Noninvasive information on left ventricular wall motion can be obtained by external kinetocardiography. Fddelman used this method for cardiac diagnosis and Silverberg, cardiomycography for detection of ischemia-induced left ventricular dyskinesia (cardiomyography). We have observed that a pulsatile signal, similar to the kinase- or cardiomyogram can be obtained by introducing a balloon probe into the esophagus (esophageal cardiomyography = FCKG). Hence we modified a standard Portex esophageal stethoscope into a dual balloon esophageal probe (Portex FCKG probe) so that heart sounds are obtained from the proximal chamber and the FCKG signal from the distal one. The FCKG detects changes in cardiac performance, it could find important applications in noninvasive intraoperatory cardiovascular monitoring. Hence we investigated in dogs whether changes in cardiac contractility could be assessed from the FCKG.

Methods
Nine mongrel dogs received IV secobarbital (25 mg/kg) followed by tracheal intubation and mechanical ventilation of the lungs. Anesthesia was maintained with fentanyl (50 µg/kg) and 50% N₂O in O₂. Heart rate, aortic and left ventricular pressure (Miller catheters), peak dp/dt and pulmonary artery pressure (by Swan-Ganz catheter) were monitored. Cardiac output was determined in triplicate by thermodilution (Edwards). Analog signals were recorded on a Gould 6 channel recorder (speed:100mm/sec). A Portex esophageal FCKG probe with its distal chamber at 25 (+7) cm from the incisors, was connected to a piezoelectric transducer providing a net system frequency response from 0.1-50 Hz. Contractility was decreased stepwise by increasing end-tidal concentration of halothane [0.4, 0.8, 1.2, and 1.6% (FFMA analyzer and gas chromatograph)] and then increased by 5 minute infusions of 1, 2, 4, and 6 µg/Kg of Dobutamine. Linear regression analysis between mean values of peak dp/dt of 3 consecutive beats at each condition and of the corresponding angle (d) between the upstroke of the left ventricular thrust (A-B) and the steep portion of the systolic retraction (C-D) of the esophageal FCKG (Fig. 1) was performed.

Results
The mean high and low values of peak dp/dt were 3170 (+1272 SD) and 1248 (+675 SD) mm Hg/sec and of the d angle 85.4 (+39.7) and 35.3 (+17.9) degrees. An excellent inverse linear correlation between peak dp/dt and d was observed. Individual regression equations and correlation coefficients (r) are listed in the Table. The average r was 0.91. Heart rate had a variable influence on the d angle of the FCKG. When expressing data as % of baseline, a good inverse linear correlation (r = -0.94) from pooled data, p < 0.001) between the d angle and peak dp/dt could be expressed by the equation % peak dp/dt = 156.94 - 0.54d. One dog, not included in this study, had respiratory arrest at induction of anesthesia. After resuscitation, a cardiomyographic pattern compatible with ventricular dyskinesia was seen.

Conclusion
We conclude that the d angle of the FCKG is a good predictor of changes in peak dp/dt in animals. The FCKG holds promise to assess continuously and noninvasively cardiac function in the anesthetized individual and possibly detect cardiac dyskinesia.

References: