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"Knowledge is like a garden; if it is not cultivated, it cannot be harvested."

Swahili proverb

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Editorial

Breastfeeding – Healthcare Professionals Need to Do More

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Breastfeeding is best. Everybody knows that. The problem is not so many believe it really matters very much. And worse, in our modern, fast-paced, urban environment where instant gratification and easy solutions are the norm, few first time mothers know what it takes to successfully initiate, establish and continue breastfeeding. Healthcare professionals need to do more to convince themselves and their patients that breastfeeding really matters, and that mothers need to be adequately prepared and determined as they start to breastfeed their newborns.

The evidence that breastfeeding is the optimum way to provide babies nutrition and for mothers to bond with their newborns is clear.[1,2] Some of the acute health benefits for infants such as reduced infectious and diarrhoeal morbidities[1] may not seem so important to mothers in developed countries but the longer term benefits should. Healthcare professionals should highlight that breastfed babies have lower risks of developing chronic conditions like being overweight, obesity, and diabetes.[1] Because of the high value placed on academic achievement in Asian societies, better neurocognitive development of their babies[1-5] should be emphasised to mothers. In the Growing Up in Singapore Towards healthy Outcomes (GUSTO) study,[6] intensive neurocognitive testing of children in the first 2 years of life suggests a significant beneficial effect of breastfeeding on young children's memory and language development,[7] which is consistent with past research.[3-5] Additionally, we also observed associations between breastfeeding duration and higher cognitive scores on the Bayley Scales of Infant and Toddler Development III.[7]

The breastfeeding situation has definitely improved in Singapore over the last 2 decades. In 1997, a study in Singapore found that only 6.3% of mothers were still breastfeeding at 4 months after delivery.[8] The rate of any breastfeeding at 4 months had improved to 29.8% by the time of the National Breastfeeding Survey in 2001.[9] In the GUSTO cohort where breastfeeding data was gathered from 2009 to 2011, the prevalence of any breastfeeding at 6 months postpartum was 46% for Chinese mothers, 22% for Malay mothers, and 41% for Indian mothers, but the prevalence of exclusive and predominant breastfeeding was only 11%, 2%, and 5%, respectively.[10] Factors associated with early cessation of breastfeeding included unfavourable early breastfeeding experiences, such as poor advice on breastfeeding frequency and lack of support to start breastfeeding soon after birth,[10] which reflect inadequate support from healthcare professionals. With the introduction of the Baby Friendly Hospital Initiative (BFHI) in Singapore in 2012,[11] it is likely that the situation will get better.

However, another finding from the GUSTO study is the popularity of breast milk expression among Asian mothers. At 3 months postpartum, 57% of mothers were feeding their infants expressed breast milk (EBM) to some extent, and, of these, 16% fed EBM exclusively. Chinese mothers were more likely to practice non-direct breastfeeding than Malay or Indian mothers. Additionally, first-time mothers, women with higher educational attainment and those who worked during early pregnancy were also more likely to feed their infants EBM.[10,12] Studies on breastfeeding mode, i.e. direct versus EBM feeding, are scarce but have important implications for maternal and child health.[12,13] GUSTO data also indicate that women who feed their infants EBM only at 3 months postpartum have more than double the risk of stopping breastfeeding early compared to those who feed their infants directly at the breast.[12]

Doctors can and should do more to help mothers prepare for breastfeeding. The United Nations Children's Fund/ World Heath Organization (UNICEF/WHO) Baby-Friendly 'Ten Steps to Successful Breastfeeding'[2] outlines clearly what every facility providing maternity services and care for newborn infants should do to promote breastfeeding. With the BFHI taking root in Singapore since 2012, these guidelines are prominently displayed in all BFHI-certified maternity units. However, there is a tendency for many doctors to delegate the measures in the 'Ten Steps' to their nursing, midwifery and other colleagues. This is not satisfactory for several reasons. First, pregnant women in Singapore are primarily taken care of by obstetricians, unlike many other countries where midwives take the lead. In this situation, the effectiveness of health messages transmitted

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Table 1. How Doctors Can Help

1.	Take a strong position on behalf of breastfeeding—this is justified because of the extensive evidence for improved outcomes in breastfed infants and their mothers.
2.	Be aware of the medical evidence for breastfeeding, and the professional guidelines.
3.	Communicate with and educate your patients about the benefits and techniques of breastfeeding.
4.	Do not do anything that might hinder the initiation, establishment and continuation of breastfeeding unless absolutely necessary.
5.	Promote breastfeeding as a normal part of daily life, and encourage family and societal support for breastfeeding.

by midwives and nurses are diminished. Second, it is usually doctors who are consulted by mothers about the advisability of breastfeeding under special circumstances, for example, when mothers are on antibiotics or have an illness. An ill-informed comment by the doctor at this point often discourages the mother from continuing to breastfeed. Doctors have to be aware of the evidence-based medical contraindications for breastfeeding,[14] which are far fewer than commonly thought. Finally, it is not uncommon to find a first-time mother 3 days after her delivery completely distraught and desperate because her baby has lost some weight and she thinks it is because she is not producing enough breast milk. As a consequence, she has taken to expressing her breast milk so she can see how much she is producing and she is appalled at the tiny quantities of colostrum she has managed to obtain so far. It then follows that she has decided that she needs to start supplementing her baby's feeds with infant formula. This common scenario can be avoided with proper maternal preparation by their main caregiver during the antenatal period, as well as routine and competent support soon after childbirth.

The recent launch of the breast milk bank in Kandang Kerbau Women's and Children's Hospital (KKWCH)[15] is a wonderful effort to help certain mothers who cannot produce milk for their babies for various reasons but doctors should do more for the majority of their patients. The doctor's role in helping prospective mothers prepare for breastfeeding and in supporting them after they start cannot be overstated. Being informed of the evidence and the guidelines around breastfeeding is a primary responsibility of all healthcare professionals providing care to mothers and infants (Table 1). Taking breastfeeding seriously and taking a few extra moments to educate and support our patients is all it takes. It is the least we can do.

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Original Article

Reasons and Factors Behind Post-Total Knee Arthroplasty Dissatisfaction in an Asian Population

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Abstract

Introduction: Up to 20% of patients who underwent total knee arthroplasty (TKA) reported dissatisfaction with surgical outcome. Despite the multiple studies looking into the factors contributing to patients' dissatisfaction, little research has been done to examine the subjective reasons and complaints patients have post-arthroplasty. This study aimed to look at an Asian patient population which underwent TKA and examine the factors contributing to patient dissatisfaction and the reasons they were dissatisfied with their surgery. Materials and Methods: A total of 3069 TKAs were performed between January 2011 to April 2013 in a single institution. Preoperative and postoperative variables were prospectively captured, such as standardised knee scores, knee range of motion and patient satisfaction scores. These variables were then analysed with a multiple logistic regression model to determine the statistically significant factors that contribute to patients' satisfaction. Dissatisfied patients were individually interviewed to find the reasons for their unhappiness. Preoperative variables were then analysed to identify the statistically significant factors associated with these subjective complaints. Results: Minimum duration of follow-up was 2 years, with an overall patient satisfaction rate of 91.3%. Preoperative variables contributing to patient dissatisfaction included female gender and better knee flexion. Postoperative variables included lesser improvement in knee flexion at 6 months postoperatively, as well as poorer scores in various validated knee scores at both 6 months and 2 years postoperatively. The top reason for dissatisfaction was pain. Weakness, another reason for patient dissatisfaction, had statistically significant preoperative predictors of increased age and poorer Short-Form 36 Physical Component Score. Conclusion: Although TKA has an impressive patient satisfaction rate in this Asian population, factors contributing to postoperative dissatisfaction suggest a targeted group of patients would benefit from preoperative counselling. The top reason for postoperative dissatisfaction in the study was pain.

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Key words: Outcomes, Quality of life, Satisfaction

Introduction

Up to 20% of patients who underwent total knee arthroplasty (TKA) were reported to be dissatisfied with the surgical outcome.[1-3] There is, however, less information available on the reasons behind these patients' unhappiness. Such information would be helpful as satisfaction post-arthroplasty is fast becoming an important outcome measure post-surgery.[4,5]

Previously, orthopaedic surgeons have used the need for revision surgery as an indicator of arthroplasty failure, neglecting the more subjective component of patient satisfaction.[6,7] Unfortunately, satisfaction is multifactorial and the literature has demonstrated a discrepancy between clinician and patient ratings of quality of life.[8,9] Patient satisfaction is dependent on both the mental and physical health of the patient, and is influenced by the fulfilment of patients' expectations aside from absolute function.[10,11]

So far, the literature has no consensus regarding specific factors predictive of patient satisfaction. Evidence is even less established in Asian populations, where although

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patients have been expected to demand higher knee flexion post-TKA as compared to the Western population, a recent study has shown that a lack of postoperative range of motion (ROM) does not translate into poorer outcome scores and dissatisfaction in an Asian population.[12]

In this study, we hypothesised that there are preoperative and postoperative variables associated with patient dissatisfaction post-TKA. Discovery of the reasons behind patient dissatisfaction as well as possible contributory factors may allow surgeons to achieve better subjective outcomes.

Materials and Methods

Participants

A total of 3069 TKAs performed from January 2011 to April 2013 were prospectively enrolled in this study with a minimum follow-up period of 2 years. Local institutional review board (IRB) waiver was granted as no patient identifiable data was used in this study.

