Electrostatic field along the symmetry axis of a charged pipe

On the pipe: (radius a, extends from –h to +h, surface charge σ)

$$dq_i = \sigma a d\varphi dz_i$$

$$\vec{r}_i = x_i\hat{x} + y_i\hat{y} + z_i\hat{z} \rightarrow \vec{r}_i = a\cos\varphi\hat{x} + a\sin\varphi\hat{y} + z_i\hat{z}$$

$$\vec{r}_p = z_p\hat{z} \Rightarrow \vec{r}_{ip} = -a\cos\varphi\hat{x} - a\sin\varphi\hat{y} + \left(z_p - z_i\right)\hat{z}$$

$$\vec{E} = ka\sigma \int_{\varphi=0}^{\varphi=2\pi} \int_{z_i=-h}^{z_i=h} \frac{-a\cos\varphi\hat{x} - a\sin\varphi\hat{y} + \left(z_p - z_i\right)\hat{z}}{\left[a^2 + \left(z_p - z_i\right)^2\right]^{\frac{3}{2}}} d\varphi dz_i = 2\pi ka\sigma \int_{z_i=-h}^{z_i=h} \frac{\left(z_p - z_i\right)\hat{z}}{\left[a^2 + \left(z_p - z_i\right)^2\right]^{\frac{3}{2}}} dz_i$$

$$\vec{E} = 2\pi ka\sigma \left[\frac{\hat{z}}{\sqrt{a^2 + \left(z_p - z_i\right)^2}}\right]\Bigg|_{z_i=-h}^{z_i=h} = 2\pi ka\sigma\hat{z}\left[\frac{1}{\sqrt{a^2 + \left(z_p - h\right)^2}} - \frac{1}{\sqrt{a^2 + \left(z_p + h\right)^2}}\right]$$

This vanishes in the very center of the pipe.

What happens as h becomes big? Then z_p is insignificant and again E approaches zero.