SOME REMARKS ON STOVAINÉ

By W. Barras.

The Presidential Address, Scottish Society of Anaesthetists, at the Annual Meeting, May 12, 1928

I fully realized when you did me the honour of electing me your president for the ensuing year that I should have to address you on some subject of general interest and more particularly of direct interest to us as anaesthetists.

This is by no means an easy matter because there appears to be great doubt about the functions and usefulness of the specialist anaesthetists, not only in the lay mind, but in the minds of some surgeons.

Many in each group appear to regard us as almost unavoidable evils mitigated by varying degrees of necessity or possibly usefulness.

In my conception we should avail ourselves of all the known means at our disposal to help the patient, the surgeon, and the advancement of our specialty. This we can never do unless we take the lead in those subsidiary branches of our art, namely, Regional and Spinal Analgesia and show that we are not content to be regarded solely as haphazard purveyors of unconsciousness.

My chief reason for selecting "Stovaine Analgesia" as the subject of my remarks, is that, in conversation with surgeons and anaesthetists of proved ability, I find the most divergent opinions not only of its usefulness, but even of the justification of its use.

Secondly, my experience in spinal analgesia is almost entirely confined to that produced by stovaine. Novocaine
I have used on a few occasions but not sufficiently often to enable me to express an opinion.

Before indulging in an analysis of some cases in which stovaine was used either alone or in conjunction with a light inhalation anaesthesia, I fear that I must call your attention, however needlessly, to some general points in spinal analgesia. I will endeavour to be brief and confine myself only to those points of direct interest to the anaesthetist, or which might prejudice the result.

I. ANATOMICAL CONSIDERATIONS AND PHYSIOLOGICAL.

The general anatomy of the spinal column and cord I take to be known to all of us, but we should particularly remember that the cord extends in the adult to the lower border of the first lumbar vertebra and in children to the third lumbar vertebra. Bending the spine forward raises a little the level to which the cord descends. The cord and cauda equina are invested by their pia, arachnoid and dura mater as far down as the middle of the sacral canal or lower border of the second sacral vertebra.

Imbrication of spinal processes varies greatly not only in the individual but at different regions of the vertebral column, being greatest at lumbar region, while from dorsal upwards very nearly straight. This is of importance when making the puncture. Average depth of theca from skin, 7-10 cm. in adult and 2½ cm. children.

It is thus possible to introduce drugs into the subarachnoid and cerebro-spinal fluid below the termination of the spinal cord. A septum pia mater—ligamentum denticulatum—has been described as separating the subarachnoid space into anterior and posterior divisions above the level of the cord. This possibly explains some of the cases in which complete analgesia is obtained (P.N. Rts) but in which motor activity persists in varying degrees (A.N. Rts). The origin of the cerebro-spinal fluid is from the choroid plexuses. Average amount is 120-130 c.cs. and Sp. Gr. 1004-1007. It is in constant motion, being driven out of the cranium with each arterial beat into the spinal subarachnoid. Coughing, straining and forcible respiration tend to drive the fluid from lumbar cul-de-sac upwards to cervical region. The pressure
Some Remarks on Stovaine

varies directly with that of the cerebral circulation and Dandy estimates that the cerebro-spinal fluid is completely replaced about five times per diem. The cerebro-spinal fluid bathes the cord and spinal nerve roots and communicates with that in the fourth ventricle through the foramen of Magendie and it also bathes the following cranial nerve roots—oculomotor, trochlear, abducent and optic.

II. CHEMISTRY.

Stovaine hydrochloride is the salt used to produce spinal analgesia and I do not wish to reiterate to you what its specific chemical characters are, but will content myself by saying—it is soluble in $\frac{1}{2}$ pts. water and in alcohol 4 pts. It is precipitated by alkalies and small traces of alkali render its analgesic properties much less efficient. It is, in crystals and in solution, stable and capable of sterilisation at 115°C. without decomposition. It is reckoned to be as powerful a local analgesic as cocaine but one-third of its toxicity. In concentrations of more than .75—1 per cent. it has been reported to cause gangrene of the tissues. The maximum safe dose—on which all authorities seem to agree—is 0.1 gm. For further information on the subject Gwathmey refers us to some 174 contributions.