Indications

All TKAs were performed for primary osteoarthritis of the knee which clinically indicated the patient for a routine TKA. Patients who underwent bilateral TKA performed in the same setting were included in the study population as well. Exclusion criteria included patients with inflammatory arthritis, post-traumatic arthritis or a history of septic arthritis. Patients with a history of prior contralateral TKA, as well as any other concomitant procedure, including removal of hardware, were also excluded.

Components and Technique

All the operations were performed by 5 qualified surgeons from the institution's orthopaedic surgery department. All procedures were performed through a midline incision with a medial parapatellar arthrotomy. All implants were fixed bearing, with either posterior stabilised (PS) or cruciate retaining (CR) designs.

Postoperative Treatment

Postoperative physiotherapy comprised 4 phases across the duration of approximately 12 weeks. This was a generalised protocol which physiotherapists modified accordingly for individual patients based on their improvement and progress. The patients were brought through the following phases.

Phase 1

The confidence and mobility phase had the following aims: 1) to decrease pain and oedema; 2) to progress knee flexion to at least 90°; 3) to do a straight leg raise without lag; and 4) to be independent with bed mobility and transfers. This typically occurred over the first week when the patient was an inpatient.

Phase 2

The initial outpatient phase had the following goals: 1) to decrease pain and oedema; 2) to progress knee flexion to 110°; 3) to increase/maintain lower limb strength; 4) the normalisation of gait pattern; and 5) for independent ambulation in the community. This occurred over weeks 2 to 5 (the initial outpatient period).

Phase 3

The semi-independent phase had the following aims: 1) to further increase knee flexion, if possible; 2) to increase cardiovascular endurance; and 3) to maximise balance, proprioception, strength and endurance of the lower extremity. This occurred over weeks 6 to 8.

Phase 4

Phase 4 was the independent phase. The aims were to: 1) improve strength; 2) improve movement strategies and movement efficiency of activities; and 3) modify activities, if necessary (e.g. no high impact sports/activities). This occurred over weeks 9 to 12, and can be extended as long as necessary.

Data Collection

Key preoperative and postoperative variables were collected, along with patient satisfaction postoperatively. Data was captured by trained personnel during each patient's follow-up in the Orthopaedic Surgery Clinic at 6 months as well as 2 years postoperatively; drop-out rate was captured to assess for non-responder bias. Two-time points were used to measure changes and improvements in surgical outcome.

Preoperative variables captured included the patient's age, gender and body mass index (BMI). ROM of the knee, as well as validated knee scores such as the Oxford Knee Score (OKS), function score and knee score from the Knee Society Clinical Rating System were also collected.

The OKS is a 12-item questionnaire specifically designed and developed to assess function and pain after knee arthroplasty.[13] The Knee Society Clinical Rating Score is a different knee rating system subdivided into a knee score that rates only the knee joint itself and a function score that rates the patient's ability to walk and climb stairs; the dual-rating system was developed to eliminate the problem of declining knee scores associated with patient infirmity.[14]

Both preoperative and postoperative ROM of the knee

was captured via goniometry. Both flexion and extension of the knee was recorded – a flexion value of 90 would mean that the patient was capable of flexion of the knee to 90 degrees, an extension value of 0 would refer to the patient being able to extend the knee fully, and an extension value of 10 would imply a fixed flexion deformity of 10 degrees.

To assess the impact of the procedure on each patient's quality of life, individual components of the Short-Form 36 (SF-36) health survey were captured, and the composite Physical Component Summary (PCS) and Mental Component Summary (MCS) were calculated. The SF-36 is a multipurpose short-form health survey which yields physical and mental health summary measures. The PCS of the SF-36 correlates well with physical functioning and pain while the MCS of the SF-36 correlates well with mental health and social functioning.

Postoperative variables captured included the OKS, ROM, knee and function score as well as the PCS and MCS calculated from SF-36 scores.

Patient satisfaction scores were recorded on a Likert scale of 1 to 6, with 1 representing excellent satisfaction and 6 representing extreme dissatisfaction. This was adapted from Question 53 of the North American Spine Society Questionnaire. In order to capture a binary score, the overall satisfaction grade was categorised into 2 groups – patients who answered 1, 2, and 3 were assigned to the satisfied group while those who answered 4, 5, and 6 were assigned to the dissatisfied group.

In order to capture qualitative insight into the reasons for patients' dissatisfaction, all patients who had indicated dissatisfaction during their assessments were invited to elaborate on the reasons for their dissatisfaction. The reasons each patient provided were subjective; no formal questionnaire was used during this process. These reasons were categorised into 4 main headings: pain, stiffness, weakness, and others. These categories were based on clinical experience from previous patients' responses during follow-up sessions, as well as predominance of pain, stiffness and weakness as keywords within patient's complaints. These complaints were allowed to be assigned to more than 1 category.

All data, including preoperative and postoperative variables as well as reasons for dissatisfaction, were prospectively collected by hospital staff from the Orthopaedic Diagnostic Centre.

Statistics

The demographic and clinical profiles of participants were summarised by using the mean and standard deviation. A two-sample t-test was used to assess whether demographic and clinical characteristics were associated with non-respondent status.

Simple logistic regression was performed on both preoperative and postoperative variables with patient dissatisfaction as the dependent variable. Multiple logistic regression model was obtained through a model-building process where the stepwise algorithm with Akaike information criterion (AIC) begins with a null model (i.e. a model with no predictors). The AIC was used to select the multiple logistic regression model because it favoured models with better fit and penalised overfitting.

In each step of the model-building process, predictors were added and removed from the model based on the AIC. The model-building process stopped when the removal or insertion of any variable did not result in an improvement in fit. The same steps were taken to identify the factors for dissatisfaction where the predictors considered were preoperative.

The odds ratios and the 95% confidence intervals were reported. A P value less than 0.05 was considered significant. The statistical analyses were performed with R.[15]

Results

A total of 2643 (out of 3069) were available for analysis with complete follow-up for 2 years (i.e. lost to follow-up rate of 13.8%). These 2643 TKAs were performed on 2483 patients with 160 of them having bilateral TKAs performed in the same setting. We will refer to this group of patients followed up for the complete 2-year period as the responder group while the group of patients we failed to follow-up on will be the non-responder group.

Data on Patients

The mean preoperative age, BMI, knee ROM and knee score values are reported for the responder and non-responder groups in Table 1. These variables were then compared using a two-sample t-test to see whether there was any significant difference between patients in these 2 groups.

Although there were statistically significant differences in preoperative BMI, OKS and functional score between the responder and non-responder groups, the absolute difference between the means were small, suggesting that the differences were unlikely to be of clinical significance. For example, the difference in mean OKS between the responders versus the non-responders is 1, which is less than the minimum clinically important difference in OKS after TKA, which is reported to be 5.0.[16]

There was no significant difference (P >0.05) in satisfaction between patients who had PS implants versus those with CR implants.

Table 1. Patient Demographics and Clinical Parameters at Baseline

Demographics	Responders (n = 2483)		Non-Responders (n = 426)		Comparison
	Mean	SD	Mean	SD	*P* for Two-Sample t-Test
Age (years)	67	8	67	9	0.715
BMI	27.8	4.7	28.7	5.5	0.002
Preoperative extension of knee (degrees)	7.1	7.3	7.8	8.3	0.114
Preoperative flexion of knee (degrees)	117.5	18.2	117.9	18.1	0.695
Preoperative OKS (points)	35	8	36	8	0.011
Preoperative knee score of the Knee Society Clinical Rating Score (points)	38	18	37	18	0.058
Preoperative functional score of the Knee Society Clinical Rating Score (points)	53	17	50	19	0.002
Preoperative PCS (points)	32	10	31	10	0.094
Preoperative MCS (points)	53	10	53	10	0.986

BMI: Body mass index; MCS: Mental Component Summary of Short Form-36 Health Survey Score; OKS: Oxford Knee Score; PCS: Physical Component Summary of Short Form-36 Health Survey Score; SD: Standard deviation

Clinical Results

The overall patient satisfaction rate at 2 years postoperatively was 91.3%. The breakdown of the respondents' satisfaction scores can be seen in Table 2. As mentioned above, patients with scores 1 to 3 were categorised as satisfied while those with scores 4 to 6 were categorised as dissatisfied postoperatively.

The preoperative variables significantly associated with patient dissatisfaction at 2 years were female gender, undergoing unilateral (instead of bilateral) TKA, having a poorer preoperative MCS, and most notably, having better preoperative flexion of the knee (Table 3). Age and BMI were not shown to be associated with patient dissatisfaction at both 6 months and 2 years.

The postoperative variables that were significantly associated with patient dissatisfaction at 2 years included poor OKS at both 6-month as well as 2-year intervals, poor flexion of knee at 6 months, and poorer knee score, MCS and PCS at 2 years.

Among the 229 patients who were dissatisfied, 157 (68.6%) provided comments regarding their dissatisfaction and these comments were categorised into 4 broad categories: pain, stiffness, weakness and others. Comments from a single patient could fall into more than 1 category.

Among these 157 dissatisfied patients who provided comments, 85 patients had indicated pain (54.1%), 27 indicated stiffness (17.2%), 16 indicated weakness (10.2%) and 45 indicated others (28.7%). Examples of complaints falling under the "others" category included non-specific numbness over the operated knee, the feeling of a non-native knee, occasional clicking sounds arising from the operated knee, as well as subjective instability of the operated knee resulting in limitation of daily activities. These percentages do not total up to 100% as some of the patients' complaints fell into more than 1 category.

