In our models, we have something similar to $y \sim N(0, \tau^2)$ with $\tau \sim No^+(0,1)$ (I'm using a half-normal here because the plots aren't so heavy tailed).

1 Thinking about $\eta = \tau^2$ as the parameter

If we think about a parameter $\eta = \tau^2$, then the prior for η is

$$p(\eta|\ldots) \propto e^{-\eta/2}|\eta^{-1/2}|$$

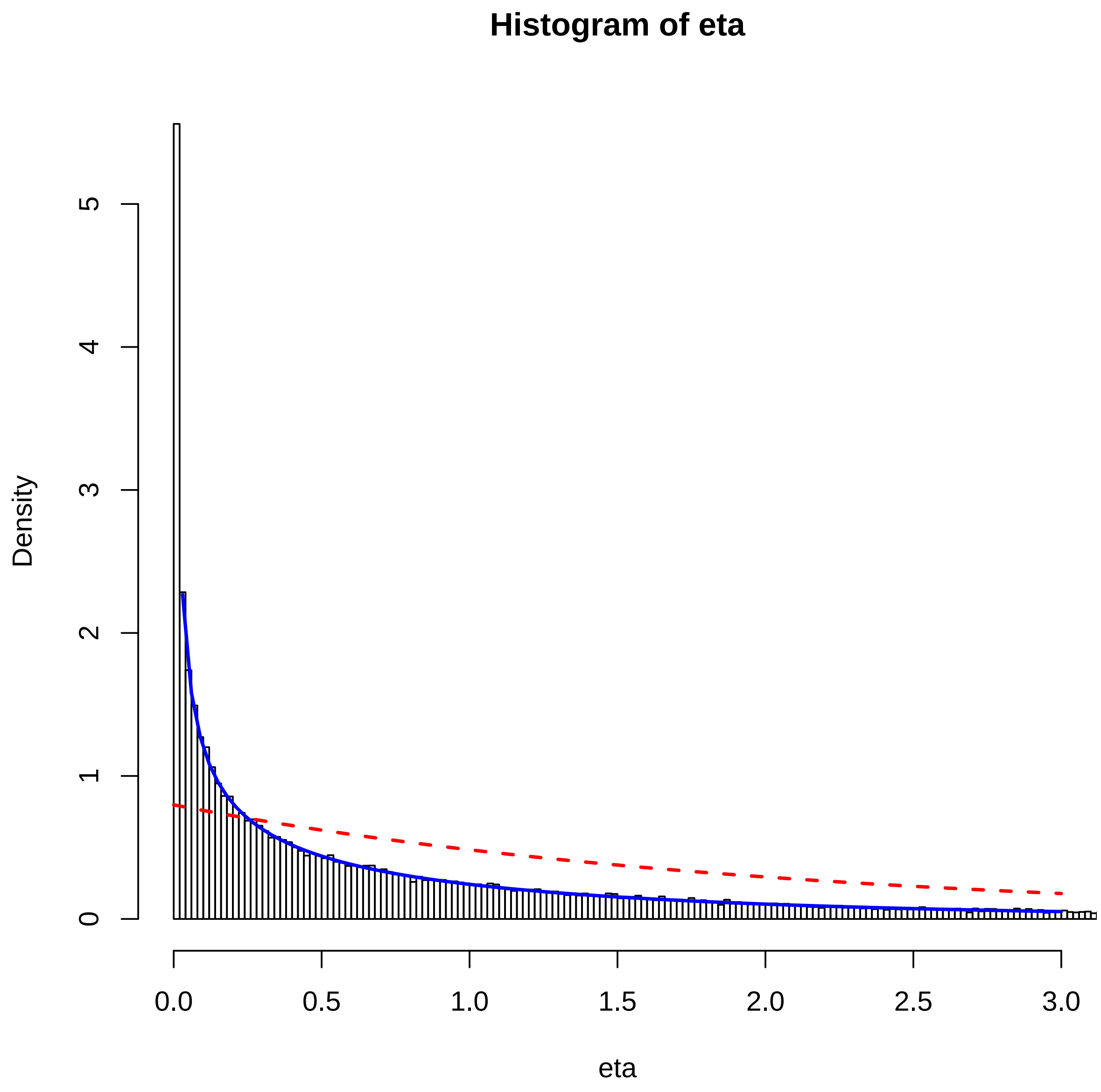
where the $|\eta^{-1/2}|$ comes from the Jacobian for the transformation $\eta = \tau^2$.

The code here shows that you need to incorporate the Jacobian.

```
tau = abs(rnorm(1e5))
eta = tau^2

# eta = tau^2
no_jacobian   = function(eta) 2*dnorm(sqrt(eta))
with_jacobian = function(eta) dnorm(sqrt(eta))/sqrt(eta)

hist(eta, 1000, freq=F, xlim=c(0,3))
curve(no_jacobian, col='red', lwd=2, add=TRUE, lty=2)
curve(with_jacobian, col='blue', lwd=2, add=TRUE)
```



The full conditional is then

$$p(\eta|\ldots) \propto \eta^{-1/2} e^{-y^2/2\eta} e^{-\eta/2} |\eta^{-1/2}|$$

and using this full conditional will get you exactly what you want.

2 Thinking about τ as the parameter

If we think about τ as the parameter, then the prior is immediate. The full conditional is

$$p(\tau|\ldots) \propto (\tau^2)^{-1/2} e^{-y^2/2\tau^2} e^{-\tau^2/2}.$$

The code here shows that this also fits.

```r
tau_conditional = function(tau) exp(dnorm(0,tau,log=TRUE)+dnorm(tau, log=TRUE))
i = integrate(tau_conditional, 0, Inf)
hist(tau, 1000, freq=F, xlim=c(0,3))
curve(tau_conditional(x)/i$value, col='red', lwd=2, add=TRUE)
```