For solutions most commonly used see Appendix A.

III. GENERAL TECHNIQUE.

1. Preparation of patient.

Elaborate preparation is, in my opinion, to be avoided: drastic or even excessive purgation and starvation are not only unnecessary, but definitely harmful. In the neurotic they increase the mental perturbation, and in the feeble, anemic and cachectic they are a probable source of syncope and further debility. The patient should, as far as possible, be made to preserve a normal routine including meals etc., until some two hours before operation, unless the surgical procedure obviously precludes this, e.g., carcinoma recti. I am in favour of giving some stimulant (particularly to the elderly)—strychnine, brandy, etc.—before what is to them an ordeal, because I believe that it increases their mental fortitude, improves their physical conditions, and can possibly do any harm.
2. Premedication.

I am definitely convinced that when spinal analgesia is employed, a preliminary injection of 1/6th grain morph. sulph.—1/100 hyoscine is beneficial. This calms the natural excitement of the patients; renders them more receptive of suggestion and in every way enables the anaesthetist to obtain a more complete control. The only possible objection to such an injection is that it tends to reduce the general metabolism and hence may increase the degree of shock. This lowering of general vitality I have to admit, but I believe that the advantages overcome the disadvantages to such an extent that I use it as a routine.

3. Strict attention to surgical asepsis is essential.

The skin over and around the area of injection should be prepared by shaving (when necessary), washing with soap and water, turpentine and a carbolic compress applied before the time of operation. Immediately prior to making the injection, I advocate the use of spirit in preference to any other disinfectant, i.e., iodine, perchloride, picric acid, etc. These are all irritants and could conceivably be carried by the needle into the deeper tissues and provide a possible cause of local irritation. The skin over the site of injection is then frozen with an ethyl chloride spray and the needle directly inserted. In no case have I had any complaint of pain on penetrating the skin or deeper tissues when this was done. The syringe and needles used must be rendered aseptic by boiling in water, without the addition of soda (reasons previously given). The best needles for this work are made of irido-platinum in that they bend but do not break. They should have short points in order to minimise the risk of damage to the cord or cauda.

4. Site of injection.

I am aware that you all know the methods of locating the individual vertebral spines but would remind you that different authorities choose different levels at which to make the injection. Jonnesco\(^3\) B.M.J. 1909 used a high injection in the mid-cervical region, but found that unpleasant phenomena—nausea, vomiting, pallor and temporary arrest of res-
Some Remarks on Stovaine

piration followed. He now uses two sites, between 1st and 2nd dorsal and 12th dorsal and 1st lumbar. Ryall uses 1st dorsal and 12th dorsal, but rarely the lumbar. Most other authorities inject through the lumbar spaces and rely on the specific gravity of the solution injected and the posture of the patient as the means of controlling the areas rendered analgesic. Even after puncture at the level of 4th and 5th lumbar space it has been stated on occasion to have become universal by extension upwards until on involvement of the cerebrum the patient becomes unconscious and is apparently in a deep sleep—I am grateful never to have had a case which demonstrated this. In my experience lumbar injection is rarely followed by analgesia above the level of the umbilicus. Injection should not be made until a definite flow of cerebro-spinal fluid is obtained. Continued bleeding is another contraindication. Venousplexuses are more numerous on the anterior wall of spinal canal. Puncture of nerve root causes sudden and sharp pain along the area of distribution. Puncture of cord causes no apparent reaction or pain as a rule.

Posture of Patient.

