Unrecognized Plugging of Bentley Cardiotomy Reservoir with Internal 3-Stage Microporous Filter

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CASE REPORT:

The patient involved was a 61 year old male undergoing surgery for repair of an aortic arch aneurysm. A Travenol TMO membrane oxygenator circuit with a Bentley Q-220F cardiotomy reservoir (Fig. 1) was used during this perfusion. The superior and inferior vena cava were cannulated to return venous blood to the bypass circuit and arterialized blood was infused via the brachiocephalic, left carotid, and left femoral arteries by means of one occlusive double roller pump. Three occlusive double roller pumps were used to expedite the removal of large volumes of blood from the surgical field and return it to the bypass circuit via the Bentley Q-220F reservoir. Left heart venting was accomplished by use of an additional occlusive double roller pump also returning blood to the Q-220F reservoir.

The Q-220F was incorporated in the bypass system because of its expanded volume capacity and its advertised high flow filtration rate. Prime and additional volume were introduced to the bypass system through a rapid prime line attached to one of the three inlet ports of the Q-220F. When this rapid prime line was not in use, it was clamped. The cap on the vent port, external to the filter core, was removed to allow venting of air.

This particular case differed from our routine, in that the suction pumps were continuously run at high speed throughout the procedure resulting in air being continually pumped into the Q-220F except when blood was being returned. Furthermore, the blood from the surgical field contained large amounts of fat particles and aneurysmal debris such as calcified material and old clot. After approximately four hours on bypass, it became necessary to add blood to the system. When the clamp was removed from the rapid prime line, air immediately began filling the blood bag. No matter how hard the bag was squeezed, it was impossible to force blood into the Q-220F. This was the first indication that the cardiotomy reservoir had become pressurized. Before the Q-220F could be replaced, it became necessary to once again return blood from the surgical field. This blood quickly passed through the internal filter and was returned to the bypass circuit. After this blood was returned, the Q-220F was quickly replaced with another. Approximately one full hour later, this Q-220F

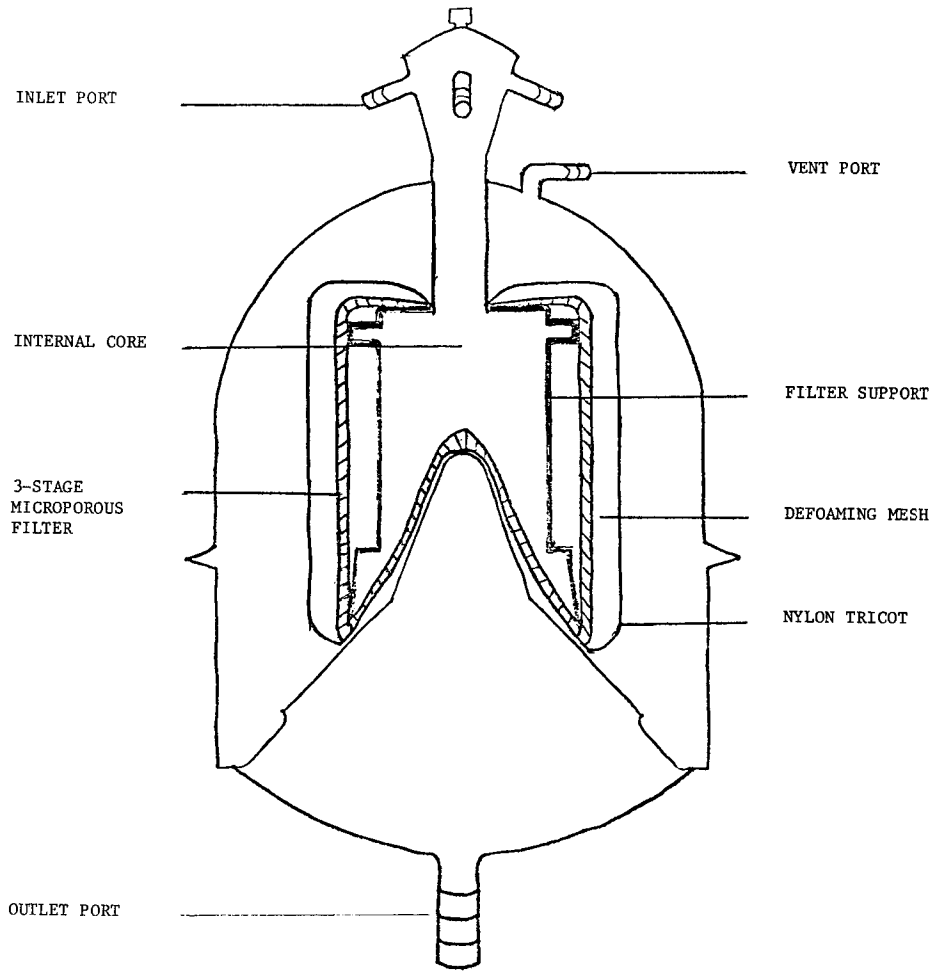


FIGURE 1

also became pressurized and was replaced by a Bentley Q-120 cardiotomy reservoir with Pall Extracorporeal blood filter which proved adequate for the remainder of the perfusion.

