FLUID AND ELECTROLYTE BALANCE IN SURGERY (A.E.)

Summary of lecture by Dr. Bruce Jones

(Editor's note: On 9th, July, we had the precious opportunity of attending a lecture given by Dr. Bruce Jones, F.R.A.C.S., who is an authority on the subject of fluid and electrolyte balance. He runs a surgical unit at the Rehabilitation Hospital in Melbourne, and is part-time lecturer in the University of Melbourne at the Austin Hospital.)

I wish to discuss the infusion of large quantity of Hartman's solution in surgical patients, basing primarily on the work of G.T. Showers.

Early experience

Regarding the metabolic response to trauma, nearly everyone followed Francis Moore's concept: post-operative patients were given not more than 2 litres/day of 5% dextrose solution for the first 24-36 hours; thereafter, 3 litres/day were allowed, including 1½ litres of normal saline. After trauma, there is sodium and water retention for 3-5 days, and potassium loss for 2-3 days. These changes are due to an increased secretion of aldosterone and ADH. This concept is supported by strong evidence: Many have described cases of water intoxication due to excess fluid given to patients during the first phase of metabolic response to trauma. Even under a restricted fluid intake, patient's serum osmolarity fell for a few days. This was explained as representing the accumulation of water released by catabolism and exudation of tissues.

When I became specialist for resuscitation at the Rehabilitation Hospital, part of my duties was to oversee all intravenous therapy. I observed large number of surgical patients with severe thirst and marked oliguria with urine of high specific gravity. Many patients had central venous pressure catheter inserted for other reasons and I believed that central venous pressure monitoring could be a safeguard for the overloading of fluid; so I began cautiously to give extra fluid to surgical patients on the first 24 hours. Finally I ordered 3 litres of 5% dextrose solution per day (previously, it was not more than 2 litres per day). Patients felt better and the urine output was increased. I cautiously extended this management without encountering any complication.

The work of G.T. Showers

G.T. Showers developed a method of simulataeous measurement of E.C.F. volume using radioactive sulphate, red cell volume using radioactive chromium, plasma volume using I^{131} albumin; giving the three in one ingestion and measuring them with one counter. Working with hypovolaemic shock in dogs, he concluded that after a period of shock, there was a decrease in functional E.C.F. volume, up to 30% in some cases. and about 20% in most cases. This deficit was still measurable after replacement with blood or even after over transfer to a measurable increased blood volume. The missing E.C.F. can be shown by measurement using radioactive tritium.

Showers showed similar deficit in functional E.C.F. volume in human subjects in shock, burns, and after surgery. In surgery, the missing fluid was said to be in part present in the wound and tissue oedema,; in burns, it existed in part as oedema around the burn and blebs forming on the burn; however, in shock, its site was not known and Showers thought that possibly it was in the cells. Showers recommended replacing this rapid loss with lactated Ringer's solution (Hartman's solution) in shock and after surgery. He recomended 1 litre/hour of Hartman's solution in major surgery. Showers further believed that if this were done, there would be no retention of water and sodium postoperatively. Hence, patients were infused with Hartman's solution at all times. (At that time, many people believed post-operative salt and water retention was due to dehydration; Showers did not claim this).

Scepticism

Last year, many papers were published criticising the validity of Showers' work because Showers relied on the validity of a 20 minute mixing period of his isotope, but equilibration may take longer in shock. Moore himself claimed that he was unable to detect the extracellular fluid deficit which Showers found. Thus there exist two schools of thought — Moore claiming that the older concepts of management were correct; Showers still claiming that extracellular fluid depot exist with modern accurate dilution technique.

Review of water and electrolyte talance

To start with, we should briefly review the physiological mechanism involved in salt and water balance.

Firstly: we think about **water balance** and **water excretion** ADH is the main determination of water excretion. How is ADH level in the blood affected? 1). Vernly showed that the osmolarity of internal carotid blood was an important factor for ADH release: it worked through osmoreceptor in the hypothalamus. 2). emotional stimulus from higher centres. 3). Pain and visceral stimuli — e.g. Traction on the mesentery. 4). Blood volume — a fall of blood volume causes a rise in ADH level in the blood. This is probably the most potent stimulus. The receptors are known to exist in the left atrium. (After mitral valvotomy, when the pressure in the left atrium is released, there is a prolonged secretion of ADH).; the impulse travelling via the vagus. 5). Drugs: acetylcholine, histamine, barbiturates, morphine all cause ADH release.