When I used Barker's solution I made the patient lie on the back with the head and shoulders raised a little and the pelvis slightly elevated, but since using a light solution I allow the whole trunk to be moderately inclined head downwards at the same time giving the patient a pillow in order to interfere with the comfort and ease of respiration as little as possible. I have found no objection to putting the patient in the Trendelenburg position (frequently extreme) provided it is done slowly and sudden changes in posture are not demanded—the influence of gravity on the cardio-vascular mechanism being very evident. Labat advocates lowering the head to the horizontal immediately the needle is withdrawn, maintaining that it improves both respiration and circulation. Following all danger signals he recommends the Trendelenburg position.

Intercurrent Phenomena.

1. Subjective. Come on almost immediately, after injection, tingling and numbness of feet gradually extending up the legs and over the buttocks are followed by a feeling of
heaviness and numbness. Disordered sensations of heat and cold are sometimes noted. A feeling of general malaise, nausea, epigastric heaviness and sweating are other manifestations of the vasomotor upset occasionally recorded.

2. Objective. Impairment of pain sensation commences about 2—3 minutes after injection and analgesia is observed in feet, legs, perineum and abdomen successively. Loss of sensation to pain is followed by loss of touch and temperature sensations. The involvement of the motor system is evidenced by paralysis of the lower limbs and relaxation of abdominal muscles and demonstrated by loss of plantar, patellar and cremasteric reflexes. Extensors more markedly affected than flexors. The musculo-kinetic sense is also lost. The maximum effect is attained in 10 to 15 minutes and persists—in my experience—from 50 to 90 minutes. Paralysis of the sympathetic system allows the intestinal peristalsis to remain active and the uterus is stated to retain its contractility.

3. Vomiting is occasionally seen during the analgesia. It usually commences some 10 to 20 minutes after the injection and disappears after a few minutes. The numerous authorities whom I have consulted express the most extreme differences in its incidence varying from 30 per cent. to nil. Personal observation leads me to conclude that it occurs seldom, is of short duration—I have never seen it persist through the analgesia. It has no apparent relationship to the amount of the injection and seems to be dependent on the fall in the general blood pressure. Traction on the mesentery and handling of the stomach appeared to cause it in some of my cases.

Post-operative Treatment.

Care should be taken in moving patient back to bed and patient should be kept perfectly still and lying flat for several hours. Some stimulant or hot drink is often advantageous as it relieves the thirst and obviates any feeling of nausea. Light diet may be ordered almost immediately unless the surgical procedure precludes it. Particular care should be taken that the patient is not burned before sensation is completely recovered and the bladder emptied by catheter if necessary.
Some Remarks on Stovaine

Post-operative Sequelæ.
I have been perhaps exceptionally fortunate in that I have on two occasions only had to deal with any sequelæ, and one of these was, in my opinion, not directly due to the analgesia. I will give the cases in detail later.

Lack of personal experience, therefore, has forced me to review the literature of this section thoroughly, and given me considerable food for thought. The possible results are apparently both numerous and of the utmost gravity.

I. Hypothermia has been reported by Alessandri quoted by Bainbridge and attributed to the action of the stovaine on the heat centre. The temperature being as high as 104°F. Minor degrees of elevation of the temperature are of course common, not only in spinal analgesia but after inhalation anaesthesia and are, in my opinion, not due to the method.

II. Intense Headache, generalized or confined to the occipital region are said to be comparatively common. My experience leads me to believe not nearly so common as supposed. In my series only five cases made any complaint even on enquiry.

Desplas' Headache, difficult to account for but present in his series of 260. 37, i.e., 16 per cent., had cephalgia, 23 were transitory, but 14 were more intense and lasting—usually occurred alone and lasted from four to six days. In six cases it was accompanied by vomiting. Tennent R (personal) Two cases in 139 series. One lasted two years, one lasted few weeks.

III. Vomiting is definitely reduced to the minimum and can justly be said to be rare. My cases four, none lasting more than 12 hours.

Despers', Vomiting 29 in 260. 20 short duration occurring in first twelve hours. Three lasted for times up to 48 hours. In six for some five to six days. These were accompanied by other symptoms which to my interpretation appear to have the result of meningism.