No significant preoperative factors were found to be associated with pain or stiffness as an attributor to dissatisfaction at 2 years postoperatively. Increased age and a poorer preoperative PCS were significantly associated with weakness as an attributor to dissatisfaction at 2 years postoperatively (Table 4).

Discussion

In our study, we have demonstrated changes in objective and subjective clinical outcomes for patients who underwent primary TKA. Consistent with other studies, our centre

Table 2. Breakdown of Satisfaction Scores

Likert Scale	1	2	3	4	5	6
Number of responders	637	916	703	166	37	24
Categorisation		Satisfied			Dissatisfied	
Number of responders		2256			227	

Table 3. Factors Associated with Patient Dissatisfaction at 2 Years

Variables	OR	95% CI	*P* Value
Preoperative Variables			
Female gender	1.621	(1.095, 2.398)	0.015
Unilateral TKA	1.767	(1.057, 2.950)	0.030
Poorer MCS	1.038	(1.026, 1.052)	<0.001
Better preoperative flexion of knee	1.008	(1.001, 1.016)	0.043
Postoperative Variables			
Poorer flexion of knee at 6 months	1.013	(1.025, 1.003)	0.01
Poorer OKS at 6 months	1.042	(1.007, 1.079)	0.02
Poorer OKS at 2 years	1.123	(1.078, 1.170)	<0.01
Poorer preoperative knee score of the Knee Society Clinical Rating Score at 2 years	1.022	(1.010, 1.035)	<0.01
Poorer MCS at 2 years	1.025	(1.040, 1.010)	<0.01
Poorer PCS at 2 years	1.030	(1.010, 1.050)	<0.01

CI: Confidence interval; MCS: Mental Component Summary of the Short Form-36 Health Survey Score; OKS: Oxford Knee Score; OR: Odds ratio; PCS: Physical Component Summary of Short Form-36 Health Survey Score; TKA: Total knee arthroplasty

Table 4. Factors Associated with Patient Complaint of Weakness at 2 Years

Variable	*P* Value	OR	CI
Increased Age	0.028	1.090	(1.009, 1.178)
Poorer PCS	0.048	1.059	(1.001, 1.122)

CI: Confidence interval; OR: Odds ratio; PCS: Physical Component Summary of Short Form-36 Health Survey Score

had a low percentage of dissatisfaction with TKA. The top 3 reasons stated by our Asian patient cohort were pain, stiffness and weakness. Other less common reasons stated by patients included, for example, non-specific numbness and the feeling of a non-native knee.

Our data demonstrated that undergoing bilateral (as opposed to a unilateral) TKA appeared to be associated with improved patient satisfaction at 2 years postoperatively. However, the outcomes of bilateral TKA appear to be mixed within the current literature. Bagsby et al found significantly higher postoperative functional outcomes including total ROM, knee flexion and function score in patients who underwent bilateral TKA as opposed to unilateral TKA.[17] The authors hypothesised that this was related to the absence of contralateral arthritis that produce painful and restricted rehabilitation. March et al found that patients who underwent bilateral TKA reported significantly better physical and social functions, reduced pain, and better general and mental health than those undergoing unilateral TKA.[18] On the other hand, Zeni JA Jr et al performed a matched pair analysis between simultaneous bilateral TKA and unilateral unicompartmental knee arthroplasty and found comparable postoperative functional scores between the 2 groups.[19] Multiple studies have also reported increased perioperative complications associated with bilateral TKAs including deep venous thrombosis, fat emboli and increased blood transfusion requirements.[20,21] Therefore we would recommend patients to be adequately counselled regarding the operative risks, and undergo appropriate patient selection prior to undergoing simultaneous bilateral TKA.[22]

Interestingly, patients with better flexion of the knee preoperatively were more likely to be dissatisfied postoperatively. There are studies that had debated the importance of poor postoperative flexion as a predictor for patient dissatisfaction, whereas there is considerably less literature on preoperative range of motion.[23,24] Fortin et al found that patients with lower preoperative physical function were not improved postoperatively to the level achieved by those with higher preoperative function.[25] Lingard et al demonstrated the strong influence of preoperative Western Ontaria and McMaster Universities Arthritis Index (WOMAC) function score on postoperative outcomes at 1 and 2 years, stating that patients with a preoperative WOMAC function score in the lowest quartile were over 4 times more likely to have a score of ≤60 at 2 years following surgery than were patients in the other groups, indicating moderate functional limitation.[26] These 2 studies suggest that poor preoperative function would be linked to poor postoperative outcomes. On the other hand, the Swedish Joint Registry Study found that there was a proportional distribution of satisfaction related to the chronicity of disease state prior to arthroplasty.[2] Those with long-standing disease were more often satisfied; Dunbar et al[1] commented that patients compare their postsurgery state with their concept of a pre-diseased knee state of health. Hence, fully healthy people may be dissatisfied with a well functioning TKA,

whereas a patient with chronic disease would likely compare the result of surgery with their preoperative diseased state, resulting in a greater perception of satisfaction. We feel that patients with higher preoperative knee flexion are likely to be more active and with higher expectations of surgery, which may contribute to dissatisfaction even from a well functioning TKA. Despite the low odds ratio, it could be an important preoperative phenomenon to be considered by the orthopaedic surgeon during planning of surgery.

Poorer validated knee scores such as the OKS correlated with postoperative dissatisfaction at both 6 months and 2 years. We also considered changes in these scores between 6 months and 2 years, but they were not found to be significantly associated with postoperative dissatisfaction (results not shown). This finding was in line with a recent study performed on Korean subjects which showed that absolute postoperative scores were better correlated with patient satisfaction than preoperative to postoperative changes for all scales.[27] The authors have suggested that this may be attributed to patients revising their goals and expectations postoperatively.

Poor postoperative knee flexion at 6 months was also a predictor of patient dissatisfaction at 2 years postoperatively. This was also similar to another Asian study by Matsuda et al, which concluded that although patient satisfaction was difficult to measure, achieving better ROM appeared to be important for increasing patient satisfaction and meeting patient expectations.[28] The importance of early postoperative knee flexion has previously been demonstrated in a Western population by Williams et al, who described knee flexion at 3 months to be a significant predictor of subsequent 12-month satisfaction.[24]

After eliciting the reasons for dissatisfaction from interviewing dissatisfied patients, we found that poorer preoperative PCS and older age are significant factors associated with subjective postoperative weakness; however, statistical analysis did not reveal any preoperative variables associated with post-TKA pain and stiffness. Exploration into this area would be a major contribution to patient outcomes, as a painful TKA is known to be a major predictor of patient dissatisfaction, yet its aetiology remains elusive.[3,29]

With the above knowledge, orthopaedic surgeons can aim to optimise patient outcomes by firstly, considering bilateral TKA as a viable option in appropriately selected patients. Secondly, achieving improved knee flexion early on in the patient's recovery, such as by the 6-month mark, may result in improved patient satisfaction even after 2 years. Finally, a thorough preoperative assessment of patients can be performed, allowing surgeons to pick up factors such as good preoperative knee flexion, poorer preoperative PCS and older age. This would allow the surgeons to counsel the patients accordingly with regards to their expectations of surgery as well as possible postoperative complaints such as weakness.

The strength of our study lies in the comprehensive collection of preoperative, intraoperative and postoperative variables from the patient population with a low drop-out rate; this allowed for robust multivariate analyses to estimate the impact of these variables on measured outcomes. Furthermore, our study was conducted in a single institution, with similar rehabilitation regimes arranged for all patients postoperatively.

One weakness of this study is the limited sample size, which may explain the lack of factors significantly associated with subjective postoperative pain and stiffness. With a bigger sample size, results may be more comprehensive. An improvement to the study could also be made by capturing the incidence of pain, weakness and stiffness in patients satisfied with their surgery; this would allow surgeons to understand if these adverse symptoms are uniquely associated with dissatisfaction or common to both patient groups.

Although this study is conducted in a single tertiary centre, varying surgical techniques employed by different surgeons as well as varying choice of implant may introduce heterogeneity in the observed outcomes. Future studies would be necessary to address these limitations, with recommendations such as using standardised implants and incorporating preoperative and postoperative radiological assessments.

Conclusion

Overall, we report high patient satisfaction of 91.3% for TKA in an Asian multiracial population. The top reason for postoperative dissatisfaction appears to be residual pain; further research into this area may eventually reveal predictors of subjective complaints, thus allowing orthopaedic surgeons to the target problem areas and maximise patient satisfaction.

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Original Article

Reversible Causes in Cardiovascular Collapse at the Emergency Department Using Ultrasonography (REVIVE-US)

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Abstract

Introduction: Ultrasonographic evaluation of patients in cardiac arrest is currently not protocolised in the advanced cardiac life support (ACLS) algorithm. Potentially reversible causes may be identified using bedside ultrasonography that is ubiquitous in most emergency departments (EDs). This study aimed to evaluate the incidence of sonographically detectable reversible causes of cardiac arrest by incorporating an ultrasonography protocol into the ACLS algorithm. Secondary objectives include rates of survival to hospital admission, hospital discharge, and 30-day mortality. Materials and Methods: We conducted a prospective study using bedside ultrasonography to evaluate for potentially reversible causes in patients with cardiac arrest at the ED of National University Hospital, Singapore, regardless of the initial electrocardiogram rhythm. A standardised ultrasonography protocol was performed during the 10-second pulse check window. Results: Between June 2015 and April 2016, 104 patients were recruited, corresponding to 65% of all out-of-hospital cardiac arrest patients conveyed to the ED. Median age was 71 years (interquartile range, 55 to 80) and 71 (68.3%) patients were male. The most common rhythm on arrival was asystole (45.2%). Four (3.8%) patients had ultrasonographic findings suggestive of massive pulmonary embolism while 1 received intravenous thrombolysis and survived until discharge. Pericardial effusion without tamponade was detected in 4 (3.8%) patients and 6 (5.8%) patients had intra-abdominal free fluid. Twenty (19.2%) patients survived until admission, 2 of whom (1.9%) survived to discharge and beyond 30 days. Conclusion: Bedside ultrasonography can be safely incorporated into the ACLS protocol. Detection of any reversible causes may alter management and improve survival in selected patients.

