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## The Craniospinal Venous System

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Abstract

The valveless craniospinal venous system consists of veins and plexuses that communicate freely and whose flow is bidirectional. It comprises (1) the intracranial-cortical veins, dural sinuses, cavernous sinuses and ophthalmic veins, and (2) the vertebral venous plexuses, which freely anastomose with the intracranial venous system. The vertebral venous plexuses anastomose with the sacral, pelvic and prostatic venous plexus. It is clinically important since it provides a route for the spread of tumours, infection or emboli. This route may go unrecognised

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Keywords

Craniospinal veins - Venous plexus - Valveless venous system - Metastatic spread

Introduction

The venous connection between the cranium, spine, and pelvic organs is a clinically important and often imperfectly understood section of anatomy. As Batson [1] pointed out, "[the] great functional complex of veins would escape recognition as a system until 1940... In the first few decades of the last century, our knowledge of the vertebral veins was developed and then almost forgotten".

In 1829, Breschet [2] had detailed the anatomy of the vertebral venous plexus, confirming the work of Bock [3]. 120 years later, Batson's [3] groundbreaking studies employed dissections, corrosion studies and injection [4,5,6,7] in human cadavers and living primates. Angiography proved an important additional technique utilised by Anderson [8] and others. Tobinick [9] has provided an excellent review.

Clinical Relevance

The craniospinal venous system (CSVS) is a pathway for the rostral metastatic spread of cancer from the prostate, bladder and uterus, and it is also important in ascending infections from pelvic organs, which can cause venous infarction of the cord. Cells can be carried via the CSVS in either a rostral or caudal direction. Metastasis to the spinal canal and cavernous sinus has been described from squamous cell carcinoma of the face; caudal spread from medulloblastomas to the spinal canal is also well known. Percutaneous vertebroplasty and kyphopexy can result in cement in the epidural venous plexus that may lead to an ascending venous thrombosis; or acrylic may extend from the paraspinous veins into the vena cava and may result in a pulmonary embolus. Serious neurological (and cardiopulmonary) complications relate to extrusion of bone cement into the vertebral venous system.

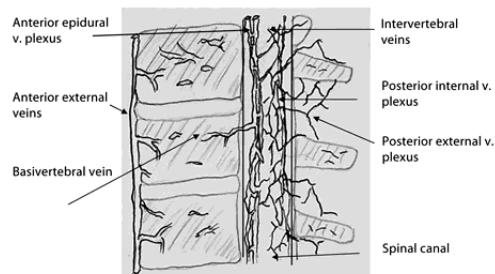
Oral contraceptives, congenital protein-S deficiency, protein-C deficiency and anticardiolipin antibodies are more recently recognized precipitating factors for veno-occlusive disorders.

Craniospinal Venous System

The CSVS is involved in the maintenance of intracranial pressure, varying with respiration and postural changes. Modern investigation has shown the vertebral venous plexus as a rich anastomosis of valveless veins along the length of the spinal canal. For descriptive purposes, Groen et al. [10] separated the vertebral venous plexus into three intercommunicating divisions (fig. 1).

Fig. 1

Vertebral veins and plexuses. Based on Groen et al. [10].



- 1 the internal vertebral venous plexuses (anterior and posterior) lying within the spinal canal but external to the dura;
- 2 the external vertebral venous plexuses (anterior and posterior), which surround the vertebral column, and
- 3 the basivertebral veins, which run horizontally within the vertebrae [10].

Both the internal and external venous plexus extend along the entire length of the spine, from sacrum to cranium. Corrosion casting and injections of Araldite® show that the internal and external vertebral venous plexuses freely communicate, a finding confirmed by intracranial spinal venography [11, 12]. The posterior internal vertebral venous plexus has a striking segmental and individual variability.

Groen et al. [13] also showed the internal and external plexuses and that the basivertebral veins contained no valves and freely intercommunicated: "... due to the absence of valves, venous backflow from the internal vertebral venous plexus into the cerebral venous system occurs under physiologic conditions."

However, the preferential direction of the flow during experimental flushing suggests the presence of functional valves, probably located in the thoracic posterior internal vertebral venous plexus [10]. The internal vertebral veins communicate with radicular, spinal and the external vertebral veins [11].



## Key Words

Craniospinal veins · Venous plexus · Valveless venous system · Metastatic spread

## Abstract

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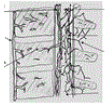
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