6-1969

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The Vasopressor Effect of Indigo Carmine

C. C. Wu, M.D.* and Arthur J. Johnson, M.D.*

Indigo carmine only recently was found to have a vasopressor effect. Intravenous injection in anesthetized and unanesthetized patients resulted in blood pressure elevation and bradycardia. This effect appears analogous to that of serotonin which indigo carmine structurally resembles. This drug should be used with caution in patients with cardiovascular disease.

Indigo carmine, a dyestuff, was introduced into the medical field in 1903 by Voelcher and Joseph. Because it is concentrated in the kidney and excreted in the urine, it has been used as a test of renal function, and in urologic procedures where its blue color aids in the identification of ureteral orifices during cystoscopy and open surgical operations. It has also been used in dye dilution methods for determining blood flow.

Side effects of this dye were not reported until recently. We noted a vasopressor effect associated with its use and Erickson and Widmer, and Kennedy et al recently reported the same observation. This study was undertaken to document and to determine the nature of the vasopressor effect.

Materials and Methods

A total of 40 patients confined at Henry Ford Hospital with various urological illnesses were selected for this study. Their ages ranged from 23 to 75 years. Azotemic patients were excluded. They were divided into two groups.

In group I, 20 patients received 5 ml of 0.8% indigo carmine intravenously while undergoing endocystoscopy or transurethral prostatic resection during general or spinal anesthesia. The base line blood pressure and pulse rate were recorded, and the dye was injected into the infusion tubing over a 30-second period. Blood pressure and pulse rate were recorded every minute until they returned to preinjection levels.

In Group II, the control group, similar data were collected from 20 patients without sedation or anesthesia. All procedures were the same except that the dye was injected directly into the vein with a syringe.

Results

The base line systolic pressures...
varied from 90 to 180 mm Hg and the
diastolic pressures ranged from 60 to
110 mm Hg. Increased systolic and/or
diastolic blood pressure and brady­
cardia were observed in all cases within
two minutes of completion of the in­
jection. The maximal increase appeared
in one minute in half of the cases, and
in two to five minutes in the remainder.

In Group I, systolic pressure in­
creased 10-60 mm Hg and diastolic
pressure increased 0-30 mm Hg. The
average increases were 25 mm Hg
systolic and 14 mm Hg diastolic, and
the mean values were 20 mm Hg and
10 mm Hg respectively. In one patient
the diastolic pressure did not change
but systolic pressure increased by 20
mm Hg. Blood pressure returned to
preinjection levels in 5 to 35 minutes,
with a mean duration of 22 minutes.
Pulse rate increased 4-20 beats per
minute. (Table I)

In Group II, systolic pressure in­
creased 0-40 mm Hg and diastolic 0-32
mm Hg. Average increases were 15 and
13 mm Hg respectively while mean
increases were 10 and 10 mm Hg. In
one patient there was no change in
systolic pressure but diastolic pressure
increased by 6 mm Hg. In another
patient, no change in diastolic pressure
was observed, while systolic pressure
increased by 10 mm Hg. Blood pres­

Table I

<table>
<thead>
<tr>
<th>mm Hg</th>
<th>PR/mm</th>
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<tbody>
<tr>
<td>0</td>
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</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
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<td>25</td>
<td>25</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
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**CHANGES in BLOOD PRESSURE
and PULSE RATE AMONG
ANESTHETIZED CASES.**
The Vasopressor Effect of Indigo Carmine

Table II

<table>
<thead>
<tr>
<th>MIN.</th>
<th>MEAN SYSTOLIC PRESSURE</th>
<th>MEAN DIASTOLIC PRESSURE</th>
<th>MEAN PULSE RATE</th>
</tr>
</thead>
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<td>80</td>
<td>80</td>
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<td>120</td>
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</tr>
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<td>80</td>
<td>60</td>
<td>50</td>
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</tbody>
</table>

CHANGES in BLOOD PRESSURE and PULSE RATE AMONG UNANESTHETIZED CASES.

Sures returned to base line levels within 5 to 20 minutes while mean duration was 10 minutes. Pulse rate decreased by 2 to 20 beats per minute. (Table II)

There was no relationship between the level of resting blood pressure and the amount of increase in blood pressure.

No ill effects or allergic reactions were observed in any case.

Discussion

Indigo carmine, sodium indigotin disulfonate, is the aqueous solution of the sodium salt of indigotin disulfonic acid. It has a molecular weight of 466.38 and the chemical formula is \( C_{16}H_{14}N_2Na_2O_8S_2 \). Its molecular structure is shown in Fig 1. Until the pressor effect was noted recently, it had been regarded as pharmacologically inactive.

Erickson and Widner\(^7\) noted that indigo carmine structurally resembles two molecules of 5-hydroxytryptamine, or serotonin.\(^7\) See Fig 2.

The cardiovascular effects of serotonin in man are complex.\(^9\) Its vasopressor action is thought to be due largely to an increase in total peripheral resistance and in cardiac output, although chemoreceptor stimulation also plays a part.\(^10\) Kennedy et al\(^8\) observed definite increase in total peripheral
resistance after administration of indigo carmine. The cardiovascular effects of serotonin are quite similar to those of indigo carmine, and therefore, their resemblance in structure may be significant. However, we did not observe the cutaneous flush and blotchy cyanosis that has been noted with serotonin in patients who received indigo carmine. This cutaneous change with serotonin results from constriction of peripheral arterioles with dilatation of minute vessels of the skin.

Increases in blood pressure were more pronounced, and the period of vasopressor effect was more prolonged, in Group I patients. The vasoconstriction from serotonin is more pronounced and prolonged in the absence of sympathetic vasomotor activity. A similar phenomenon may account for the more sustained vasopressor effects of indigo carmine in anesthetized patients.

No allergic reaction was encountered in our series. A nearly fatal reaction to only 0.75 cc of indigo carmine was reported by Schwerin, however.

Serotonin releases histamine from the skin of the cat, and antihistaminic agents can inhibit the vascular response to serotonin. Whether indigo carmine acts in this manner remains to be proved, but, if so, antihistamines may prevent vascular reactions during the employment of indigo carmine.

**Summary**

The vasopressor effect of indigo carmine has been studied in anesthetized as well as in unanesthetized patients. Elevation of blood pressure and bradycardia were noted in all cases. The reasons for this vasopressor effect and its implications are discussed.

Indigo carmine is a useful and generally safe agent. It should be administered with caution, however, in the markedly hypertensive and cardiac patients.

**REFERENCES**