

# Isosulfan Blue Affects Pulse Oximetry

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**Background:** Certain vital dyes are known to cause pulse oximetry (SpO<sub>2</sub>) desaturation. The authors studied the effect of isosulfan blue (IB) on SpO<sub>2</sub>.

**Methods:** Thirty-three women, aged 34–81 yr, who were undergoing surgery for breast cancer were studied. IB, 5 ml (50 mg), was injected intraparenchymally around the tumor area by the surgeon. A pulse oximeter was used to continuously record SpO<sub>2</sub> values up to 130 min after IB injection. Friedman repeated-measures analysis of ranks was used to analyze the baseline SpO<sub>2</sub> and values at 5, 10, 20, 30, 40, 50, and 60 min.

**Results:** SpO<sub>2</sub> values were significantly different from baseline values at 5, 10, 20, 30, 40, 50, and 60 min ( $P < 0.05$ ). In a typical patient, a maximum SpO<sub>2</sub> decrease of 3% can be anticipated 25 min after injection of IB.

**Conclusions:** After peritumoral administration of IB, 50 mg, a significant interference with SpO<sub>2</sub> will occur. (Key words: Oxygen saturation; sentinel lymph adenectomy.)

CERTAIN vital dyes are known to alter light absorbency of blood, causing pulse oximetry desaturation, which may be interpreted as arterial desaturation.<sup>1–4</sup> Isosulfan blue (IB; Lymphazurin 1%; Kirsch Industries, Richmond, VA) is a patent blue dye absorbed by lymphoid tissue after subcutaneous or intraparenchymal injection. The dye is used in identification of the sentinel lymph node.<sup>5</sup> Before the trial, we noted a prolonged decrease in pulse oximetry readings when using IB. The object of this prospective study was to determine the possible effects of IB on oxygen saturation as measured by pulse oximetry (SpO<sub>2</sub>) in patients undergoing sentinel lymph node biopsies.

## Methods

After we obtained approval for IB blue administration from the Stanford Administrative Panel on Human Subjects in Medical Research, 33 woman with invasive breast cancer, aged 34–68 yr (American Society of Anesthesiologists physical status I or II), who were undergoing sentinel lymph node biopsy using IB dye or IB dye and <sup>99</sup>Technetium sulfur colloid were studied. All patients signed informed consents. The study was per-

formed as part of an Internal Review Board-approved sentinel node protocol at Stanford University School of Medicine. Patients with significant cardiac, respiratory, hepatic, renal, and hematologic disorders were excluded from the study. Anesthetic management included general endotracheal tube administration of anesthesia with mechanical ventilation in 23 patients, general anesthesia with spontaneous ventilation in 7 patients, paravertebral block with sedation in 2 patients, and local infiltration anesthesia with monitored anesthesia care in 1 patient. Five milliliters of IB dye, 1%, was injected into the breast tissue around the tumor or before breast cavity biopsy. The pulse oximeter (Nellcor, Hayward, CA) readings were recorded continuously after induction of anesthesia and for up to 130 min after the injection of 5 ml IB into the breast tissue around the tumor. Statistical analysis with use of Friedman repeated-measures analysis of ranks was performed to analyze the baseline SpO<sub>2</sub> and values at 5, 10, 20, 30, 40, 50, and 60 min.

## Results

A decrease in oxygen saturation as measured by pulse oximetry (SpO<sub>2</sub>) was seen in all patients receiving the IB injection. SpO<sub>2</sub> values were significantly different from baseline values at 5, 10, 20, 30, 40, 50, and 60 min ( $P < 0.05$ ). Figure 1 shows the measured SpO<sub>2</sub> values and the time course of the SpO<sub>2</sub> changes in a typical subject.

