been inserted via an antecubital vein (60 cm), but the
same finding was present in the two short catheters (24
cm) inserted via a more central route. In one case, a
significant amount of air (30 ml) was withdrawn during
an episode of VAE early in the case, although all but the
proximal orifice were found to be occluded postopera-
tively.

Using a constant infusion pump, we have found that
it is not possible to uniformly perfuse all of the orifices,
even with infusion rates as high as 1000 ml/h. These
findings have been of concern to us, because it appears
that a slow, continuous flush is inadequate to ensure
continued patency of the multiorificed catheters as they
are presently designed and used. This seems likely to
defeat the purpose for which these catheters are de-
dsigned.

It has been demonstrated that treatment of certain
types of catheters by chemical methods can be used to
reduce thrombus formation. Bonding heparin to the
polymer plastics used in pulmonary artery catheters re-
duces the incidence of the thrombogenesis resulting
from these catheters. We wonder if a similar process
could be used for multiorificed CVP catheters.

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In Reply:—We certainly appreciate the observations
and comments of Drs. Donegan and Rupp concerning
their experience with clot formation in multiorificed
catheters. Their observations encompassed both the
Cook CVAE-580 and the Arrow AK-04250 catheter
sets. Our experience is limited to the Cook Bunegin-
Albin Air Aspiration Set, which is available in both a
heparin-coated (CVAE-580-BH) and the uncoated
(CVAE-580) versions. We have been routinely using the
heparin-coated catheter, and have found little or no clot
formation following removal after 6–8 h in situ. These
catheters were used for both CVP monitoring and/or
fluid infusion at a minimal rate of 0.5 ml/min with
occasional heparinized saline bolus flush.

In four animal experiments using the 60-cm heparin-
coated Cook catheter, some clot formation was noted in
the distal orifices, but these clots were easily flushed off
after removal of the catheter following 6 h in situ.

If the catheters appear to have functioned adequately
during the intraoperative course, as indicated by Drs.
Donegan and Rupp, it is possible that orifice-clotting
may have possibly occurred during patient transfer
from the operating room to recovery room or intensive
care unit if the infusion through the catheters was sig-
nificantly reduced or terminated during that time.

In terms of orifice perfusion-patency, Poiseuille's
Law relating to the flow of liquid through a tube indi-
cates that the most proximal orifice will have the great-
est outflow, the more distal ones exhibiting proportion-
ately smaller outflows. As such, it would be impossible,
regardless of the catheter flow, to perfuse each orifice
equally. Our laboratory evaluation of the Bunegin-
Albin multiorificed catheter indicates that a minimal
flow of 0.3 ml/min is necessary for perfusion of all the
orifices.

It is felt that the problems concerning orifice cloting
with the multiorificed catheter can, for the most part,
be obviated by using the heparin-coated catheter; by
occasional bolus flushes with heparinized saline when it
is in the CVP mode; and by vigilantly ensuring that
catheter perfusion occurs when it is in the infusion
mode.

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(Accepted for publication October 1, 1987.)