IV. Various Sensory Disturbances and Pain along Nerve Tracks, are sometimes got, and are, I think, due to possible injury by the needle.
V. MOTOR PARESES. Most commonly the bladder and rectum are said to be affected but I again have not had an example, although my greatest number of cases have been for operations on the bladder and consequently that organ has been drained. Desplas agrees with me in that he had no cases of sphincter disorder. Gray and Aitken in personal communications inform me that retention of urine has been so troublesome that they use the method much less frequently than formerly, but regard it as the anaesthesia of selection for bladder and urethral cases.

Tennent in series of 139 cases had very few cases requiring catheterization.

Pareses of limbs, one or both, etc., but none of the writers enter into detail.

Ocular disturbances due to pareses of abducens, trochlearis and oculomotor are said to occur 4 to 18 days after, some 4 to 6 weeks. I have no experience. All pareses may become permanent.

Trophic lesions—bed sores and ulceration.

Psychic—insomnia to insanity. I cannot comment upon.

Meningism—syndrome: including pain in back, cephalalgia, vomiting, dizziness and cervical tenderness, probably due to mild cases of infection through faulty technique.

Albuminuria has been reported by some, but my experience agrees with that of Babcock who failed to get any evidence of renal irritation.

Lusk regards most after-effects as being the result of imperfect aseptic practice.

Pneumonia has been said to follow stovaine as often as inhalation anaesthesia; with this statement I do not agree. I have never seen a single case, and in view of the general condition of the patients to whom it is usually given, I feel bound to express grave doubts as to stovaine being in any way the causal factor. Desplas, however, records ten cases of pulmonary congestions and says "those prove spinal anaesthesia to be no protection against pulmonary complications," while Schultz (Chicago) says "Post-operative pneumonias are reduced to a very low figure" which he attributes to the use of spinal in all cases having chest complications and no contra
Some Remarks on Stovaine

indications. All cases of obstruction are also done under this analgesia in Lankenau Hospital.

In an interesting short article, Shapp\textsuperscript{13} notes that nausea, faintness, sweating and pallor during the analgesia is much more marked in Europeans than natives (West African), and on the educated native more than his fellow. He gives the post-operative complications in order of frequency. Headache, backache, pyrexia, retention of urine, and injury to cauda.

\textit{Difficulties and Dangers and Treatment} have already been mentioned as occurring in the analgesic period and post-operative. They may be summarized:

1. Difficulties in making puncture due to spinal deformity: osteo-arthritis and partial ossification of the ligaments.
2. Failure to get flow—definite contra-indication.
3. Sepsis—faulty technique.
4. Vomiting and retching during the analgesia is said to be controlled most efficiently by oxygen administration. (Schultz).

\begin{verbatim}
Caffeine 0.25 gm.
Spartein Sulph. 0.25 ,, 
Sod. Benzoate. 0.30 ,, 
Strychnine. 0.001 ,, 
Aq. dis. ad. 2 c.c.s.
\end{verbatim}

may be used subcutaneously as a preventative or on supervention of symptoms. In cases of failure of respiration he advocates its injection into the subarachnoid before artificial respiration is begun.

In those cases in which I supplemented the stovaine by a light ether anaesthesia, I was struck with the effect of ether and would now urge ether inhalation as a restorative.

The Trendelenburg position alone will often improve the condition of faintness and all authorities are agreed that it
should be adopted if the fall in blood pressure becomes extreme and in cases of complete collapse. Strychnine—used extensively by Jonnesco—I have never been able to persuade myself to have had any effect.

Adrenalin will undoubtedly raise the blood pressure, but it has a comparatively short effect. It acts most quickly when injected—5 to 10 minims to each 6 to ten ounces of saline—intravenously. I prefer to inject it subcutaneously and have found it of much use. On the supernention of marked depression the site of injection is massaged and in this manner a progressive absorption of the drug is assured. Given in this way I am of opinion that the effect is more sustained.

VI. **Unilateral Analgesia**, needle has not entered the cisterna terminalis and injection has been into or around the nerve roots of one side.