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Key words: Advanced cardiac life support, Heart arrest, Hospital

Introduction

Cardiac arrest, the sudden cessation of heart contractility and effective cardiac output, carries a very high mortality rate regardless of an out-of-hospital or in-hospital setting. There are more than 350,000 patients who suffer an out-of-hospital cardiac arrest (OHCA) annually in the United States alone,[1] while the incidence in Singapore is around 1500 cases per year.[2] The rate of in-hospital cardiac arrest ranges from 0.17 to 0.26 events per bed-year, with higher event rates occurring in hospitals with fewer beds.[3] Survival to discharge in OHCA varies from 2% to 11% depending on the continent, with Asia having the lowest survival rate of only 2%.[4] In Singapore, the survival rate to discharge is 3.9%.[5] In a Japanese study, survival with neurologically favourable outcomes is even lower at 2.2%.[6]

The use of bedside echocardiography by non-cardiologists first gained clinical interest more than 20 years ago.[7] Since then, it has garnered increasing use and attention among novice sonographers in the evaluation of the critically ill. From the year 2001, bedside point-of-care ultrasonography has evolved to include systematic sonographic evaluation for other abnormalities such as abdominal aortic aneurysm and intra-abdominal free fluid in the haemodynamically unstable patient.[8] Subsequently, more well established protocols such as Rapid Ultrasound in SHock (RUSH),[9] Bedside Lung Ultrasound in Emergency (BLUE)[10] and

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Extended Focused Assessment using Sonography in Trauma (EFAST)[11] have been widely used for the evaluation of hypotensive, dypsnoeic and trauma patients, respectively. Such protocols utilise point-of-care bedside ultrasonography to guide management.

Potentially reversible causes of cardiac arrest such as massive pulmonary embolism, cardiac tamponade and tension pneumothorax can be readily detected and images accurately interpreted by non-experts using ultrasonography.[12,13] The main concern about bedside ultrasonography, especially of the thorax, is the increase in no-flow interruptions (in order to obtain images) while a patient is undergoing cardiopulmonary resuscitation (CPR). Therefore, a critical challenge would be to devise a well defined ultrasound protocol that not only is able to acquire interpretable images comprehensively but also minimises pauses in chest compressions. This would enable better coordination with ongoing resuscitative efforts and identifying causes of the cardiac arrest that may be amenable to emergent interventions, thus improving the chances of survival.

Most previous studies focused on the use of echocardiography alone in resuscitation,[12,14-16] while ultrasonographic evaluation of the abdomen during resuscitation was mainly studied in traumatic arrest.[17] Hernandez et al derived an algorithm to incorporate both echocardiography and lung views for evaluation in cardiac arrest but its applicability was not evaluated in clinical practice.[18] The objective of our study entitled "REVersible causes In cardioVascular collapse at the Emergency department using UltraSonography (REVIVE-US)" was to evaluate the incidence of reversible causes by incorporating an all-encompassing bedside ultrasonography protocol into the advanced cardiac life support (ACLS) algorithm with no interruptions to cardiac compressions. Secondary objectives were to evaluate the rates of survival to hospital admission, hospital discharge and 30-day mortality.

Materials and Methods

Study Design and Setting

This prospective study was conducted from June 2015 to April 2016 in the Emergency Department (ED) of National University Hospital, Singapore. The ED is situated in a 1100-bed tertiary academic medical centre that receives over 110,000 attendances annually, of which about 47% of the cases require urgent (42.5%) or immediate (4.5%) care. Ethics approval was obtained from the local ethics review board for waiver of consent followed by delayed informed consent from the patient (after recovery) or their legally acceptable representative.

OHCAs were managed by emergency medical services as per ACLS protocols that included early defibrillation using automated external defibrillators, chest compressions with LUCAS™ 2 (a mechanical chest compression device), ventilation using laryngeal mask airways and intravenous or intraosseous administration of adrenaline prior to arrival in the ED.

Selection Criteria

Inclusion criteria were patients aged at least 21 years who arrived in the ED in cardiac arrest regardless of initial electrocardiographic rhythm. Exclusion criteria were pregnant women and terminally ill patients where resuscitation efforts were deemed to be inappropriate or futile by the attending physician.

Ultrasonography Training

A structured training programme for credentialing in bedside ultrasonography was formulated for emergency medicine specialists and residents beginning from their junior residency year. Every participant had to go through a lecture followed by hands-on training sessions on simulated and real patients. At the end of their training, all participants were required to pass a multiple choice question test to ensure their understanding of anatomy, image interpretation and decision-making skills. Competency was achieved after the participants had completed the training programme, passed the test and performed 25 scans for each organ system (for example, cardiac, lung and aorta), 5 of which were done under direct observation (Direct Observation of Procedural Skills) by the ultrasound programme director.[19] This was to ensure good probe handling techniques, accurate image acquisition and interpretation skills.

The bedside ultrasonography protocol in this study was subsequently only performed by senior residents and above who had completed the training programme.

Ultrasonography Protocol

The protocol for bedside ultrasonographic evaluation during resuscitation of patients in cardiac arrest is shown in Figure 1. The protocol included the evaluation for presence or absence of cardiac wall motion, pericardial effusion with or without tamponade, pneumothorax, free fluid in the abdomen, aortic dissection or aneurysm, femoral deep vein thrombosis (DVT) and regional wall motion abnormalities and ventricular sizes, if return of spontaneous circulation (ROSC) was achieved. The presence of ultrasonographic signs of right heart strain (i.e. dilated right ventricle and straightened interventricular septum) would suggest that massive pulmonary embolism could be a possible cause for the cardiac arrest. The protocol was implemented using

the SonoSite Edge II (Fujifilm SonoSite, Inc., Bothell, WA) and Terason (Teratech Corporation, Burlington, MA) ultrasound scanners.

The evaluation of inferior vena cava (IVC) size and collapsibility or distensability was not included in the protocol as evidence had shown that assessment of the IVC in an intubated patient with ongoing chest compressions is likely to be fraught with misinterpretation.[20] Detection of free fluid in the abdomen was performed using the right hypochondrium, left hypochondrium and suprapubic views. Abdominal ultrasonography with evaluation of the abdominal aorta and presence or absence of intra-abdominal free fluid, lung sliding and femoral DVT were performed during ongoing chest compressions (Fig. 1).

Ultrasonographic assessments of the heart and lung were performed only during pulse checks and limited to less than 10 seconds to avoid unnecessary interruptions to chest compressions, which is in congruence with guidelines recommended by the ACLS committee.[21] Evaluation of the aorta and intra-abdominal free fluid was done with ongoing chest compressions to avoid disruptions. As part of the department's resuscitation protocol, a scribe nurse was designated to be in charge of time-keeping and documentation. An emergency physician who was not part of the study team led the resuscitation. Once the resuscitation leader assessed that further resuscitation efforts were to be continued (for instance, defibrillation was required for a shockable rhythm or chest compressions were to be continued for those in asystole) or if the 10-second limit was reached, whichever occurred earlier, bedside ultrasonographic assessment would cease.

The scanning physician reviewed the ultrasound images and conveyed the findings to the managing team. Subsequent treatment rendered was based on the clinical evaluation and decision of the resuscitation team.

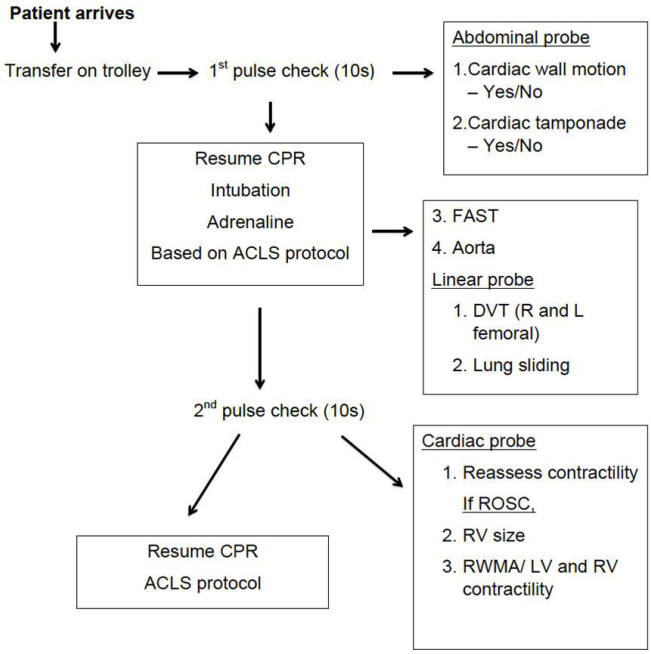

Fig. 1. Ultrasonography protocol. ACLS: Advanced cardiac life support; AP4: Apical 4 chamber; CPR: Cardiopulmonary resuscitation; DVT: Deep venous thrombosis; FAST: Focused assessment using sonography in trauma (views include hepatorenal, splenorenal and suprapubic views for intra-abdominal free fluid); PSL: Parasternal long; PSS: Parasternal short; ROSC: Return of spontaneous circulation; RV: Right ventricle; RWMA: Regional wall motion abnormality; LV: Left ventricle.

