KRT5 but not KRT7, and the gastric epithelium, which expressed none of the proteins (Fig. 1). KRT7, which is expressed in cells of Barrett's oesophagus in humans[6], is thus specific to the transitional epithelium.

Next, Jiang and colleagues surgically redirected bile acid to the oesophagus of mice to mimic severe reflux, which is a major risk factor for Barrett's oesophagus[7]. This led to expansion of the transitional epithelium, which contained epithelial cells expressing the protein CDX2 and goblet cells — both markers of Barrett's oesophagus[8]. By contrast, the neighbouring squamous oesophagus, which was also exposed to bile-acid reflux, contained neither cell type.

So it seems that there is a link between the transitional epithelium and Barrett's oesophagus. The authors' next step was to exclude the possibility that cells from the neighbouring epithelia migrate to the GEJ, acquire KRT7 expression and transform into Barrett's oesophagus cells.

Jiang *et al.* used a genetic technique to generate mice in which KRT7-expressing cells of the transitional epithelium were indelibly labelled with a fluorescent protein, so that they and all their descendants fluoresced. The authors labelled the cells at birth. After 14 days, all the cells in the transitional epithelium — but none in the surrounding tissues — were marked. Therefore, formation and maintenance of this tissue is independent of the oesophagus and stomach. The authors also demonstrated that forced expression of CDX2 in both the transitional epithelium and oesophagus led to metaplasia arising from the transitional epithelium only, further suggesting that this tissue is an origin for Barrett's oesophagus.

How relevant are these findings to human disease? Jiang *et al.* examined the human GEJ and found that the transitional epithelium expressed the same marker proteins as in mice. To better study the human tissue, the authors turned to organoids — three-dimensional *in vitro* 'mini-organs', which maintain the biological features of their tissue of origin. The researchers grew organoids from KRT7-expressing cells isolated from a normal human GEJ, and induced expression of CDX2 in the cells. These organoids gave rise to metaplastic cells similar to those seen in Barrett's oesophagus. By contrast, organoids formed by cells that did not express KRT7 — presumably derived from oesophageal epithelium — did not give rise to metaplastic cells, even after CDX2 overexpression.

Jiang and co-workers' findings are important on two levels. First, they imply that the transitional epithelium arises during embryonic development, and is distinct from the oesophagus and stomach (at least in mice). Second, the transitional epithelium seems to be more susceptible than the oesophageal and gastric epithelia to metaplasia following environmental damage or genetic manipulation.

The work also raises further questions. For instance, it is not clear what triggers abnormal CDX2 expression in the transitional epithelium. Another human organoid study[9] suggested that mutations gradually accumulate in adult stem cells, and it is possible that the transitional epithelium contains stem cells that are mutation-prone. Indeed, the cells of Barrett's oesophagus are highly mutated[10]. The mutational landscape of the transitional epithelium remains unknown, and this should be investigated in the future.

In addition, the authors did not exclude the possibility that their KRT7-expressing organoids originated from cells of the submucosal glands. It has been reported[11] that patients in whom the transitional epithelium has been removed can still acquire Barrett's oesophagus or a metaplasia resembling the condition.

Nonetheless, Jiang and colleagues' comprehensive characterization of the transitional epithelium sheds some light on the possible origin of Barrett's oesophagus. The stage is set to investigate whether the transitional epithelium is the sole origin of the condition, and what role this tissue has in the progression to oesophageal cancer. ■

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EVOLUTION

Fan-assisted insects

Insects of the genus *Rhagovelia* are unusual among water striders, because they can move on fast-flowing water. They are also the only organisms to have propelling fan structures on their midlegs (pictured; scale bar, 100 micrometres). Writing in *Science*, Santos *et al.* examine this evolutionary innovation (M. E. Santos *et al. Science* **358**, 386–390; 2017).

The authors identify two genes that control fan development. One, *geisha*, is specific to *Rhagovelia* and evolved when another, *mother-of-geisha*, was duplicated early in the insect's lineage. The duplicates acquired expression only in the cells from which the fans arise.

Santos *et al.* demonstrate that the fans facilitated *Rhagovelia*'s adaptation to fast-flowing water, by enabling fast and manoeuvrable running against a current. Thus, their work provides insights into how the evolution of lineage-specific genes can enable organisms to inhabit previously inaccessible environments. **Jennifer R. Gardiner**