VII. **Incomplete Analgesia**, due to idiosyncrasy; deterioration of drug; use of alkali; faulty puncture, etc.

I do not advocate a second injection but prefer to supplement the first with general anaesthesia—gas and oxygen.

Indications for and against the use of spinal analgesia are exceedingly difficult to assess.

From the mass of literature on the subject I find that all shades of opinion are represented from those who can see no contra-indication to those who would have its use prohibited.

I, consequently, express my own opinion formed after consultation with the works of many writers and from experience. In general, I may thus express it:

**Indications:**

1. Those cases in which inhalation anaesthesia is contra-indicated, e.g., pneumonia; pulmonary T.B.; bronchitic aneurism; pericarditis; uraemia; diabetes; senile gangrene and intestinal obstruction.

2. Conditions requiring an extreme degree of muscular relaxation or involving an unusual degree of shock—deep pelvic operations; rectal carcinoma; prostatectomy and other operations on bladder. In this latter group I regard it as almost essential to complete success.
Some Remarks on Stovaine

Contra Indications:
I. All cases which before operation evidence any considerable degree of shock, from whatever cause.
II. All cases of cerebral or spinal disease.
III. Pyæmia.
IV. Operations above the level of the umbilicus.
V. All cases of advanced cardiac disease and those having a systolic blood pressure below 100.

Spinal Analgesia.
Deaths: The following are given by Bainbridge.

<table>
<thead>
<tr>
<th>Name</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiene</td>
<td>12,000</td>
<td>22</td>
</tr>
<tr>
<td>Strauss</td>
<td>22,717</td>
<td>46</td>
</tr>
<tr>
<td>Jonnesco</td>
<td>1,005</td>
<td>0</td>
</tr>
<tr>
<td>Kohler</td>
<td>7,780</td>
<td>12</td>
</tr>
<tr>
<td>Chaput</td>
<td>7,000</td>
<td>0</td>
</tr>
<tr>
<td>Bainbridge</td>
<td>1,065</td>
<td>1</td>
</tr>
</tbody>
</table>

I have no personal opinion to express.

Conclusions.
I. I believe that spinal analgesia by the injection of stovaine is, in selected cases, not only advantageous, but definitely indicated in the interest of the patient and surgeon.
II. That spinal injections are at least potentially dangerous and should not be used as a routine method.
III. Should not be regarded as a means to supplant inhalation anaesthesia, but rather to augment it.
IV. That the immediate mortality rate is low and the morbidity rate even after the most severe operations on debilitated but selected subjects, is also reduced.
V. That an anaesthetist should be present in all cases; should make the injection and be responsible for the general condition of the patient.
VI. That post-operative phenomena—paralysis, pareses, vomiting, headache, are rare.
VII. I have intentionally omitted any reference to the
psychic influences which may complicate any anaesthesia because of its extent and vagueness. The theories of the action of drugs injected into the cerebro-spinal fluid I have also avoided because they are at present non-conclusive.

### Appendix A

Solutions in common use:

**Bier:**
- Stovaine: ... ... ... ... ... ... 4%
- Sod. Chlor.: ... ... ... ... ... ... 0.11%
- Epirenin borate: ... ... ... ... ... ... 0.01%

**Tuffier:**
- 10% Stovaine in normal saline.

**Chaput:**
- Stovaine: ... ... ... ... ... ... 10%
- Sod. Chlor.: ... ... ... ... ... ... 10%
- Oxygen: ... ... ... ... ... ... 80%

**Stovaine Billon—dose 2 c.c.s.**
- Stovaine: ... ... ... ... ... ... 0.04 gm.
- Adrenalin: ... ... ... ... ... ... 0.00013 gm.
- Sod. Ch.: ... ... ... ... ... ... 0.0011 gm.

**Barker:**
- 5% Stovaine in 5% glucose in sterile oxygen to 2 c.c.s.

**Gray:**
- Stovaine 3% in dextrin and adrenalin.

**Jonnesco:**
- Uses 0.001-0.1 gm. of stovaine with strychnine.

**Babcock:**
- **Light solution.**
  - (1) Stovaine 0.08 gm.
  - Lactic acid 0.2 c.c.
  - Alcohol 0.04 c.c.
  - Aquæ 1.8 c.c.