One significant point is that even if serum osmolarity and blood volume are normal postoperatively, there is increased ADH secretion because of pain, and morphine (or barbiturate) given. How about the effects of continued ADH secretion? What happens when ADH is continuously injected into a human subject? It is reported by Alexander Leaf in NEJM in 1962. (This paper, called the "Clinical significance of serum Na", I recommend all of you to read). Leaf, working with ADH on human volunteers, showed the following result — If the person had been drinking large quantity of water, on the 2nd or 3rd day he would go into water intoxication. If he drank normally, the blood volume slowly increased over two to three days; the serum osmolarity and sodium level dropped due to the water retained. But on the 3rd day, something unexpectedly happened: A massive diuresis occured — there was also massive excretion of sodium, producing a low serum sodium. This steady state would persist as long as the effect of ADH lasted. If the subject were given another water load, he would respond by another sodium diuresis. Hence, it was easy to push sodium level in animals or human down to about 110mEq./litre. It is important to realize that ADH activity long continued will not result in redema.

Secondly: **sodium balance.** Sodium excretion is determined by

1). Glomerular filtration rate.
2). Aldosterone — Acting on distal tubules in the kidneys and affecting the exchange of sodium and potassium with hydrogen ions.

The regulation of aldosterone secretion is by several factors:

1). ACTH — This is probably the main factor causing increased aldosterone secretion after surgery.
2). Blood volume — By stretching the right atrium, aldosterone excretion changes; renal perfusion has a marked effect on aldosterone secretion; this is thought to be due to the direct effect of angiotensin on the adrenal cortex.
3). The level of potassium in the blood perfusing the adrenal cortex has an effect on aldosterone secretion but the change is only in the order of 1mEq./litre.

We should note here that excess aldosterone levels continued over long periods would not produce oedema: because after 3 days, the phenomenon of aldosterone release occurs, the excessive sodium retained is at least partly excreted by the kidney.

In the last 3 or 4 years, a new factor called the "Third Factor" has come into prominence as a determinant of sodium excretion by the kidney. This third factor was postulated to exist by de Wardener in 1956. The concept is that the rise in blood volume produces, acting through this third factor, a sodium diuresis from the kidney. This factor is also called the natriuretic hormone. (However, some people claimed that dynamic changes in the kidney might be responsible for the effect rather than any hormone.) Anyway, there is no doubt that if the blood volume is raised, the kidney will excrete sodium due to changes in the reabsorption of sodium in the proximal tubules of the kidney.

With this background, we can proceed to discuss some of my work.

All who claim that they are able to prevent the post-operative retention of sodium and water specify that one must start before, or, at the latest, during the operation, by giving Hartman's solution. I tried Showers' recommendation: 1 litre of Hartman's solution per hour during surgery, and found that there was still quite marked sodium and water retention in the early post-operative phase. (If retention were simply due to E.C.F. lack, one would be able to alter this at any time). Later, I used ½ litre per

(Contained on Page 3)

COMPULSORY? VOLUNTARY?—OUR VIEWS

— An Interview with 12 medical students on the issue of "voluntary or compulsory hall membership"

"While compulsory membership tends to direct one to identify oneself with a hostel, voluntary membership enables the establishment of individuality. While compulsory membership is non-democratic in that the authority forces an idea on the student, voluntary membership allows the student to search his conscience and pocket and to decide for himself. While compulsory membership permits the hostels to take advantage of affiliated members, voluntary membership enatails the hostels to improve their facilities for affiliated members . . . " (letter from 'A group of Medical Students', correspondence section, Caduceus, Vol. 2 No. 6).

Recently, the question of voluntary or compulsory hall membership has become a most controversial subject around the campus. Well, 'A Group of Medicap Students' had voiced their opinion openly. Are you one of them? Or do you think otherwise? We must say that the aforesaid opinions are not representative of the view of all medical students. In view of this, a number of medical students from different years (some residents and some non-residents) were interviewed and their ideas gathered in the following account.

A Word on the Background

On the 7th October, 1969, the Senate set up a Working Party to consider the need for non-residential affiliation and related matters. On 5th May, 1970, it was resolved that non-residential membership of residential halls and membership of non-residential halls be voluntary from the academic year, 1970-1971. Soon after the Senate's resolution, the H.K. U.S.U. held an Emergency Council Meeting to discuss the issue. The conclusion drawn at the meeting was reflected in John Ng, our President's letter to the Senate:—

May 27, 1970.

Mr. Dudgeon,
Asst. Registrar,
Acting Registrar, HKU

Dear Mr. Dudgeon,

The resolutions of the Senate concerning voluntary affiliation of undergraduates to Halls/Colleges have been duplicated and passed on to Halls/Colleges Associations, and at their request, an emergency Union Council Meeting was convened to discuss the matter. It was felt that such resolutions of Senate have large bearings on student life, and that the Union Council was not in a position to decide on behalf of many others when their personal welfare are at stake, hence the Council have decided to hold an Emergency General Meeting (EGM) to gather members' opinion, scheduled on 29th June. And in the meantime, the Union Council petitions to the Senate to defer the implementation of these resolutions before sufficient opinions from students have been gathered.

Yours sincerely,
Sd. John Ng
President,
HKUSU

So at 'our' request, the Senate agreed to defer the resolution **on condition** that the scheduled E.G.M. be postponed to the next academic year after the new lot of undergraduates have moved in, so that the new undergraduates can decide for themselves. So the whole matter was brought to a dead halt.

Q. 1. Do you think compulsory Hall Membership will have any effect on 'individual identity'?

A. To identify oneself with a hostel implies a sense of belonging — something that can be personally felt. This sense of belonging can never be attained by compelling someone to affix to a certain hall. No compulsion can engender a sense of belonging.
B. To identify oneself with a hall or association is not needed. There will then be no individualism. One would tend to become an unknown figure in a crowd, following mass activity, mass opinion. In a way there is no sense of 'individual freedom'.
C. Affiliation to any hostel may form only part of our identification as a university student. Even within the same hostel, students can still have their own individual identity, for a hostel does not contain a group of 'homogeneous' students. So I do not think hall membership, be it voluntary or compulsory, will have any effect on 'individual indentity'.
D. Individual identity is up to the individual to decide. Nobody can force any form of identity e.g. by enforcing any form of belonging, on anybody.

Q. 2 Do you think the university is democratic on this issue?

A. The Senates' act is correct and democratic. If there is anything wrong, it is John Ng or the Union Council that should be responsible. In fact the Senate should be congratulated on readily accepting students' opinion.
B. The university authority is democratic in this case. But the Student Union is not democratic. An E.G.M. should be called for before deciding this issue.
C. I am very surprised by the Senate's deferrment of the issue, and I'm virtually shocked by the way the whole issue was handled. The Union Council seemed to have consulted no one except some hostel representatives and these, needless to say, are all against the proposal (of voluntary affiliation), whereas I am sure that if the whole matter is put to a vote in an EGM, an overwhelming majority will agree to voluntary affiliation. It makes me wonder how democratic the procedures had been.
D. We are glad that we are ultimately asked to voice our opinions on this matter and that the issue is being suspended at our request. We must say there is a touch of democracy in this.

Q. 3 Financial Implication of such an issue — on hostels and individuals.

A. The hall will suffer financially. But is it not reasonable for the residents, who enjoy most of the facilities and functions, to pay more to ride over the difficulty?
B. Compulsory affiliation means financially exploiting the affiliated members.
C. An annual sum of $60-$90 may not mean much to an average student. But the issue of voluntary hall membership will certainly threaten to shut down a good financial source on the part of hall associations. May be this is why the present hall committees are so eager to defer the issue — so as to leave the financial trouble to the next session.

Q.4 What effects will the issue of voluntary hall membership have on the ultimate welfare of all students-residents and non-residents?

A. "Welfare" is a term that should be interpreted individually. Someone says 'social gatherings' form part of the student welfare while others think not. So if the 'welfare' of a certain hall appeals to a certain individual, he can by all means apply for the hall. But this should be voluntary!
B. If a hall really cares for the welfare of all members — residents and non-residents, then I think the hall will have no trouble in securing its members. So why not let the students choose for themselves?
C. If voluntary hall membership is enforced, the welfare of hall residents will be worse as the hall committee will surely find it difficult to maintain the present standard on a reduced capital.
D. The student welfare will improve, especially that of the non-residents.
E. I think voluntary hall membership is a perfect way to enforce a better link between residents and affiliated members. In this case the welfare of all will be considered in all issues of the hall.

Q.5 What is the present status of non-residents in the eyes of residents and hall student committees?

A. This depends on the individual hostel and student. But generally, they are regarded as second-class members — for they are ignored completely.
B. We are tempted to feel that we are strangers when we come back to the halls. It is true that we are never unwelcome, but never welcome either. There is no sense of belonging whatsoever.
C. They are an exploited group. My sympathy truly goes to them.
D. Non-residents are truly treated as 'affiliated' members. No resident, I dare say, will treat an affiliated member as one of them.
E. The only trouble with non-residents is that we do not see them often enough to get to know them well. In fact we do welcome them back on every special occasion.

Q.6 Any other comment?

11 out of 12 students interviewed voted for the issue of voluntary hall membership.

3 of the students favoured the deferrment of such an issue until the general opinion of students is sought. Others disapproved on grounds that the request for deferrment was not made by the general student body. (C.L.)

「制定學生隸屬一個宿舍」的我見

一個五年級非住宿生

問：你認爲制定學生隸屬一個宿舍，對學生「個性」有無影響？

答：作爲一個非住宿生，我認爲名義上的隸屬，對「個性」的影響很微。

問：這次大學當局把「自由隸屬」一案押後，你認爲是否民主？

答：如果論及大學當局，我認爲除了去年的所謂改革外，就根本不大重視民主不民主。至於學生會要求押後該案，正徹底暴露了一小撮人爲着維護已得利益，而出賣大衆利益。該案影響最廣泛的，是一般非居住性的同學，而學生會評議會亦認爲本身不能輕易爲這大多數人妄下決定。但討論的結果，却並非待已召集中的全體大會決議該案，反向大學當局「請願」「緩期執行該案，直至有足够同學的意見可知。」（譯自學苑）於是召集中的大會便胎死腹中，如此又何能「有足够同學的意見可知」？正如某宿舍代表在評議會坦然指出：該案令可住的宿舍財政恐慌，令不住的宿舍產生會員問題。我認爲因沒有會員而强人入會是不講理，這樣的會解散也罷。因財政恐慌而硬要非住宿生維持是不公道，何不令住宿生維持？不然，這簡直是「損人利己」。

問：此案擱置對宿舍及對個人經濟影響如何？

答：對宿舍來說，該案擱置當大受歡迎，理由已如上述。對個人經濟這點，實在因人而異，亦影響不同。但近年來一般大學學生家境並非富裕，已是很顯明的事實，經濟上因此受到或大或小的打擊，當不可否認。

問：這次事件，你認爲對住宿生或非住宿生的福利，最後會發展到怎樣？

答：評議會的議員們，竟不待衆見明顯，便下了一個這樣武斷的決定；我對於一般同學（不論是住宿或不住宿）的最終福利感到悲觀。一事如此，他事可知。

問：我想知道你對這事的立場究竟怎樣？

答：我是贊成「自由隸屬」一案的。這樣才可以使各宿舍力求改善，希望吸引同學隸屬。

問：最後，你對擱置該案有何意見？

答：極端遺憾！

A GOOD START

Medical Students' Centre,
Sassoon Road,
HKU

2nd August, 1970.

Dear Sir,

May I congratulate the Caduceus Editorial Board for their success on their last issue, (July issue). The paper of course is not perfect but one can see that improvements have been made. Various criticisms on the paper as gathered by the survey conducted in June have been looked into. I am especially glad to see the paper coming out exactly on time. Of course there is still room for improvement, but this is a good start.

Yours,
P's.

Editor's Note: Thank you! Any other criticism is welcome.

Deadline for all letters: 29th of each month.

