol Reprod Biol* **70**: 3–8.
3. Short RV. 1984. Why menstruate? In Fraser S, Porter J, Mason C, eds; *Obstetrics, Gynaecology, Psychiatry and Family Planning*. Abbotsford, Australia: York Press Pty. Ltd. pp. 131–6.
4. Rasweiler JJ IV, Badwaik NK. 2000. Anatomy and physiology of the female reproductive tract. In Crichton EG, Krutzsch PH, eds; *Reproductive Biology of Bats*. London: Academic Press. pp. 157–219.

Marilyn B. Renfree
m.renfree@unimelb.edu.au
University of Melbourne, Melbourne,
Australia

This article comments on DOI 10.1002/bies.201100099.