expiration. It would be interesting to know if the absolute
gastric pressure was different before and after operation
or before and after drug therapy, since abdominal muscle
activity could account for some of the observations. The
work that the authors quote with regard to abdominal
muscle activity is in patients with respiratory failure and
is hardly relevant to their own observations. The influence
of aminophylline seems to have been to alter the change
in gastric pressure during inspiration from −1 to +1.2
cmH₂O.

This could have been partly the result of a change in
the pattern of abdominal muscle action, for example, a
reduction in tonic activity (spasm due to pain) or a loss of
expiratory activity. In another circumstance, we have
found a decrease in Pga on inspiration, in patients breath-
ing spontaneously during anesthesia, of the same order
of magnitude. We attributed this to expiratory abdominal
muscle activity. However, it is clear that if ΔPpl does not
change, and ΔPga increases, that ΔPdi will increase, in-
dicating a more forceful contraction of the diaphragm.
This would be expected from the known actions of ami-
nophylline. However, changes in Pga depend on the ex-
tent of use of the abdominal and rib-cage muscles as well
as the diaphragm, and, unless an attempt is made to assess
the action of these muscle groups, the pressure data pre-
sented cannot be reliably interpreted as an indication of
an action on the diaphragm alone.

G. B. DRUMMOND, F.F.A.R.C.S.
Senior Lecturer in Anaesthetics
Royal Infirmary,
Edinburgh, EH3 9YW
Scotland

REFERENCES

1. Dureuill B, Desmonts JM, Mankikian B, Prokocimer P: Effects of
aminophylline on diaphragmatic dysfunction after upper ab-
2. Drummond GB, McCulloch WJ, Brown DT: Contribution of ex-
piratory muscle activity to ventilation during anesthesia. Br J
Anaeseth 56:1200P, 1984
(Accepted for publication July 22, 1985.)

In reply: Dr. Drummond is questioning the change in
the difference between gastric pressure at end-inspiration
and gastric pressure during inspiration (ΔPga) as a reliable
parameter to assess the contribution of the diaphragm to
quiet breathing. He suggests that abdominal muscle
contraction may occur after upper abdominal surgery and
could influence ΔPga. According to his comment, changes
in absolute gastric pressure (Pga) would be a better index
to reflect the expiratory abdominal muscle activity. Al-
though, negative changes in Pga during inspiration might
be related to expiratory relaxation of abdominal muscles,
Pga also can be altered by other factors such as pneu-
mo-peritoneum. Few data regarding abdominal muscle
activity after upper abdominal surgery are available at
this time, and it may be questionable to compare respira-
atory muscle activity occurring during general anes-
thesia with that after upper abdominal surgery. In ad-
dition, absence of abdominal muscle contraction after up-
per abdominal surgery was reported by Simmonneau et
al. in patients developing negative ΔPga.

As stated by Ford et al., any reduction in ΔPga after
upper abdominal surgery, without any change in pleural
pressure (ΔPpl), indicated a decrease in diaphragmatic
contribution to tidal volume. Conversely, any increase in
ΔPga, without change in ΔPpl, indicates an increased
contribution of the diaphragm to breathing. Therefore,
during quiet tidal breathing, ΔPpl determines tidal vol-
ume, whereas any contribution from the diaphragm is
directly reflected by ΔPga. Thus, we can conclude that
an increase in the ratio of ΔPga to transdiaphragmatic
pressure (ΔPdi) is well related to the effects of aminoph-
ylline on the diaphragm alone.

B. DUREUIL, M.D.
Resident in Anesthesia

J. M. DESMONTS, M.D.
Professor of Anesthesia

Department d’Anesthésiologie
Hôpital Bichat, Paris 75018
France

REFERENCES

1. Drummond GB, McCulloch WJ, Brown DT: Contribution of ex-
piratory muscle activity to ventilation during anesthesia. Br J
Anaeseth 56:128, 1984
2. Simmonneau G, Vivien A, Sartene R, Kunstlinger F, Samii K, No-
viant Y, Duroux P: Diaphragm dysfunction induced by upper
3. Ford GT, Whitelaw WA, Rosenthal TW, Cruse PJ, Gerente GA:
Diaphragm function after upper abdominal surgery in humans.
(Accepted for publication July 22, 1985.)