(Continued from Page 2)

hour during the operation, adding blood replacement when necessary at the time of the loss; then to give excess post-operative Hartman's solution. I tested the result by estimating the effect of a water load 24 hours post-operatively. I realized that if I gave an excess of Hartman's solution post-operatively, and if the retention of sodium and water normally seen was simply due to a deficit of ECF volume, there should be no tendency for the patient to retain a water load. Result: in a normal patient, a water load such as 10ml/Kilo body weight gives a very brisk diuresis with a fall in urine osmolarity to under 100. (normal serum is 190). The serum osmolarity with this sort of water load usually drops by 4 milliosmoles/litre and this returns to normal within 3 hours.

啟思

香港大學學生會
醫學會月刊
第二卷
第七期
一九七〇年八月十五日

中文月刊

「啓思」編輯先生：

我看「啓思」的時候，感到這份月刊很有趣味，可是有一點我不明白。難道您們香港大學醫學系學生都不是中國人嗎？那麼請告訴我爲甚麼「啓思」是完全用英文寫的呢？我是英國人，跟我同胞通消息的時候，總不想用中國語言。可能您們覺得使用中國語言是一種羞恥吧！也許因爲您們的殖民地統治者不懂得您們的語言，所以您們使用他們的語言呢！可惜您們在本港使用英文慣了，無論在任何的競爭上您們總處于不利地位，因爲您們總比不上外國人用外國語言來得那麼精巧。但如果您們能多多使用自己的語言代替了外國語言，那麼您們在一切的競爭上，就能處于有利地位，更能迫使外國人學習和使用中文了。

在六月十五日的「啓思」月刊上，我知道有百分之九十二的讀者沒有給「啓思」寫文章。如果「啓思」能變成中文月刊，也許投稿的人就可以多一點兒吧！

此致

敬意

一九七〇年七月二十五日

雨夜

點點滴滴的雨像離人的淚
夜盡了天還會亮的
就在這黑暗無際的夜裏
雨散後
院外彷彿有人在數着落花

（編者按：歡迎讀者投稿，來稿請將眞實姓名連同筆名附上，敬希留意，多謝合作。）

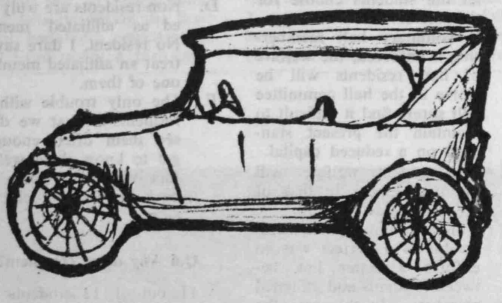
船灣行

雙木

數年前因事前赴船灣，沿灣畔有四、五條村落，共有居民約四百人，據說大部份姓李，由後面山坡移居至此，已有百載。居民由打漁轉業耕種，近年年青一輩且多遠涉重洋，到英國等地謀生。自淡水湖完工後，該地居民已爲政府徙置，從此永離故居。回想灣畔百年人事滄桑，不禁有感：

是巨人偶踏一脚使海隅留下了一灣
多少年代以來
幾許波濤於此憩息
是何時淒淒草岸
印上了人類的足跡？
若桃花古津
戰神的車不臨於斯（一）
一任落英繽紛
只是誰爲武陵客
引渡桃源？
芬芳的泥土，
染着百年的血汗
像徵了百載的辛勤
百載耕耘
可有百載收獲？
悄悄的，灣畔開始靜下來
一如當初它悄悄的熱鬧起來
如今波濤已給擯諸堤外
當廣陵人散後
你可有爲它乾最後一杯？

註（一）據云該地歷香港淪陷而未罹戰禍。



MEDI Broad speed MOBILE

IMP

Meaning 'little devil' the imp is a series of cars under one litre produced by Rootes. Basically it consists of three series of engines and two types of body shells in various combinations and sold under the brands Hillman, Singer and Sunbeam. Simply:

1. Hillman imp, Sunbeam imp and Singer Chamois are those with the basic 875 cc engine and body shell,
2. Hillman imp Californian is the same with a fast-back body,
3. Imp sports are twin carburetter versions in basic body,
4. Sunbeam Stilleto is the same in fastback body,
5. Rally imps are 998 cc twin carburetter engines in basic body.

Since medical students are reputed to be ignorant of basics, the most basic version of the imp series will form the centre of discussion in this issue.

