WHAT'S NEW IN SURGERY

The eleventh annual program of What's New in Surgery was presented at the last Clinical Congress of the American College of Surgeons. The evaluations of contributions which have recently been made in several fields of surgery have been written by surgeons chosen by the Committee for the Forum on Fundamental Surgical Problems for their authoritative criticisms. The Errors

CARDIOTHORACIC SURGERY

C. RAINEY WILLIAMS, M.D., F.A.C.S., Oklahoma City, Oklahoma

Both cardiac and pulmonary transplantation continue to attract great interest. The recognition of significant lesions of the coronary artery in both clinical and experimental cardiac transplants presents a new, and obviously important, problem for which no complete explanation has yet been suggested. Barnhorst has studied the high energy compounds in the myocardium of long range survivors of dog heart autotransplants and demonstrated no impairment of the capacity of the myocardium for energy production. Graham evaluated the control of rejection of cardiac allografts in dogs using presently available methods of immunosuppression. In 76 episodes of acute rejection, reversal was achieved in 55 per cent and partial reversal, in 17 per cent. Reversal was judged by return of electrocardiographic voltage, and this correlated well with histologic studies of the myocardium. Serum enzyme levels did not correlate well with either rejection crises or reversal. Histochemical analysis of the rejection of cardiac allografts in dogs was presented by Hattler, who demonstrated histochemical changes in the myocardium prior to the appearance of evidence of rejection by light microscopy. An interesting correlation was found by Nelson between survival and cardiac rhythm in dogs with cardiac transplantation. Dogs with synchronous atrioventricular contractions showed a significantly increased survival rate over those with nonsynchronous atrioventricular contractions.

The theoretic advantages of membrane oxygenators have been recognized for years and, indeed, the ability to support the cardiopulmonary system for more than a few hours has appeared dependent upon the development of practical membrane oxygenators. Ladé and Lillicrae have described a small, relatively efficient membrane oxygenator which may be manufactured in modular units. These investigators have reported supporting the circulation in conscious dogs for up to 48 hours with survival. Bypass flows were 500 cubic centimeters per minute, and oxygen saturation was nearly 100 per cent at all times. Use of this oxygenator in a small group of desperately ill patients with encouraging results has been briefly mentioned. Buckley described a membrane oxygenator in which blood flowed through 10 centimeter long, silicone rubber capillary tubes with an inside diameter of 280 micron ± 13 and with oxygen circulating around the tubes. Increasing the number of capillary tubes to increase the oxygenating capacity of the unit resulted in little decrease in efficiency. By both in vivo and in vitro experiments, these investigators have demonstrated oxygenation of adequate volumes of blood with an acceptable pressure differential and an acceptable degree of damage to formed elements of the blood. Experiments involving a toroidal flow membrane oxygenator were described by Bartlett. In these experiments, femoral arteriovenous bypass without oxygenation was well tolerated in experimental animals for up to five days. Damage to blood was minimal, even with five days of continuous bypass at flows up to 1,000 milliliters per minute.

Several studies have been concerned with myocardial ischemia. Bolooki appears to have demonstrated elaboration of vasoactive sub-
stance from the ischemic myocardium of the
dog. Ecker studied the effects of anoxic arrest on
myocardial contractility, with particular empha-
sis on the prolonged effect of ischemia, and was
able to show delayed return of ventricular
function extending to 48 hours and, in one
animal, to 72 hours. Mundth also studied myo-
cardial function in dogs after varying periods of
ischemia. His data indicate marked deteriora-
tion in left ventricular function after 60 minutes
of normothermic ischemia. This depression in
left ventricular function was less severe when the
myocardium was cooled to 28 degrees and when
asanguineous coronary perfusion was used under
normothermic conditions. A combination of
hypothermia and asanguineous coronary per-
fusion resulted in striking preservation of left
ventricular function after 90 minutes of ischemia
in the dog. These experiments again cast doubt
on the advisability of permitting long periods of
cardiac ischemia and are particularly pertinent
to the current controversy regarding whether or
not coronary artery perfusion should be used
during aortic valve replacement and cardiac
transplantation.

The optimum level of coronary perfusion
pressure during cardiopulmonary bypass in dogs
has been studied by Sokol. Using base line
values of 80 millimeters of mercury, diminution
of coronary blood flow and left ventricular
function was found with perfusion pressures of 60
and 40 millimeters of mercury, and increases in
coronary flow and ventricular function occurred
at pressures of 100 and 120 millimeters of mer-
cury. Since many procedures involving cardiopul-
nmonary bypass are carried out at mean pres-
sures of less than 80 millimeters of mercury,
these findings are particularly disturbing and
warrant careful attention. In this regard, the
work of Hardesty, investigating the cause of
hypotension during the early stages of cardiopul-
nmonary bypass, is of special interest. After
observing a marked fall in systemic resistance
during carefully monitored cardiopulmonary
bypass in human beings, laboratory experiments
involving bypass in dogs were carried out, and
the effect of hemodilution on peripheral resis-
tance was quantitated.

Hollon and Maginn have presented convinc-
ing experimental evidence of the sensitivity of
the Doppler flowmeter in detecting small air
emboli in the arterial system. Using transcuta-
neous flowmeter probes and standard recording
devices, the Doppler flowmeter was more sensi-
tive than the electroencephalogram in detecting
arterial emboli. The incidence and importance
of air emboli in the arterial system is of great
interest, and increased use of this method may
yield important clinical information.

