Background

- COVID-19 has infected more than 43.5 million people causing over 1.1 million deaths worldwide.
- Safe and efficacious vaccine is the need of the hour.
- Spike glycoprotein (viral surface protein) on the Severe acute respiratory syndrome coronavirus (SARS-CoV) consists of 2 subunits: S1 subunit and S2 subunit.
- The S1 subunit binds to the Angiotensin Converting Enzyme-2 (ACE-2) receptor on susceptible cells → virus entry into host cell → immune response.
- Thus, spike S1 subunit is a suitable vaccine candidate against SARS-CoV and the ongoing COVID-19 pandemic.
- Advantages of Microparticles:
  1. Better taken up by antigen presenting cells.
  2. Effective encapsulation of active agent.
- Advantages of Microneedles:
  1. Needless, painless delivery.
  2. Readily reach its site of action.
  3. Ease of administration.

Material and Methods

Microparticle formulation
- Double emulsion method
- Using PLGA as polymer and SARS-CoV spike S1 subunit as antigen
- Microparticles were lyophilized
- Similarly, microparticles were formulated for adjuvants such as Alum and MF59

Microneedle fabrication
- Microparticles were loaded in hyaluronic acid gel to obtain quick dissolving microneedles

Nitric oxide assay
- Dendritic cells were pulsed with microparticles to evaluate production of nitric oxide which correlates to the induction of innate immune response

Flow cytometry
- Microparticles were evaluated with dendritic cells for the expression of antigen presenting molecules MHC I and MHC II and their co-stimulatory molecules CD80 and CD40

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Results

Fig 2. MHC I and its co-stimulatory molecule CD80. Data are expressed as mean ± SEM. *p<0.05 significant.

Fig 3. MHC II and its co-stimulatory molecule CD40. Data are expressed as mean ± SEM. *p<0.05 significant.

Expression of antigen presenting molecules and their corresponding co-stimulatory molecules of the surface of dendritic cells.

Conclusion

✓ Spike S1 glycoprotein loaded microparticles (SPMPs) along with adjuvant microparticles and microneedles loaded with SPMPs only and with adjuvant microparticles were successfully formulated.
✓ SPMPs with alum and MF59 as adjuvant microparticles exhibited significant expression of MHC I, MHC II, CD 80 and CD 40 on the surface of dendritic cells as compared to the other groups.
✓ SPMPs with alum and MF59 microparticles demonstrated significant release of nitrite by dendritic cells in comparison with other groups.
✓ In vitro studies indicate SPMPs induced both humoral and cellular immune responses.