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Blood product storage age and type determine pathophysiology of TRALI

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Queensland and The Prince Charles Hospital; Cardiac Surgery Research Unit, The Prince Charles Hospital; Institute of Health and Biomedical Innovation and School of Public Health, Queensland University of Technology and The Princess Alexandra Hospital, Brisbane, Queensland and Research and Development, Australian Red Cross Blood Service, Australia; and Research Department, Bonfils Blood Center and Departments of Pediatrics and Surgery, University of Colorado, Denver, Colorado, USA

The age of transfused blood products has been identified as an independent risk factor for increased morbidity and mortality in critical care patients. We aimed to investigate whether stored packed red blood cells (PRBC) or pooled platelet concentrates (PC) induced transfusion-related acute lung injury (TRALI) in an in vivo ovine model.

Sheep (n=44) were randomised into two groups, receiving either saline or lipopolysaccharide (LPS), and further randomised to receive pooled supernatant from either fresh (day 1) or stored (day 42) human PRBC, fresh (day 1) or stored human PC (day 5) or saline (control). TRALI was defined by hypoxaemia and pulmonary oedema. Cytokines were quantified using commercial assays.

TRALI developed in 80% of LPS-treated sheep following transfusion with either stored PC supernatant (n=5) or stored PRBC supernatant (n=5), with significantly lower ($P < 0.05$) incidence in control sheep (9%; n=23). Decreased mean arterial pressure and cardiac output as well as increased central venous pressure and body temperature were observed in PRBC-induced TRALI compared to PC-induced TRALI. Levels of inflammatory cytokines (IL-8, IL-16 and MCP-1) were higher in stored PRBC than in stored PC, indicating a dose-response relationship may underline the development of TRALI.

TABLE 1

1st event + 2nd event	n	TRALI	
		# pos	% pos
Saline + saline	5	0	0%
Saline + fresh PC	3	1	33%
Saline + stored PC	3	0	0%
Saline + fresh PRBC	4	4	0%
Saline + stored PRBC	3	0	0%
LPS + saline	6	0	0%
LPS + fresh PC	5	1	20%
LPS + stored PC	5	4	80%
LPS + fresh PRBC	5	1	20%
LPS + stored PRBC	5	4	80%

TRALI=transfusion-related acute lung injury, PC=platelet concentrates, PRBC=packed red blood cells, LPS=lipopolysaccharide.

In conclusion, the type of blood components transfused and their storage age, as well as the health of the recipient are all key determinants in the development of TRALI.

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