Nature Reviews Genetics | AOP, published online 10 November 2010; doi:10.1038/nrg2909

DEVELOPMENT

Strand-specific satellite expression

At fertilization, the paternal genome undergoes dramatic changes in its chromatin state, including the *de novo* establishment of epigenetic marks. By analysing pericentric heterochromatin (as a model for constitutive heterochromatin) in early mouse development, a new study provides insights into the mechanisms by which these changes could occur and how nuclear organization in the zygote is set up. This approach has shown that transcripts from pericentric satellite repeats are important for higher-order chromatin organization of the pericentric domain and developmental progression of the embryo.

Probst and colleagues used RNA fluorescent *in situ* hybridization to examine pericentric satellite expression in early-cleavage-stage embryos, as previous studies had indicated that the organization of satellite repeats is dynamic at this stage in development. At the two-cell stage, they observed a specific peak in major satellite transcription from the zygotic genome followed by a rapid downregulation. This coincided with the organization of pericentric regions into clusters called chromocentres, suggesting a link between the expression dynamics of satellite repeats and chromocentre formation.

The transcription of major satellites can occur from both strands of the DNA, so by using highly specific locked nucleic acid (LNA) oligonucleotide probes, the authors examined whether satellite expression was subject to strand-specific regulation in pre-implantation embryos. They found temporally and spatially restricted strand-specific regulation of these satellite transcripts: forward transcripts accumulated during the S phase of the cell cycle and localized to both pericentric domains and the cytoplasm, whereas reverse transcripts were produced during the G2 phase and accumulated in discrete nuclear foci at the pericentric domains. Moreover, the satellites, particularly the forward strand DNA, were predominantly expressed from the paternal genome and therefore strongly reduced in parthenotes. The authors suggest that this parental bias might reflect the asymmetry in histone marks between maternal and paternal pericentric domains, such that higher levels of satellite transcription are favoured by the lack of somatic heterochromatin marks at paternal pericentric regions.

How does satellite transcription affect developmental progression of the mouse embryo? To address this, Probst *et al.* injected zygotes with DNA–LNA gapmers (oligonucleotides with a central DNA region and LNAs at their 3′ and 5′ ends) that target the major satellites. Gapmers deplete the transcripts they target, but may also interfere with RNA folding and interactions between transcripts and RNA-binding proteins. The authors found that satellite transcript depletion resulted in developmental arrest during the G2 phase of the two-cell stage before pericentric domains have been completely organized into chromocentres, strongly supporting the idea that pericentric satellites have an important functional role during embryo development.

Therefore, this study highlights the strand-specific regulation of satellite repeat transcription as an important developmental mechanism, and this finding could have broader implications for the roles of repeat transcripts in higher-order chromatin organization in early stages of mammalian development.

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ORIGINAL RESEARCH PAPER Probst, A. V. *et al.* A strand-specific burst in transcription of pericentric satellites is required for chromocenter formation and early mouse development. *Dev. Cell* **19**, 625–638 (2010)