## Discussion

Isosulfan blue is a dye that is absorbed by lymphoid tissue. It is used in identification of sentinel lymph nodes. Sentinel lymph node biopsy is a technique used in patients with small invasive breast cancer without clinically diseased lymph nodes. Afferent lymphatics from the affected area of the breast drain first to the sentinel nodes. If these nodes are free of metastatic tumor, then it is highly predictive that other lymph nodes will also be tumor free.<sup>6–7</sup>

We have shown in this study that IB, similar to many other vital dyes, alters the absorbency properties of blood and interferes with pulse oximetry. IB has no clinically significant pharmacologic action; however, life-threatening anaphylaxis after subcutaneous administration of IB has been reported.<sup>8</sup> IB comes in an aqueous solution. After injection, 50% of IB is weakly bound to serum protein (albumin). Because interstitial protein is presumed to be carried almost exclusively by lymphatics, and in view of evidence of binding of dyes to proteins, visualization may be caused by protein binding. Up to 15% of IB is excreted in urine over a 24-h period causing

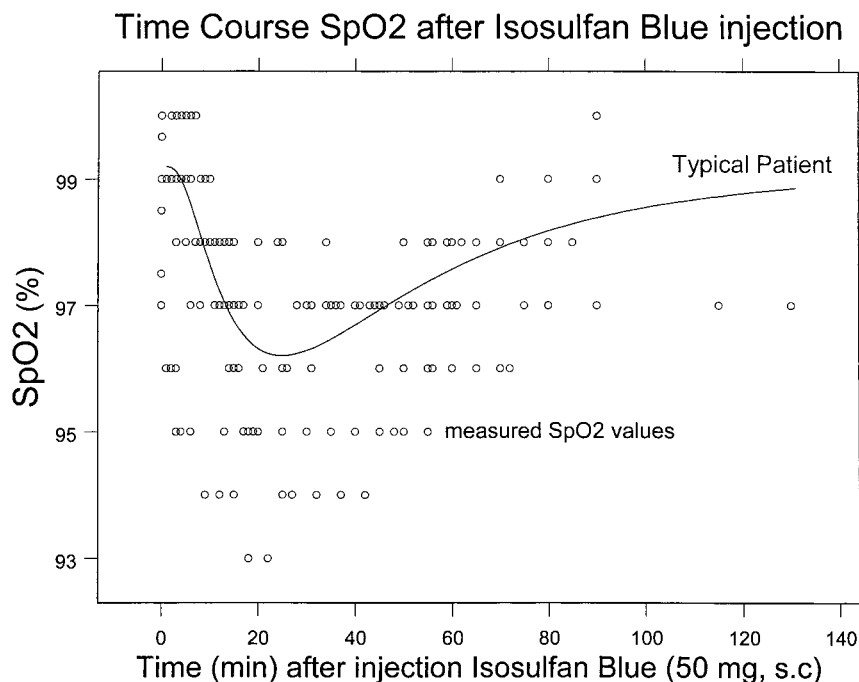
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**Fig. 1.** Time course of  $\text{SpO}_2$  after isosulfan blue injection (IB). The dots are the measured  $\text{SpO}_2$  values. The line is the time course of  $\text{SpO}_2$  after IB injection in the typical subject, which was best described by the following function:  $\text{SpO}_2 = a + b \cdot \exp(-0.5(\ln(\text{time}/c)/d)^2)$ , where  $a = \text{SpO}_2$  at baseline,  $b = \text{maximum decrease of } \text{SpO}_2$ ,  $c = \text{time of } b$ , and  $d = \text{a term}$ . The maximum decrease of  $\text{SpO}_2$  was 3.0% at 25 min after injection of IB. The age of the patient was a significant covariate for  $\text{SpO}_2$  at baseline.



the urine to turn blue green and the remainder is presumed to be excreted through the biliary route causing blue emesis (Product Monograph; Kirsch Industries).

We conclude that the administration of 50 mg IB causes significant interference with  $\text{SpO}_2$ . In a typical patient, a maximal  $\text{SpO}_2$  decrease of 3% occurs 25 min after injection of IB.

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