A474 - An evaluative study of the novelty device with the function of auto-aspirating and pressure indicator for safety central venous catheterization

LY LIN; WF Luo; CY Tsao
National Taiwan University Hospital, Taipei, Taiwan

Introduction:
Previous studies have shown that 0.8% of CVC attempts resulted in arterial punctures that were not recognized by blood color. To overcome the problem, our team has developed a concept of pressure detecting syringe that can indicate the artery puncture [1]. Based on previous research, different springs, the actuator of the design, have been evaluated to optimize the proposed device and reduce the risk of CVC procedure.

Methods:
Tested devices
The inner-spring is set between the pressure indicator and plunger (Fig. A1). Three springs are tested.

Test condition
Blood samples were simulated by glucose solution with absolute viscosities of 2 and 6 mPa-s. Different blood pressures were applied to simulate the artery and vein (Fig. A2). The response time (RT) is defined as the time required to show the indicating signal (IS) which is the movement of the piston from the position in Fig. A2-1 to A2-2.

Results:
The RT is strongly influenced by spring (A2) but every design can show the IS when pressure is higher than 50 mmHg, the assumed minimum artery pressure. The RT of S1, the strongest spring design, is about 10s in the 50mmHg-pressure and high viscosity condition. During our tests we found the user can realize the IS before the position be fully changed from Fig. A2-1 to A2-2. Thus, we believe the 10s RT, the worst case, is still acceptable. We also found the weak spring force may lead to difficulty to empty the syringe because the spring must to overcome the blood pressure and the friction between the piston and barrel. As a result, it was difficult for S3 to absolutely empty the syringe even if the blood pressure is only 30mmHg. The spring will be compressed as Fig.A2-2 and fail to push the piston when pushing the plunger forwardly, which is not acceptable in clinical use.

Conclusion:
The results indicate the feasibility of using the device to facilitate CVC and we believe the S1 or S2 are more suitable for the future application.

References:
Lin L. Y. et al. EJA Volume 36, e-Supplement 57, p222, June 2019
Figure A1. The illustration of the proposed device.  
Figure A2. The relationship between response time and blood pressure.

Tested spring (S1, S2, S3) is set inside.