The use of hyperbaric oxygenation to improve
oxygen utilization in dogs subjected to four
atmospheres of pressure for 30 minutes was stud-
ied by Jacobs. A decrease in cardiac output and
cardiac power, as well as a fall in systemic oxy-
gen consumption was consistently measured.
These observations appear to indicate oxygen
toxicity and cast doubt on the rationale for the
use of hyperbaric oxygenation in cardiac opera-
tions.

The sophistication and versatility of auto-
mated patient monitoring and care systems are
impressive. Rosti has described a modular system
using externally applied, noninvasive sensors.
This system is versatile as it permits an increased
number of observations in patients, depending
on the severity of illness; is simple, in that it can
be used by personnel not having extensive
knowledge of electronics or computers; and, in
addition, it stores the information in retrievable
form. Black has described a method of con-
tinuous monitoring of cardiac output utilizing a
computer to calculate cardiac output from an
intra-arterial pressure sensor. This is correlated
with dye dilution outputs and clearly represents
a highly desirable capability. Kouchoukos has
demonstrated the continuous recording of
cardiac stroke volume computed from an intra-
arterial pressure curve. By correlation with more
cumbersome dye dilution methods, it was shown
that the constant necessary for calculation re-
mained valid during the first 24 hours after an
operation. Despite the appropriate warning that
electronic devices cannot replace human ob-
servation in the management of seriously ill
patients, it seems abundantly clear that instru-
mamentation using relatively simple sensors is
capable of detecting deleterious physiologic
trends well in advance of recognition by con-
ventional means, of warning human observers
that such events are occurring, and even of initi-
ating corrective measures. In addition, accurate
records are made available in retrievable form.
The contribution of such instrumentation to the
currently popular goal of lowering the cost of
medical care remains obscure.

Despite improvements in both operative and
eter was more semilogram in detecting ice and importance of this method may
personation to improve subjected to four 0 minutes was study cardiac output and in systemic oxygen-systen- tently measured, to indicate oxygen he rationale for the m in cardiac opera-
versatility of autored care systems are a modular system oninvasive sensors, permits an increased patients, depending on, in that it can: have extensive computers; and, in ation in retrievable a method of conv output utilizing ac output from an . This is correlated clearly represents y. Kouchoukos has is recording of uted from an intrarelation with more methods, it was shown for calculation rest 24 hours after a priate warning that replace human ob-ent of seriously ill very clear that inly simple sensors is serious physiologic ecognition by con- g human observers g, and even of ini- addition, accurate in retrievable form, trumentation to the wering the cost of e.

late mortality rates for cardiac valve replacement, there is no general agreement on which of the many available prosthetic valves is preferable. Kaiser has described a malleable stent-preserved xenograft (pig) which has been used in 21 patients with no recognized postoperative embolization. The experiments of Detmer, demonstrating increased susceptibility to bacterial endocarditis in calves three months after insertion of valve prostheses, are disturbing. This susceptibility occurred even in valves totally covered by host tissue. The clinical implications of this study are obvious.

Surgical interest appears to be rapidly widening in several aspects of the management of coronary artery disease. The use of saphenous vein bypass grafts from the aorta to relatively small distal branches of the coronary artery has been extensively reported and seems to have great promise. Important questions concerning systemic artery implants in the myocardium remain unanswered, but an increasing number of leaders in the field appear to believe that the procedure has a bona fide place in the surgical armamentarium. Excision of acute myocardial infarcts has attracted considerable attention, although the number of reported human survivors of the operation is extremely low. Stein and Cordell showed evidence of improvement of left ventricular function after excision of experimental infarcts caused by ligation of the anterior descending branch of the left coronary artery. Clinical studies of the use of diastolic augmentation in patients with shock after myocardial infarction have been reported by Butner and Kantrowitz. The physiologic evidence for improvement in these patients is impressive. The utilization of membrane oxygenators in supporting the circulation in those patients after infarction has been mentioned previously.

Several studies have been concerned with the effect of pharmacologic agents on the cardio-pulmonary system. Hitch and Nolan have evaluated chloralosezoxide hydrochloride (Librium®) and its effects on the cardiovascular system. In dogs, a significant depression in myocardial function was noted as well as a decrease in total peripheral vascular resistance. Wex reported that diphenylhydantoin is an effective agent in raising the fibrillation threshold in dogs. This was accomplished without evidence of decreased myocardial responsiveness. Glucagon was administered to a number of critically ill surgical patients by Levine, and increases in cardiac output were noted in slightly more than one-half of the patients without evidence of arrhythmia or tachycardia. This drug appears to have real value in supporting the cardiovascular system in seriously ill patients. Lynch and Rosenkrantz have reported experiments using dipyridamole to modify the pulmonary vascular response to hypoxia in pigs. Since this drug appears to act principally on platelet function, this may offer a new approach to the prevention of acute pulmonary hypertension.

In the field of congenital heart disease, McCooon has reported a sizable group of patients with trunca arteriosus who have survived construction of a pulmonary outflow tract using an autologous aorta and aortic valve. Concomitant closure of the ventricular septal defect resulted in relatively normal cardiac function in these patients for whom there was no previously effective surgical treatment. Hallman has described a vast experience with endocardial cushion defects and advocated insertion of prosthetic mitral valves in the more severe forms of this anomaly. Malm made an interesting obser- vation regarding the puzzling combination of ventricular septal defect and aortic valve valvular insufficiency. He has divided these anomalies into those in which there is a structural abnormality of the aortic valve, amenable only to valve replacement, and those in which the valvular insufficiency is indeed due to prolapse of a cusp into the ventricular septal defect. This type is corrected only by repair of the septal defect. Van Way has demonstrated an increase in plasma renin activity with stimulation in human beings with coarctation and in dogs with experimental coarctation, thus contributing to an understanding of the cause of hypertension in coarctation.