Influence of Temperature, Light and Plastic Material on Vitamin C Stability in Total Parenteral Nutrition Administration Sets

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Introduction

Long exposure to light, ambient temperature, and plastic material may affect vitamin C stability in IV administration sets during administration of total parenteral nutrition (TPN) (Figure 1). This study aimed to assess vitamin C stability in different conditions mimicking TPN administration to the patient.

Methods

After addition of vitamins and trace elements in NuTRIflex® Lipid 3-chamber bag (BBraun, Germany), TPN mixture was passed through IV administration sets made of polyurethane (PU), polyvinyl chloride (PVC), polypropylene (PP) at a temperature of 4, 20, and 40°C and a flow rate of 50 and 100 ml/h, using a dynamic iv injection system. The effect of light was evaluated using opaque tubing or tubing with anti-UV pigments (CIBA). Triplicate samples were collected at the piercing spike and injection site of the tubing and analyzed using high-pressure liquid chromatography.

Conclusion

These results showed that the stability of vitamin C is particularly affected by prolonged exposure to light and high temperature. Incorporation of anti-UV pigments in the tubing should ensure patient's need coverage of vitamin C (Figure 4).

Reference :

Dupertuis Y et al. JPEN 2005; 29:125-130

Results

Except for light-protective tubing, vitamin C was significantly degraded in all the plastic tubing tested at a rate of 50 ml/h, but not at a rate of 100 ml/h). Vitamin C degradation, however, was significantly lower in PP compared to PU tubing (Table). The effect of temperature on vitamin C stability was highlighted by reduced degradation at 4°C and increased degradation at 40 °C regardless of the tubing tested (Figure 2). Similarly, vitamin C degradation was reduced in IV administration sets stored in the dark compared with IV administration sets stored in the ambient light or under an UV lamp (Figure 3).

Table: Degradation rate (%) of Vitamin C in different plastic tubes.

	50 ml/h	100 ml/h
PU	39 ± 19*	14 ± 09
PP	24 ± 18*#	11 ± 25
PP + CIBA	0 ± 9#	nd
PVC	33 ± 21P=.057	25 ± 20
PVC + Airstop Filter	28 ± 11*#	27 ± 20*#
PVC DHEP-free + CIBA	0 ± 11#	nd
PVC Opaque	-6 ± 2#	3 ± 10

*, $P < 0.05$, Significant degradation; #, $P < 0.05$, different from PU (Student's *t* test)

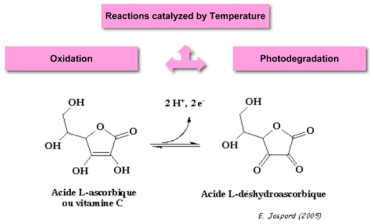


Fig. 1: Mechanism of Vitamin C degradation by exposure to air, light and high temperature.

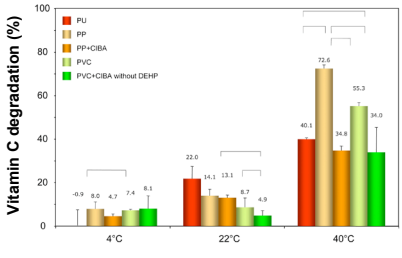


Fig. 2: Influence of the temperature on vitamin C stability in TPN mixture flowing through different IV administration sets at 50 ml/h in the dark.

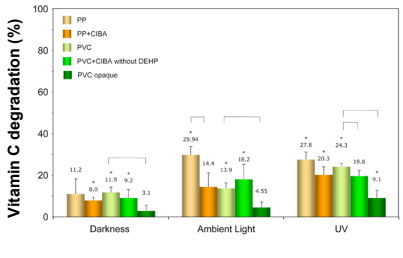
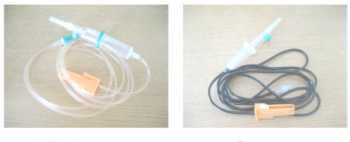


Fig. 3: Influence of light and UV exposure to vitamin C stability in TPN mixture flowing through different IV administration sets at 50 ml/h and 22°C.



UV pigments Opaque

Fig. 4: The TPN mixture is visible in IV administration sets with anti-UV pigments compared with opaque tubing.

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