- **Heavy solution.**
  - (2) Stovaine 0.08 gm.
  - Lactic acid 0.04 c.c.
  - Lactose 0.10 gm.
  - Aquæ 2 c.c.

**Self:**
- Stovaine 0.04 gm.
- Borate of Epinephrine 0.0013
- Sod. Chlor. 0.0017
- Sod. Chlor. 0.0011 per c.c. Dose 1–2 c.c.s.

Solutions should be fresh or drug may deteriorate.
Some Remarks on Stovaine

**APPENDIX B.**

<table>
<thead>
<tr>
<th>Operative Procedure</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senile gangrene</td>
<td>16</td>
</tr>
<tr>
<td>Diabetic gangrene</td>
<td>19</td>
</tr>
<tr>
<td>Excision of Rectum</td>
<td>73</td>
</tr>
<tr>
<td>Prostatectomy</td>
<td>156</td>
</tr>
<tr>
<td>Other bladder operations</td>
<td>8</td>
</tr>
<tr>
<td>Haemorrhoids</td>
<td>15</td>
</tr>
<tr>
<td>Gastrojejunostomy</td>
<td>2</td>
</tr>
<tr>
<td>Gall bladder</td>
<td>3</td>
</tr>
<tr>
<td>Herniotomy</td>
<td>44</td>
</tr>
<tr>
<td>Pelvic operations</td>
<td>10</td>
</tr>
<tr>
<td>Varicose veins</td>
<td>8</td>
</tr>
<tr>
<td>Appendix</td>
<td>5</td>
</tr>
</tbody>
</table>

Total 299

Results:

One complete failure to get any analgesia.

In 167 cases Stovaine was given alone with complete success.

In 15 cases Stovaine plus light ether anaesthesia and in 79 cases plus nitrous oxide plus oxygen anaesthesia.

No death: no after effects, except vomiting in 3 cases and headache in 5.

**APPENDIX C.**

*Case I. Post Operative Syncope.*

Half an hour after the completion of the operation patient shewed sudden collapse—I regret I had left hospital. When seen by the surgeon he was extremely pallid and pulse and respirations were almost imperceptible. Injections of caffeine and ether and vigorous artificial respiration were resorted to and patient shewed marked improvement in some ten minutes. He made a complete recovery. Stovaine used alone. Patient was a man over 60 years of age with arteriosclerosis, chronic bronchitis and enfeebled by carcinoma recti. At operation the rectum was excised—time 1 hour 35 minutes—and there was very considerable loss of blood.

I believe the collapse to have been as much due to haemorrhage as to the injection.
Case II.

Woman—aged round about 40—operation myomectomy and ovariectomy. General condition of patient good, and anaesthesia was gas and oxygen plus 1 c.c. spinal injection containing 0.05 gm. Stovaine.

Complete loss of motor function of lower limbs quickly followed injection but abdominal muscles did not relax either immediately or later. Analgesia on limbs and buttocks was perfect but over the abdomen poor. Following day patient complained of intense headache and visual disturbances—both distortion of object and diplopia.

On examination—I found all sensations—pain, touch, temperature, normal in legs. Motor power was completely recovered. Bladder and rectal control and function perfect. Eye condition certainly not due to impairment of action of any of the muscles. Movements of eyeballs in all ranges being complete. Areas of double vision were not constant, and on my suggestion straight lines became "wavy." Diplopia was never constantly present. Patient was known to be neurotic and regarded herself as "different to other patients." The visual phenomena disappeared on the third day, but headache was still complained about. Patient refused to take any drugs to remove headache because "she could not take opiates."

It is worthy of note that all symptoms were subjective but I have little doubt that the headache was due to the stovaine injection.

References.

5. Labat. "Regional Anaesthesia."
8. Tennent. Personal communication.