Data Collection

Data was collected using a standardised data collection form. Variables including age, gender, ethnicity, initial rhythms at scene and in ED, ultrasound findings and survival to admission were entered into the data collection form by the scanning physician. Patients who survived to admission were followed up for discharge outcome and survival at 30 days after informed consent was obtained.

Statistical Analysis

The primary outcome measure is the incidence of reversible causes detected on ultrasonography. Secondary outcomes include survival to hospital admission, survival to hospital discharge and 30-day mortality. Categorical data are reported in frequency and percentages, while continuous data were reported as mean (standard deviation [SD]) or median (interquartile range [IQR]) as appropriate. Parametric variables were analysed using Student's t-test and non-parametric variables were analysed using Mann-Whitney U test. Statistical significance was set at $P < 0.05$. Binary logistic regression was used to obtain odds ratio estimates with 95% confidence intervals (CI). Data analyses were performed with Stata 14 (StataCorp LP, College Station, TX).

Results

A total of 104 patients were recruited over a period of 10 months between June 2015 and April 2016, corresponding to 65% of out-of-hospital cardiac arrest patients seen in our ED who were eligible for inclusion into this study during the corresponding period (Fig. 2). Patients were predominantly male (68.3%) with a median age of 71 (IQR: 55 to 80) years. The majority (45.2%) of patients were found to be in asystole by paramedics at scene and in the ED (Table 1).

Ultrasound Findings

The incidence of potentially reversible causes (composite

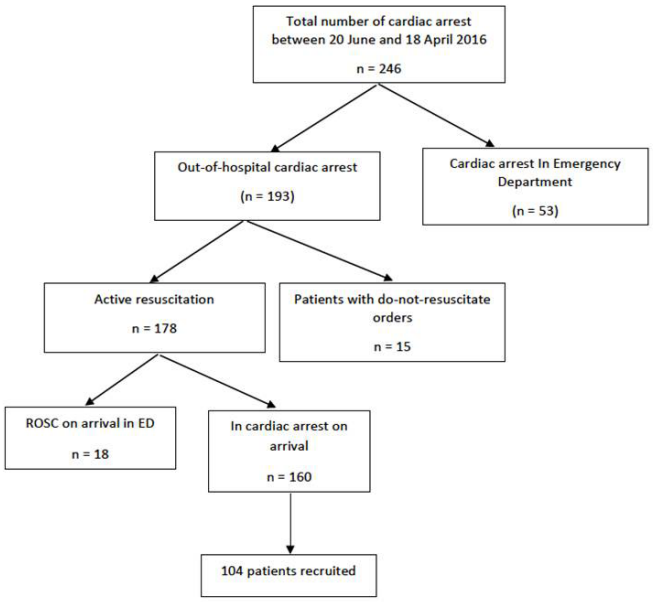

Fig. 2. Recruitment flowchart.

Table 1. Characteristics of Patients

Characteristics	Number of Patients, n (%)
Gender	
Male	71 (68.3)
Female	33 (31.7)
Ethnicity	
Chinese	71 (68.3)
Malay	16 (15.4)
Indian	9 (8.7)
Others	8 (7.7)
Ventilation via LMA (pre-hospital)	
No	21 (20.2)
Yes	81 (77.9)
Unknown	2 (1.9)
Initial rhythm at scene	
VF	17 (16.4)
Asystole	47 (45.2)
PEA	33 (31.7)
Other rhythms	7 (6.7)
Initial rhythm on arrival in ED	
VF	10 (9.6)
Asystole	57 (54.8)
PEA	32 (30.8)
Other rhythms	5 (4.8)

ED: Emergency department; LMA: Laryngeal mask airway; PEA: Pulseless electrical activity; VF: Ventricular fibrillation

of pericardial effusion and pulmonary embolism) was 7.7% (n = 8).

Straightening of interventricular septum ('D' sign) in the presence of a dilated right ventricle suggestive of massive pulmonary embolism as the cause of cardiac arrest was found on ultrasonography in 4 out of 35 (11.4%) patients with ROSC (Table 2). One of these patients received intravenous thrombolysis with alteplase and survived to discharge from hospital. The same patient also had a positive DVT scan of the right femoral vein.

Four (3.8%) patients had pericardial effusion without tamponade detected on ultrasonography (Table 2). However, no intervention was carried out by the resuscitation team after clinical considerations and feasibility.

Presence of cardiac wall motion was detected in 26 (25.0%) patients on initial ultrasonographic assessment (Table 2). This was significantly associated with survival to hospital admission (Table 3). Patients with asystole and pulseless electrical activity (PEA) as initial rhythms in the ED with presence of wall motion seen on ultrasonography were more likely to survive until hospital admission (Table 4).

Intra-abdominal free fluid was present in 6 (5.8%) patients, all of whom experienced non-traumatic cardiac arrest and had underlying medical conditions such as ascites or renal failure. One patient had an aneurysmal abdominal aorta but without accompanying free fluid in the abdomen to suggest an aneurysmal rupture as the cause of the cardiac arrest.

There were 20 (19.2%) patients who survived to hospital admission but only 2 (1.9%) survived until discharge from hospital and beyond 30 days. The overall survival rate was 1.9% (2/103; 1 patient's next-of-kin declined consent for follow-up of discharge outcomes). The initial cardiac rhythm at scene and on arrival to the ED did not predict survival to hospital admission (Table 3).

Discussion

Although ultrasonography has been recommended for the detection of reversible causes of cardiac arrest during resuscitation in the 2015 ACLS guidelines, concerns remain on whether its use would delay and compromise the quality of chest compressions given the lack of a structured protocol.[22] In our REVIVE-US study, we successfully devised and implemented a bedside ultrasonography protocol in keeping with the acceptable 10-second pauses for pulse checks during CPR. Potentially reversible causes of massive PE and pericardial effusion constituted 7.7% of the study population from more than 90% of interpretable images.

Since no gold standard diagnostic tests are available for some of the reversible causes of cardiac arrest, ultrasonography is a useful modality and easily available diagnostic tool in time-sensitive situations. Laboratory tests,

Table 2. Ultrasound Findings

Ultrasound Findings	Number of Patients, n (%)
Wall motion present	
Yes	26 (25.0)
No	75 (72.1)
Unable to assess	3 (2.9)
Pericardial effusion	
Yes	4 (3.8)
No	98 (94.2)
Unable to assess	2 (1.9)
Cardiac tamponade	
Yes	0
No	103 (99.0)
Unable to assess	1 (1.0)
Presence of intra-abdominal free fluid	
Yes	6 (5.8)
No	97 (93.3)
Unable to assess	1 (1.0)
Aorta	
Normal	94 (90.4)
Aneurysmal	1 (1.0)
Unable to assess	9 (8.7)
Pneumothorax	
Yes	0
No	99 (95.2)
Unable to assess	5 (4.8)
DVT	
No DVT/femoral veins compressible	94 (90.4)
DVT/femoral veins not compressible	1 (1.0)
Unable to assess	9 (8.6)
RV size (for patients with ROSC) (n = 35)	
Dilated RV with straightened IVS	4 (11.4)
Normal RV size	28 (80.0)
Unable to assess	3 (8.6)

DVT: Deep vein thrombosis; IVS: Interventricular septum; ROSC: Return of spontaneous circulation; RV: Right ventricle

Table 3. Survival to Admission

	Survived Until Admission, n (%)	Odds Ratio (95% CI)	*P* Value
Initial cardiac rhythm at scene			0.387
VF	5 (25.0)	1.00	
Asystole	6 (30.0)	0.35 (0.09 to 1.35)	
PEA	8 (40.0)	0.77 (0.21 to 2.85)	
Others*	1 (5.0)	0.40 (0.15 to 1.18)	
Initial cardiac rhythm in ED			0.627
VF	2 (10.0)	1.00	
Asystole	9 (45.0)	0.75 (0.14 to 4.13)	
PEA	7 (35.0)	1.12 (0.19 to 6.52)	
Others*	2 (10.0)	2.67 (0.25 to 28.4)	
Presence of wall motion on US			<0.001
Yes	13 (72.2)	14.0 (4.26 to 46.0)	
No	5 (27.8)	1.00	

ED: Emergency department; PEA: Pulseless electrical activity; US: Ultrasound; VF: Ventricular fibrillation

*Other rhythms include unknown, sinus or idioventricular rhythms for patients who had cardiac arrest en route to ED during ambulance transfer.

