The Bicoid gradient gets into shape without nuclei

Morphogen gradients provide key positional information during embryogenesis but how they are established is not well understood. A gradient of the transcription factor Bicoid is known to provide Drosophila embryos with positional information along their anterior-posterior axes. Since Bicoid is enriched in nuclei, nuclei have recently been proposed to act as potential traps or sites of degradation that could slow down Bicoid diffusion from the anterior pole and hence contribute to the observed Bicoid gradient. On p. 2857, Oliver Grimm and Eric Wieschaus address this issue experimentally and find that the Bicoid gradient is shaped independently of nuclei. Using mutated Bicoid with impaired nuclear localisation, they show that the resulting gradient of this protein is indistinguishable from that formed by normal Bicoid protein. They also show that the initial centre-to-surface redistribution of Bicoid and the scaling of the gradient are not influenced by Bicoid nuclear accumulation. Based on these findings, the authors propose that nuclei do not play a role in shaping the Bicoid gradient.

Spinal cord development BuMPs into epigenetics

During spinal cord development, transcription factors and signalling proteins, such as the BuMPs, are involved in neural tube (NT) patterning and in inducing neural differentiation. Although epigenetic modifications are known to regulate the expression of key neural development genes in stem cells, whether they have a role in spinal cord development remains unclear. On p. 2915, Marian Martínez-Balbás and colleagues study histone H3 lysine 27 trimethylation (H3K27me3) in vivo during chick embryo neurogenesis. They show that global levels of H3K27me3 increase along neurogenesis and regulate BMP signalling within the NT. Using microarray analysis, they find that the expression of Noggin, a BMP inhibitor, is repressed by H3K27me3. Importantly, they show that, in response to BMP activity, the histone demethylase JMJD3 interacts with the Smad1/4 complex to demethylate and thereby activate the Noggin promoter. This reveals a novel pathway by which BMP signalling can regulate its own activity within the spinal cord by modulating expression of its inhibitor Noggin.

microRNA regulation of Hox genes: RNA tails matter

The Hox family of transcriptional regulators plays a central role in specifying segment identity along the anteroposterior axis of animal bodies. The Drosophila Hox gene Ultrabithorax (Ubx) is dynamically expressed during development and controls the development of posterior thoracic and anterior abdominal segments. On p. 2951, Claudio Alonso and colleagues show that during development the Ubx gene produces multiple transcripts that vary in their visibility to microRNAs (miRNAs). They demonstrate that different parts of the embryo express Ubx transcripts that contain variable 3'UTRs, each harbouring a distinct set of miRNA target sites. The differential distribution of these transcripts during development is independent of miRNA-mediated degradation but is instead due to an in-built system that processes mRNAs according to developmental context. They also show that other Hox genes, such as Antennapedia, abdominal-A and Abdominal-B, exhibit similar developmental RNA processing and propose that developmental processing of 3'UTR sequences is a general molecular strategy that allows spatiotemporal control of mRNA-miRNA interactions during development.

IN JOURNAL OF CELL SCIENCE

The histone locus body muscles in

The terminal differentiation of muscle – which involves muscle growth, extension and attachment to tendons – requires remodelling of chromatin at muscle-specific loci, but many of the key proteins in this process are unknown. In J. Cell Sci., Sarada Bulchand and colleagues identify and characterise muscle wasted (mute), a new Drosophila mutant that has severe and progressive loss of muscle mass. The authors show that late muscle differentiation (rather than early myogenic events) is defective in mute mutants. Notably, mute colocalises with the histone locus body (HLB; a nuclear structure that is thought to be important for processing histone pre-mRNAs, and histone pre-mRNAs are misprocessed in mute embryos. Moreover, heterochromatin protein 1 (HP1) is mislocalised in mute embryos, and several important regulators of late muscle differentiation are misregulated. Finally, the authors show that other histone-processing mutants also have defective muscles. They speculate that mute regulates terminal muscle differentiation through histone processing and heterochromatin organisation, which points to a novel role of the HLB in the maintenance of muscle integrity.