Description

A box-like two-doored saloon with relatively big passenger cabin and short nose and tail. Engine is rear-placed and is an 45 degree inclined four cylinder unit which has its origin in the famous Conventry-Climax racing engines. The pioneering features are overhead camshaft and aluminium engine which was quite advanced engineering in the early days of production in 1964. But still there were faults in the design which are rectified in later imps.

Performance

Top speed of 74 mph and 0-50 mph in 16.9 secs is very good indeed for its engine size of 875 cc and its power output of 39 bhp. The good thing about the acceleration is that the gears are ratioed very well and that one feels an urgent thrust when one is getting away in 2nd gear, a very delightful sensation not experienced with its rivals in the sub 1 litre class. The gear lever is short and stubby making gear changing a smooth process. However the gate for reverse gear is entered by pushing the lever left and then back- a manoevre which requires skill because of the spring loading of the gear box.

Straight line stability of the car at speed is not satisfactory partly because of the concentrated weight distribution at the rear of the car making it nose light and also because of the rack-and-pinion steering mechanism which transmits bumping too readily, making the steering wheel difficult to hold.

Braking in my prototype imp is unsatisfactory. I remembered the days when I have to virtually stand on the brake pedal frantically to effect a stop which compelled me to spend 300 dollars in fitting a servo unit. But days have changed and now the brakes are said to be a lot better in recent models.

Roadholding is very good with the imp. I can hardly produce any skidding no matter how hard I drove (although I am hardly a fast driver) in the dry but I dare not try the same in the wet- the cornering character is said to be slight oversteer (Meaning tail-out).

Economy

This all depends on how hard one drives. The usual figure should be well above 30 mpg. If one gets abnormally low figures one should check with the ignition system- the spark plugs, the distributor, and also the fuel system- any blockage to the carburettor jets and so on.

The imp is also a success in space economy. The passenger cabin is big for its class. The back row can accommodate three normal sized adults easily whereas in cars such as the minis and fiat 850s they would be very cramped. With the back row of seats folded the rear is transformed into a flat loading platform which can be loaded from the tail of the car- the rear window can be opened like an estate car. The usefulness of this extra space is immense- big models, drawing boards and whatnots can be accommodated easily. There is also some space under the bonnet which is also of use for small and soft luggages such as swimming suits, white shoes etc.

Luxury

Very meagre in prototype imps but is better in later models. The big parcel shelf in front is transformed into a wooden veneer with a locker which is very desirable. Still I think a lot can be done to improve- the new imps do have wood all over but it is just short of the term 'opulance'.

Seats have improved but still not up to the standards of Renault cars. With big panels of glass all round the all round visibility is good. I recommend the clip on type of wide-angled reversing mirror which is also good for other makes of cars for the simple reason that you can see virtually all round without moving your head.

Durability

There are vulnerable points to the design of the car. No lubrication services is said to be necessary because of sealed lubrication and there touble arises. You will get wearing and rattling all round after 30000 miles on the clock. There are kingpin defect, universal jonit defect and steering box defects which are most irritating. One gets a sense of insecurity when driving such a car.

The clutch of the prototype is too small for the stress it bears, and wear is too soon to be acceptable. And because the clutch is inaccessible without removing the engine, every time you change the clutch you have to give away a sum for getting the engine out of way. The carburettor is operated by a long steel cable which runs throughout the length of the car. If your are a hot person you would find in the event of overtaking the cable would slip or even break leaving the accelerator flabby and helpless- the lesson being never to stand on the accelerator pedal.

Otherwise the mechanical parts and the engine are smooth and starting is always prompt.

Other Criticism

The automatic choking in the prototype is not as good as the manual choke in later models.

Negative camber in the front wheels is odd to look at in this era of fat tyres and positive camber.

As with most rear-engined cars the noise when reving hard is annoying. This can be remedied by fitting a straight through exhaust system which will cover the noise by a sporty burble- only when the length of pipe is long enough and the brand of exhaust pipe is good.

Summary

Here is a small saloon with good performance, economy moderate luxury and poor durability. Balancing the pros and cons I still think that the imp is the best car in the 850 cc class for the average medical student.

The views expressed by our Contributors are not necessarily those of the Editorial Board.

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