After the completion of bypass, the first Q-220F was taken apart. The entire surface of the internal filter was found to be coated with debris (Fig. 2 & 3) which accounted for the pressurization, but didn't explain why blood could pass through the filter while air would not. After some thought, it was deduced that when blood entered the Q-220F, it suspended a substantial amount of the debris. In this way, the filtering surface was exposed to allow the passage of blood. However, when blood was no longer being returned to the reservoir, the aneurysmal debris again plastered itself against the filtering surface and effectively plugged it. As air must pass through the filter to be vented, pressurization of the internal core of the Q-220F resulted (Fig. 1).

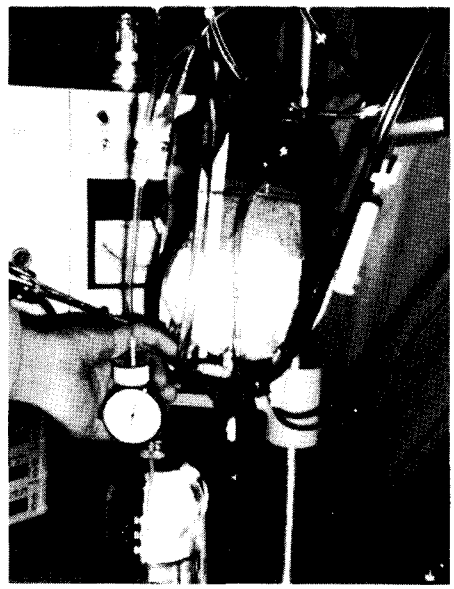


FIGURE 2

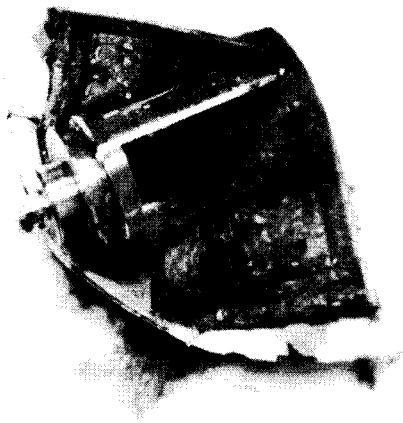
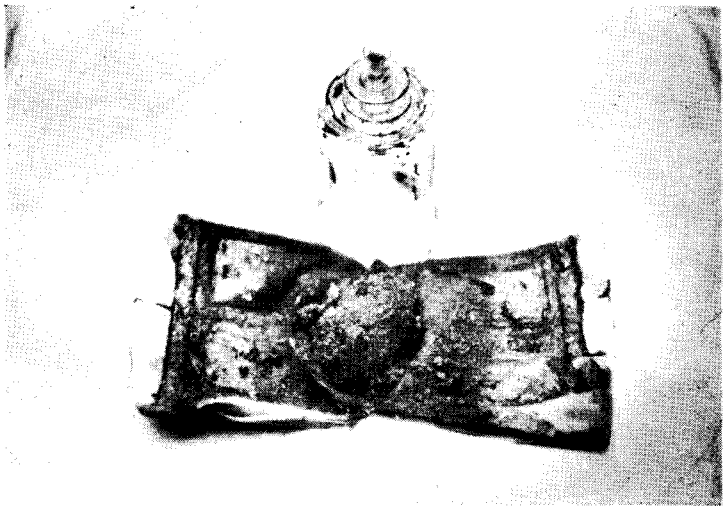


FIGURE 3

DISCUSSION:

During a standard perfusion, a sufficient amount of debris or clot necessary to completely plug the entire filtering area of a Q-220 is unlikely. In the case just described, the problem of the Q-220F was compounded, in that the situation was not recognizable by any external signs. This problem could have grave consequences if left ventricle drainage was accomplished by gravity or by non-occlusive roller pump.

Pressure in the internal core of the Q-220 reservoir has been measured during a number of subsequent perfusions and found to be essentially zero (Fig. 4). Thus, addition of a pressure gauge attached via an extension line to the leur lock port on top of the Q-220F serves to monitor core pressure, providing an indicator of filter plugging.



On cases where large amounts of particulate material are anticipated being returned to the bypass circuit, we now incorporate a Bentley Q-220. The Q-220, like the Q-220F, contains an internal defoaming mesh and nylon tricot barrier. This barrier will effectively remove debris larger than 110 microns which, in this case, constituted the major portion of the plugging material (1). The possibility of plugging of the internal core of the Q-220 is greatly reduced due to the absence of the polyfilter. Microparticulate matter passing through the Q-220 is trapped by an external cardiotomy filter which can be replaced much easier if plugging occurs.

Another potential solution to this problem is the redesigning of the reservoir so that defoaming and course filtration occur before microfiltration. This would simply require placement of the polyurethane filtration sponge external to the position of the defoaming mesh and nylon tricot barrier. This has been suggested to the manufacturer.

REFERENCES

1. Bentley Laboratories, Inc., Product Information Leaflet No. Q76030-176-10PG, 1976.