Let G be a real rank one connected semisimple Lie group with finite center. We introduce a real Hardy space $H^1(G//K)$ on G as the space consisting of all K-bi-invariant functions f on G whose radial maximal functions $M_\phi f$ are integrable on G. We shall give a relation between $H^1(G//K)$ and $H^1(\mathbf{R})$ via the Abel transform on G. As an application, we shall consider $(H^1(G//K), L^1(G//K))$ boundedness of heat, Poisson maximal operators and the Riesz transform on G.