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Lateral migration and deformation of a vesicle in Poiseuille flow
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— The lateral migration and deformation of a suspended vesicle in Poiseuille flow is investigated numerically in the low Reynolds number limit. We consider two cases, the external suspended fluid is unbounded or bounded by a steady infinite solid wall. Using the boundary integral method we solve the corresponding hydrodynamic flow equations and we track explicitly the vesicle dynamics in 2D. Here we limited our study to vesicles without viscosity contrast between their internal and external fluids. In the unbounded geometry case, we find that the nonlinear character of the Poiseuille flow causes the lateral migration of the vesicles towards the flow centerline, this is in a marked contrast to the migration of droplets, which are known to migrate outward the centerline in the absence of a viscosity contrast. Once the vesicles reach the centerline they keep moving just parallel to the flow direction with a steady parachute-like shape. We find that the lateral migration velocity normalized by the curvature of the Poiseuille flow velocity profile is a universal function of the local capillary number. In the wall-bounded geometry, an additional lift force caused by the presence of the wall appears. Here we considered one wall in order to be able to investigate the interplay between the wall- and the Poiseuille flow curvature-induced lift forces. We find that the closer the vesicle is to the centerline, the more the curvature induced lift force is dominant.

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