Table 4. Presence of Wall Motion in Patients with PEA and Asystole

Initial Rhythm in ED	Wall Motion Present	Survived until Admission	*P* Value
Asystole (n = 57)	Yes (n = 13, 22.8%)	6/13 (46.2%)	0.003
	No (n = 44, 77.2%)	3/44 (6.8%)	
PEA (n = 30)	Yes (n = 7, 23.3%)	4/7 (57.1%)	0.01
	No (n = 23,76.7%)	2/23 (8.7%)	

ED: Emergency department; PEA: Pulseless electrical activity

such as D-dimer, are non-specific for pulmonary embolism and have an unacceptable turnaround time to results in resuscitation situations. A patient in extremis would be too unstable for transport to undergo definitive imaging such as computed tomography of the pulmonary vessels or a ventilation-perfusion scan.[23] Clinical assessment with history and physical examination is also limited either due to lack of corroborative history or absence of signs when there is circulatory shutdown. For example, findings of muffled heart sounds and distended neck veins in pericardial effusion or unilateral decreased breath sounds in pneumothorax are difficult to be detected in the absence of spontaneous circulation and respiration. Emergency physicians who are non-experts in ultrasonography can be adequately trained to obtain interpretable images.[12,16] With appropriate training, emergency physicians can obtain ACLS-based echocardiographic images to identify pathology within 5 seconds and pneumothorax images within 3 seconds.[13]

Our study results demonstrated that the presence of cardiac wall motion was associated with higher odds of survival; this is in congruence with results from other studies.[24-27] However, the incidence of reversible causes detected in our study population was low. Nonetheless, in view of a low survival to discharge rate of 3.9% in the

local population,[5] detection of any reversible cause with prompt treatment would make a significant difference to each patient's chances of survival. Timely administration of intravenous thrombolysis in patients with PEA due to massive PE has also been shown to achieve high rates of ROSC and survival with good neurological recovery.[28]

That being said, the intervention rate for detectable causes in our study cohort was marginal. For instance, the resuscitation team did not undertake any aggressive intervention for the 4 patients with pericardial effusion. As echocardiographic features of cardiac tamponade may not always be present during arrest states, the presence of a pericardial effusion should prompt consideration for pericardial drainage.[29] There is a generally low risk of complications associated with ultrasound-guided pericardiocentesis.[29] Further training of emergency physicians in ultrasound-guided pericardiocentesis should be considered. Familiarisation with this procedure may increase the confidence of clinicians and likelihood of intervention. Pericardiocentesis in the presence of pericardial effusion during cardiac arrest has been shown to increase survival rate to hospital discharge from a baseline of 1.3% to 15.4% among this group of patients in a large study in the United States by Gaspari et al.[24]

Our study has several limitations. First, there is currently no gold standard for interpretation of ultrasound images during cardiac arrest. Radiologists trained in ultrasound interpretation may not be adept in evaluating images obtained during cardiac arrest states. It is also impractical to station a radiologist in the ED for the purpose of interpretating and performing ultrasound images on cardiac arrest patients. There have been multiple previous studies to show that novice sonographers can be trained in as short as 1 day to obtain images of diagnostic quality.[13,30] Second, the images were not reviewed independently due to practical limitations. The scanning physicians may not have time to save images in a standardised format during resuscitation for subsequent evaluation. However, the scanning physicians in this study were senior staff who had completed the structured training programme for credentialing in bedside ultrasonography. Furthermore, as this was a pragmatic study mimicking real world scenarios, accredited scanning physicians were expected to obtain, interpret and act on the images as they would have during their daily practice. Due to lack of confirmatory tests and post-mortem reports for all patients, we could not exclude missed pathology or false-positive findings.

Third, the setting of the study in a single tertiary centre may limit generalisability worldwide. The emergency medicine community in Singapore does have regular ultrasonography training programmes conducted annually. By collaborating across hospitals through our ultrasound programme director, the protocol utilised in this study may be incorporated into the training curriculum and in other institutions, thus enabling applicability to all institutions locally. Future prospective multicentre studies can be explored to further characterise the incidence of reversible causes of cardiac arrest nationally and internationally.

Fourth, we were not able to ascertain the true incidence of reversible causes of cardiac arrest as 35% of eligible patients (56/160) were not recruited. Although we were unable to ascertain the underlying reasons, we postulate that the lack of available credentialed staff in the midst of a busy shift during the resuscitation and lenient enforcement of the study protocol may have led to this less than desirable result. Nevertheless, audit data from departmental statistics of OHCA cases during the corresponding period reported a 1.6% (26/160) survival rate, which was not significantly different from our study cohort of 1.9%. Hence, recruitment of the rest of the arrest patients was unlikely to increase the positive detectable conditions significantly. As all the cases were out-of-hospital cardiac arrest cases, those excluded are unlikely to differ significantly in terms of prognostic factors in the incidence of reversible causes. In our personal communications with the department's OHCA and mortality auditor (unpublished data from departmental clinical audit on OHCA cases in Emergency Medicine Department, National University Hospital, Singapore), there were no final diagnoses of pulmonary embolism or pericardial effusion for the other 56 cases that were not recruited during the study period.

Lastly, as this was designed to be an observational study, we did not mandate the interventions to be performed for any positive reversible cause detected. All interventions were based on the clinical judgment of the managing team. As such, the intervention rate was dismal. However, as a result of this study's findings, we were able to identify areas of deficiency where further training could be carried out.

The strengths of our study included the use of a protocol that incorporated evaluation of all possible reversible causes that could be diagnosed by ultrasonography. By integrating this into the ACLS protocol for resuscitation, the evaluation of the cardiac arrest patient would be more thorough and exhaustive, potentially allowing for timely detection of treatable causes. More importantly, by restricting the time of image acquisition to less than 10 seconds during pulse checks, it does not compromise the quality of chest compressions. With ease of training and widespread availability of ultrasonography, evaluation of arrest patients with ultrasound should be part of the resuscitation management algorithm and can be extended to both OHCA and in-hospital cardiac arrest patients. In addition, we have since established a regular simulation training programme for pericardiocentesis with the help of

cardiologists to address this need. All senior staff have been accredited with capabilities to perform ultrasound-guided pericardiocentesis.

Conclusion

Bedside ultrasound assessment during CPR in cardiac arrest is feasible and can be safely incorporated into the ACLS protocol with no interruptions to chest compressions. Detection of any reversible causes can potentially alter clinical management and greatly benefit the patient in extremis with increase in chances of survival.

Acknowledgment

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Commentary

Geriatric Surgery Service – Our Journey Piloting in Colorectal Surgery and Future Challenges

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The Geriatric Surgery Service of Khoo Teck Puat Hospital (KTPH) today was born in 2007. The idea arose from a journal article that was written in 2006 where the need for a better way of managing elderly patients through surgery was identified.[1] There was a realisation that elderly surgical patients could not be managed in a similar fashion as younger patients. In elderly patients, comorbidities, functional capacity and frailty interplay with each other. The treatment goals in the elderly may also differ and they need to be more individualised.

The Geriatric Surgery Service was started to deliver the complex and multifaceted care that elderly (>75 years of age) surgical cases demanded. The processes involved in the service were piloted in major colorectal resections performed in our institution. At the start state, the 30-day mortality rate was nearly 10% and major morbidity rate was about 30%. The team started with a surgeon and a nurse coming together to anchor the service and was subsequently expanded to include an anaesthetist, a geriatrician, cardiologist, physiotherapy, dietitian and medical social worker. A pharmacist was also added to the team. The first few cases were managed by a team in Alexandra Hospital before the move to KTPH.

The earlier period of the service involved studying the epidemiology and outcomes of this patient group.[2] An important development was the identification of the deficiencies of multidisciplinary care and the evolution to a transdisciplinary care process. The pitfalls of our multidisciplinary care were identified as such:

a. Failure of the team members to have a common vision or goal.
b. Failure to do the interventions in a timely and coordinated fashion.
c. Poor communication – the only form of communication was often done through entries in case notes.
d. Failure to understand what each in the multidisciplinary team was doing.
e. Lack of ownership to take patients from start to finish as care was fragmented.

The articulation of transdisciplinary care was pivotal in the development of the Geriatric Surgery Service; the use of the word "transdisciplinary" was crucial in helping to understand that multidisciplinary care as we knew it may have been suboptimal in providing care good enough for the elderly. There was a need for a higher evolution of the care to facilitate a more coordinated and seamless process of the entire care team. The transdisciplinary model of care aimed to address the pitfalls that were identified through a flattening of the hierarchy, heightened communication, being more patient-centric and role enhancements of the members of the team. Patients and family also become an integral part of the team. This was with the realisation that patient and family buy-in was crucial to the whole process. Family members provided good support and care that could not be surpassed by any healthcare worker but they needed to be engaged.[3]

There was also a need to not just look at mortality and morbidity as postoperative outcomes but also at functional recovery in the longer term. It was found that many patients in the service were more fearful of disability and loss of independence than death. In 2010, a review of the literature on surgical outcomes of elderly patients who had undergone major surgery was conducted. Many papers had boasted good mortality rates after surgery; however, only few reported on postoperative functional outcomes. One needed to ask the question: what good would surgery do for an elderly individual who survived, yet becomes debilitated and loses independence?[4] The direction then became very clear. There was a need to manage elderly patients with vigour and attention, and the prime motive must be for these patients to return to their original functional ability after major surgery.

