**Additional file 2**



**Schematic illustration of possible neuronal circuits regulated by α1A-ARs expressed in *Vgat-Cre*+ inhibitory interneurons in the SDH**

Pruriceptive information from primary afferents is relayed through SDH interneurons including GRPR+ neurons. Based on our findings showing that (1) *Adra1a* was expressed in *Vgat-Cre*+ SDH inhibitory interneurons (Fig. 1b, c), (2) the knockout of α1A-ARs in these neurons enhanced scratching behavior elicited by chloroquine but not by compound 48/80 (Fig. 1a, e), and (3) activation of spinal α1A-ARs has been shown to facilitate the transmission of inhibitory synaptic inputs onto GRPR+ SDH neurons (Koga et al., Mol Brain 13: 144, 2020), it is hypothesized that inhibitory signals acting on GRPR+ neurons via α1A-AR-expressing SDH inhibitory interneurons suppress histamine-independent itch. On the other hand, because silencing SDH-projecting locus coeruleus-NAergic neurons has shown to enhance histamine-dependent and independent itch (Koga et al., Mol Brain 13: 144, 2020), other ARs such as α2-ARs in SDH neurons and at primary afferent terminals may also be involved in histamine-dependent itch.