알부민이 고정화된 폴리우레탄의 표면 특성과 혈액적합성에 관한 연구

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SURFACE CHARACTERISTICS AND BLOOD COMPATIBILITY OF ALBUMIN-IMMOBILIZED POLYURETHANE

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INTRODUCTION

The initial events following exposure of polymer surfaces to blood lead to cellular adhesion and coagulation[1]. Many researchers have examined these events with the aim of passivating the foreign surface by appropriate surface modifications.

One of the most promising methods is the surface pretreatment with albumin which contains no peptide sequences to interact with cell membrane or enzyme receptors in the coagulation cascade and reduces subsequent platelet adhesion [2] and surface activation of the coagulation pathway[3]. However, though adsorbed albumin improves blood compatibility, rapid desorption occurs when these surfaces are exposed under circulating blood.

In this study, we immobilized human serum albumin at the polyurethane(PU) surface to investigate its blood compatibility and serum albumin at the polyurethane(PU) surface to investigate its blood compatibility and extended effects on blood-material interface.

MATERIALS AND METHODS

The methanol extracted PU surface was treated with hexamethylene diisocyanate (HMDI) to introduce free isocyanate groups(PU-HMDI) at 40°C for 1 hour.[4]. Consecutively, PU-HMDI was further grafted with albumin (human,Sigma) in phosphate buffered saline (PH 7.4,PBS) at 4 °C for 24 hours to produce albumin immobilized PU surface (PU-Alb). The surface of PU-Alb was characterized by ATR-FTIR, ESCA, SEM and dynamic contact angle.

The quantification of immobilized albumin onto PU surface was performed using Coomassie brilliant blue G-250. The blood compatibility was evaluated by in vitro protein adsorption, and platelet adhesion tests, and also by ex vivo rabbit A-A shunt occlusion time.

For protein adsorption experiment , human fibrinogen (Sigma) was purified and labeled with [^{14}C] - Formaldehyde by reductive alkylation.

RESULTS AND DISCUSSION

The immobilization of albumin was confirmed from the disappearance of the -NCO peak observed at 2250 cm^{-1} on the PU-HMDI surface by IR and the existence of S atomic % by ESCA (table 1).

The content of albumin immobilized on PU surface was of the order of 5.8 ug/cm^2.

At SEM observation untreated PU surface was relatively smooth, whereas PU-Alb surface was somewhat rough due to reaction intermediate, HMDI. Also albumin grafted PU displayed the slight increase of the hydrophilicity from the Wilhelmy plate method.

Figure 1 shows the fibrinogen binding kinetics for diluted plasma. One and twenty minutes adsorption isotherms of fibrinogen is also indicated in figure 2. PU-Alb surface showed less fibrinogen adsorption than PU control in both figures.

Platelet adhesion and subsequent activation are thought to be promoted by fibrinogen.

In fact, PU-Alb surface showed less platelet adhesion, activation and reduced thrombogenicity. The ex vivo occlusion time of

untreated PU was only 50 min, but that of albumin immobilized PU was extended to 150 min, indicating that this PU-Alb surface is significantly blood compatible.

REFERENCES

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Table 1 Surface proprties of PU-Alb

Material	ESCA(atomic %)				Contact angle	
	C	O	N	S	θ_{adv}	θ_{rec}
PU, MeOH ext.	76.9	21.5	1.5	-	86	41
PU-HMDI	73.5	14.4	11.0	-	85	wet
PU-Alb	72.9	15.2	9.7	2.2	61	wet

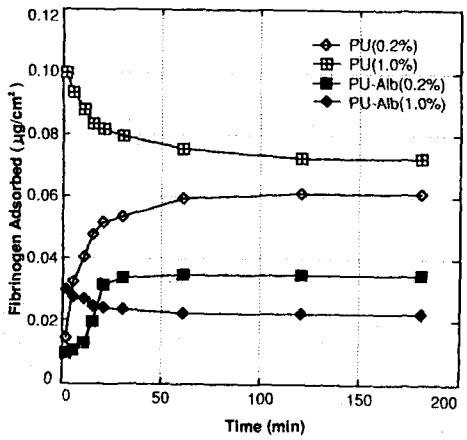

Fig. 1 Fibrinogen adsorption on polymer surfaces from 0.2% and 1.0% of normal plasma concentration

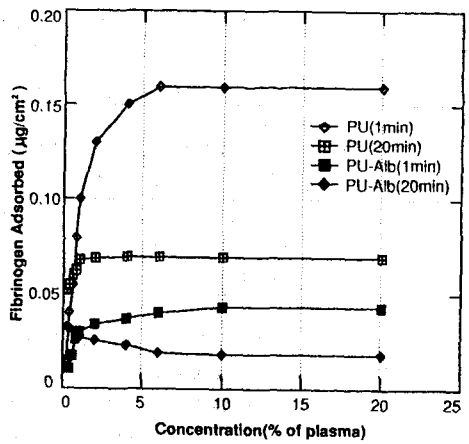

Fig. 2 Fibrinogen adsorption on polymer surfaces from diluted plasma after 1 and 20 minutes incubation