Online Technical Appendix

1. MERS-CoV RT-PCR

Nucleic acid was extracted from respiratory and plasma specimens with a SeePrep12™ Viral NA kit (Seegene, Seoul, Korea) and SELIAISON Ixt instrument (DiaSorin, Saluggia, Italy). Nucleic acid from respiratory specimens was tested with a PowerChek MERS-Real-time PCR kit (KogeneBiotech, Seoul, Korea) and that from plasma specimens was tested with a LightMix® Modular MERS-CoV PCR kit (Roche Diagnostics, Basel, Switzerland). Both tests target the upstream region of the E gene (upE) and the open reading frame of the 1a gene (orf1a). Ct values < 39 for both targets were considered positive. The pattern of the amplification curves was also examined to confirm the PCR results. Inconsistent curves were considered negative.

2. Cytokine analysis

Serum concentrations of GM-CSF, Granzyme B, IL-1α, IL-1β, IL-2, IL-4, IL-6, IL-8, IL-10, IL-12p70, IFN-α, IFN-γ, IP-10, MCP-1, MIG, MIP-1α, MIP-1β, RANTES, TNF-α were measured simultaneously in serum samples using a cytometric bead array (BD Biosciences) according to the manufacturer's protocol. Data were acquired on a FACS LSR II flow cytometer (BD Biosciences). Total 19 cytokines/chemokines were analyzed in serial serum samples from 20 patients for which samples were available (14 recovered and 6 deceased patients; blood samples from other 10 patients were not collected due to mild illnesses and early discharge).

3. MERS-CoV serology

An immunofluorescence assay (IFA) was used to detect human anti-MERS-CoV IgG (Euroimmun, Luebeck, Germany). The antigen source was a cell culture infected with MERS-CoV. Serum samples were used at dilutions of 1:20 – 1:2560. A patient's serum was used as the primary antibody and fluorescein-labeled antihuman IgG as the secondary antibody. Neuralizing antibody titers were measured with MERS-Spike pseudovirus particles, as described previously with modifications [Wang L. et al., *Nat Commun* 2015;6:7712]. Briefly, MERS-Spike pseudovirus particles were produced by cotransfecting 293TN cells with packaging plasmid pCMVΔR8.2, transducing plasmid pHR' CMV-Luc and CMV/R-MERS-CoV S plasmid, which were provided by Dr. Barney S. Graham of the US NIH. 48 hrs later, filtered supernatant was 5-fold concentrated with WELPROT^{TM} virus concentration reagent (WelGene). For the neutralization assay, concentrated MERS-Spike pseudovirus particles were preincubated with serially diluted patients' serum for 1 hr at 37°C, and the mixture was added to Huh7.5 cells with polybrene (Sigma-Aldrich, St. Louis, MO). The luciferase activity in infected cells was read at 72 hrs post-infection and IC_{50} neutralization titer was calculated for each individual serum sample.