The following goals were then set for patients who went through the service: not only should they survive, they should also not have a prolonged hospital stay for any reason, be

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Fig. 1. The 'Start-to-Finish' process of the Geriatric Surgery Service.

it for surgical or medical complications, or social issues. Patients were also expected to have functional recovery within 6 weeks after surgery. If any of these 3 criteria were not achieved, the management was considered a failure. The cumulative sum (CUSUM) curve methodology, a powerful tool that tracks clinical outcomes, was used to assess consecutive cases for success and failure. The difficulty of the cases was adjusted using physiological and operative parameters and measures consistency of obtaining successful outcomes. Through these methods, comparisons could be made between heterogenous groups of patients. It was then demonstrated that with these changes, consistently good outcomes for the elderly patients who passed through the service was achieved. This was in stark contrast to the consistency of patients that were managed in the conventional way.[5]

In 2009, the impact of the entity of frailty on elderly surgical patients was explored. There was an increasing understanding of the condition and how frailty should be considered separately from comorbidities. There was a collaborative study with a Japanese hospital that was subsequently published in the American Journal of Surgery in 2012. It was found that frail patients were 4 times more likely to experience major complications after surgery even after their medical conditions were adequately optimised in the conventional way.[6] Frailty in the elderly represents the reduction of functional reserves in one's body and thus carries a higher risk of precipitous deterioration after the trauma of surgery. This group of patients needed even more preparation before surgery; more attention also needed to be paid to them during the perioperative period and the subsequent postoperative period, including after discharge.

It became clear that rehabilitation should not start after the trauma of surgery but before. Learning how to exercise only when they were experiencing pain with tubes attached to their bodies was suboptimal. A programme was developed through the input of enthusiastic and dedicated nursing, physiotherapy and nutrition support staff together with the surgeons. Areas of focus included education, physical conditioning and attention to nutrition. All these interventions would start weeks before surgery and were followed through after surgery. Post-surgery, there was attention paid to self-care, independence and social integration. Through funding from the Healthcare Quality Improvement Fund, a community-based programme termed 'Start-to-Finish' was developed. This programme spans the continuum from diagnosis all the way to functional recovery and social integration (Fig. 1).

The process starts at the time of diagnosis and does not end until the patient has attained a functional capacity similar to before the disease and has integrated back to society. Perioperative care is much more than "from operating theatre to recovery area". Enhanced recovery was also incorporated into the programme in 2013.

The traditional model of care is shown in Figure 2, in

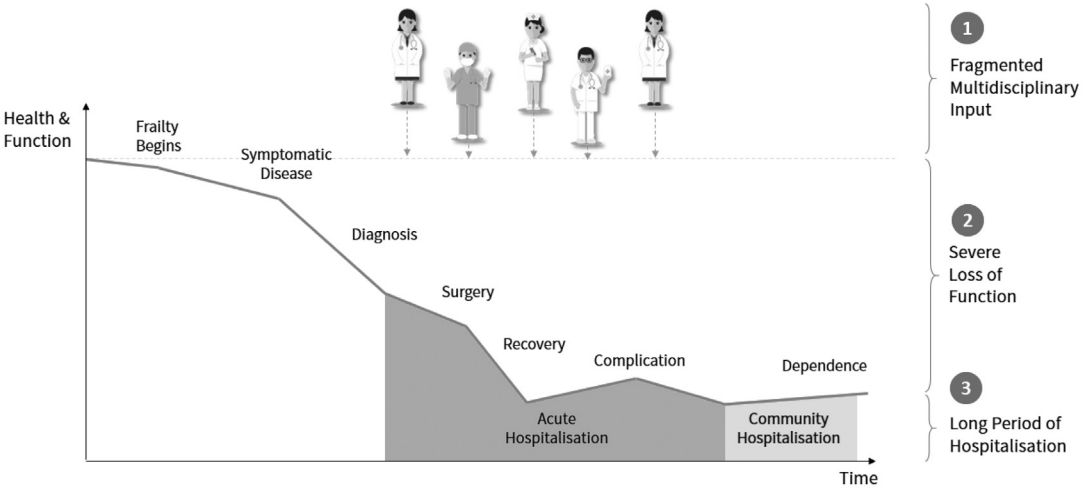

Fig 2. Traditional model of care for elderly surgical patients.

comparison with our current model of care shown in Figure 3.

The programme has now been kept sustainable through continued support from the hospital and involvement with transitional care. It was initially piloted with the major colorectal surgery department but has now been extended to departments of other forms of abdominal surgery. Only through this process from start to finish can the healthcare team ensure good outcomes and eventual good disability-free survival after surgery. The medium-term functional outcomes and subsequently, the long-term outcomes from the 'Start-to-Finish' programme, have been published.[7,8]

Throughout this whole process, major complication rates were reduced from 30.8% to 5.3%. Mortality rate was reduced from 9.6% to 1.7%. Functional recovery is now 98% and for frail elderly patients, the mean length of stay has been reduced from 11.0 days to 8.4 days. This was achieved despite having increased the number of frail patients who were operated on.

Essential milestones of the Geriatric Surgery Service are as follows:

- January 2007: The basic Geriatric Surgery Team was formed. It consisted of a surgeon, nurse, geriatric physician, anaesthetist and cardiologist, and was started with no added resources.
- 2007 to 2009: Processes and protocols were developed for elderly patients of colorectal surgery. A study was done on the epidemiology and outcomes of this patient group.
- 2009 to 2011: Processes were consolidated and the transdisciplinary team was expanded to include more allied health practitioners. The transdisciplinary process was formally described. The results of our study, which demonstrated a sustained pattern of consecutively successful outcomes measured mainly by functional recovery after major surgery through CUSUM methodology, was published.
- 2012: The entity of frailty and the development of new processes, including prehabilitation, were recognised. The transinstitutional 'Start-to-Finish' programme was borne after securing the Healthcare Quality Improvement Fund funding of S$200,000. The textbook 'Colorectal Cancer in the Elderly' was published by Springer.[9]
- 2013: All subspecialties in our institution's Department of General Surgery used similar processes. The study that found functional recovery to be more than 83% at 6 weeks after major surgery and more than 90% after 90 months was published.[7] Enhanced recovery was incorporated into the programme.
- 2014: The philosophy of our work was published in a high impact journal, 'Annals of Surgery'.
- The textbook 'Transdisciplinary Perioperative Care in Colorectal Surgery' was published by Springer. [10]
- 2016: The results of the 'Transinstitutional Transdisciplinary Start to Finish Programme' was published.[8]

Despite these encouraging developments, the challenges ahead remain real. The surgeons' and other healthcare workers' mindsets need to evolve and there needs to be more buy-in into these needs of the elderly surgical patient. There remains an uneven culture in most institutions where the silos of administrative barriers and historical departments hinder true team-based care. There is a need to constantly

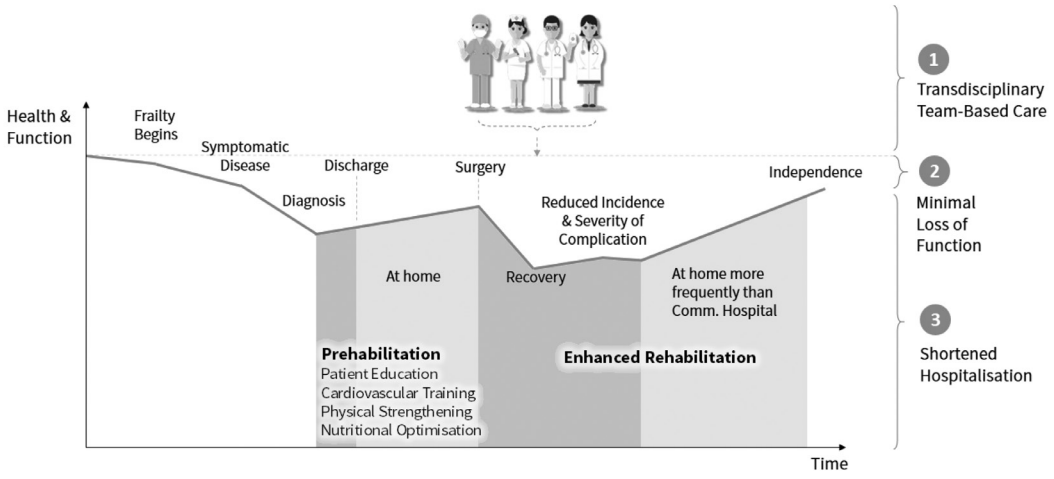

Fig. 3. Our Geriatric Surgery Service model of care.

look at the processes and collaborations critically and without reservation in order to ensure sustainability. The distinction of having value over quality needs to be a constant reminder. In doing so, there is a need to streamline and reduce redundant processes. There is also a greater need for collaborations between administrative departments and across institutions so that pockets of excellence can be amalgated and integrated for the greater good of patients. Ultimately, there is still a long way to go.

Moving forward, we will be considering how to further improve our processes and extend prehabilitation to pre-frail patients. We will continue to share our work to other hospitals in and out of Singapore and we look forward to forming collaborations to develop more care for the elderly surgical patient in Singapore and the region. More recently, the National Health Service in the United Kingdom has been articulating new models of perioperative care with a similar mindset. Over in Australia and New Zealand, the awareness of the need for more specialised care for elderly surgical patients has also increased. We have truly come to an era where geriatric surgery has taken centre stage.

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Letter to the Editor

Experience with a Community-based Multidisciplinary Memory Clinic: A Primary Care Perspective

Dear Editor,

Ten percent of Singapore's elderly suffer from dementia.[1] This figure is set to rise with our ageing population. As a patient's first contact point in the health system, family physicians working in the primary care setting are increasingly challenged to meet the healthcare needs of patients with dementia. Primary care-based multidisciplinary memory clinics have been designed and implemented in Western countries.[2,3] In Singapore, this is a novel concept. We report our experience in developing such a service at SingHealth Polyclinics (SHP).

The Cognitive Assessment and Rehabilitation Programme (CARe), a collaboration between SHP and National Neuroscience Institute (NNI), was set up in 2013. The team developed a workflow to receive and manage patients, standardised documentation templates, and trained healthcare personnel. Sited within polyclinics, CARe comprises a multidisciplinary team of neurologists, family physicians, and nurses. It receives internal referrals for assessment of patients above 55 years with cognitive complaints.

Referred patients were assessed on the Mini-Mental State Examination (MMSE), and the 15-item Geriatric Depression Scale (GDS).[4] They were also offered blood tests to screen for secondary causes of cognitive impairment: serum vitamin B12, folate and thyroid function. Accompanying caregivers were asked to complete a 12-item Zarit burden questionnaire.[5] Patients underwent clinical assessment by a dementia-trained family physician co-consulting with a neurologist. The diagnosis of dementia or mild cognitive impairment (MCI) were made on clinical grounds, based on the National Institute on Aging-Alzheimer's Association (NIAA) criteria.[6,7]

Results

A total of 251 patients (86 male, 77.7 ± 9.2 age, 235 Chinese, 8 Malays, 7 Indians) and 166 of their caregivers were seen between May 2013 and December 2014 (Table 1); 119 (47.4%) and 91 (36.3%) patients were diagnosed with dementia and MCI, respectively. The most frequent cognitive symptoms were memory difficulty (93.2%), mood/behavioural changes (40.2%), and executive dysfunction (35.1%). The mean MMSE score (graded out of 30) was 17.0 ± 5.8 and 24.2 ± 4.3 for patients with dementia and MCI respectively ($P = 0.019$). Sixty-eight (57.2%) patients with newly diagnosed dementia had MMSE scores of greater than 16 at the time of presentation. Screening for secondary causes of cognitive impairment was done. The following previously undiagnosed conditions were found: 43 (17.1%) patients had B12 deficiency, 59 (23.5%) had folate deficiency, and 3 (1.2%) patients were found to be hypothyroid.

Patients with dementia were more likely to be female (OR 10.4, $P = 0.006$), older ($P < 0.001$), and of lower educational level ($P = 0.002$). Amongst patients with dementia, the prevalence of behaviours of concern (BOC) was 4.4% for the group with MMSE ≥16; 15.8% in the MMSE 10-15 group, and 10% amongst those with MMSE <10 ($P = 0.13$). Eleven subjects (9.2%) were found to be depressed (GDS score ≥10). In contrast, there was a significantly higher incidence of depression amongst patients with no cognitive impairment (NCI); 24% (10 out of 41) were found to be depressed. In addition, 4 (9.8%) patients in this group were suspected to suffer from anxiety disorder.

The mean Zarit score amongst the 166 caregivers surveyed was 16.4 ± 8.5 (graded out of 48). Caregivers were more likely to attend if their relative was suffering from dementia (OR 26.6, $P < 0.001$). Forty-one (34.5%) carers of patients with dementia reported high caregiver burden (Zarit ≥17). Worse dementia severity was correlated with higher caregiver burden ($r = 0.19$, $P = 0.014$).

Discussion

There was a female predominance amongst patients diagnosed with dementia or MCI. This is in keeping with data from Asia and Europe, which have found a significantly higher risk of dementia amongst females.[8,9] Inter-ethnic differences in dementia risk has previously been studied in several large scale studies in Singapore.[10-12] These papers have consistently reported a higher prevalence of dementia amongst Malays and Indians as compared with Chinese. Our study was not adequately powered to study these inter-ethnic differences. Population census data[13] in 2014 show that ethnic Chinese accounted for 76.2% of the citizen population, followed by Malays and Indians at 15% and 7.4%, respectively. The ethnic distribution of patients

Table 1. Baseline Characteristics of the Study Population

	Dementia (n = 119)	MCI (n = 91)	NCI (n = 41)	*P* Value
Demographics				
Female	81 (68.1%)	50 (54.9%)	34 (82.9%)	0.006
Age	80.0 ± 8.2	76.2 ± 9.1	74.1 ± 10.7	<0.001
Chinese	110 (92.4%)	86 (94.5%)	39 (95.1%)	0.85
Ever smoker	11 (9.2%)	14 (15.4%)	4 (9.8%)	0.36
Years of education	4.2 ± 4.4	5.8 ± 4.2	6.8 ± 5.0	0.002
Cognitive assessment				
MMSE score	17.0 ± 5.8	24.2 ± 4.3	26.8 ± 3.3	<0.001
MMSE <10	10 (8.4%)	0	0	
Chronic disease burden				
Hypertension	88 (73.9%)	64 (70.3%)	28 (68.3%)	0.74
Hyperlipidaemia	86 (72.3%)	72 (79.1%)	33 (80.5%)	0.40
Diabetes mellitus	42 (35.3%)	32 (35.2%)	13 (31.7%)	0.91
Previous stroke	13 (10.9%)	10 (11.0%)	2 (4.9%)	0.50
Ischaemic heart disease	16 (13.4%)	12 (13.2%)	4 (9.8%)	0.80
Cognitive symptoms				
Memory difficulty	116 (97.5%)	87 (95.6%)	31 (75.6%)	<0.001
Executive dysfunction	64 (53.8%)	16 (17.6%)	8 (19.5%)	<0.001
Mood/behaviour problems	55 (46.2%)	32 (35.2%)	14 (34.1%)	0.12
Visuospatial problems	41 (34.5%)	17 (18.7%)	4 (9.8%)	<0.002
Attention deficits	40 (33.6%)	17 (18.7%)	7 (17.1%)	0.019
Language difficulty	18 (15.1%)	14 (15.4%)	3 (7.3%)	0.41
Depression (GDS score ≥10)	11 (9.2%)	8 (8.8%)	10 (24.4%)	0.025
GDS 6 – 9	17 (14.3%)	18 (19.8%)	7 (17.1%)	
GDS 0 – 5	76 (63.9%)	62 (68.1%)	22 (53.7%)	
High caregiver stress (12-item Zarit burden score ≥17)	41 (34.5%)	20 (22.0%)	10 (24.4%)	0.35
Total caregivers who attended	98 (82.4%)	51 (56.0%)	17 (41.5%)	<0.001
Secondary causes of cognitive impairment*				
B12 deficiency (B12 <145 pmol/l)	27 (22.7%)	13 (14.3%)	3 (7.3%)	0.27
Folate deficiency (folate ≤13.4 nmol/l)	36 (30.3%)	18 (19.8%)	5 (12.2%)	0.30
Hypothyroidism (TSH ≥10 μU/l)	2 (1.7%)	0	1 (2.4%)	0.50

MCI: Mild cognitive impairment; MMSE: Mini-Mental State Examination; NCI: No cognitive impairment; GDS: Geriatric Depression Scale; TSH: Thyroid stimulating hormone
*Previously undiagnosed.

visiting SHP follows similar trends. In our study, 93.6% of referred patients were Chinese. This is likely a reflection of referral patterns rather than disease trends.

At the time of first presentation to primary care, the majority of patients are in the early stage of disease (MCI, or mild to moderate dementia severity). This emphasises the important role that memory clinics in the primary care setting can play in the early diagnosis and management of patients with dementia, where interventions are likely to be more effective.

In our study, we used a cutoff score of 9/10 for the GDS to define depression in dementia.[14] The prevalence of depression in patients with dementia was at 9.2%. A review by Enache et al[15] found that the prevalence of depression amongst outpatients with dementia varied widely in different studies (ranging from 0.9% to 44%), due to differing diagnostic criteria and study design. Amongst NCI patients, the prevalene of comorbid depression or anxiety was high; 24.4% (10 patients) were depressed, and 9.8% (4 patients) were suspected to have anxiety disorder. These diagnoses could account for the subjective cognitive complaints. Primary care physicians should be alert to

differentiate these mimickers of dementia. It should be noted that amongst patients without dementia, the optimal cutoff score for depression has been suggested to be GDS 4/5.[16] Using this cutoff, 41.5% of those in the NCI group would have fulfilled the criteria for depression. While this may be related to the small sample size in the NCI cohort (n = 41), this finding warrants further confirmation in larger cohorts of primary care population.

Insights

Siting memory clinics within the primary care sector facilitates the outreach of dementia care to a wider audience. With adequate training, the family physician can be equipped with the necessary skills-set to diagnose and manage patients with dementia. Primary care memory clinics can also serve as a triage system, to allow rightsiting of more complex cases to the appropriate tertiary institutions. Caregiver stress occurs commonly and should not be overlooked.

One of the limitations to our service is the lack of established workflows for access to neuroimaging. Furthermore, management of dementia is a resource-intensive undertaking. SHP is still in the infancy stage of developing our memory clinic. With the necessary funding, we hope to enhance our multidisciplinary support staff to include nurse educators, medical social workers, psychologists, and occupational therapists. We are also looking to expand our range of services, to include patient education and caregiver training workshops, and caregiver support services.

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Bullous Pesentation of Idiopathic Wells Syndrome (Eosinophilic Cellulitis)

Dear Editor,

A 44-year-old female presented with pruritic oedematous papules and plaques with vesiculobullae formation over her face, trunk and limbs over 1 week (Fig. 1). She denied fever and other associated symptoms, drug intake, or insect bites. Her medical history was unremarkable. Complete blood count analysis revealed the presence of eosinophilia (0.81×10^9/L, normal $0.04\text{-}0.40 \times 10^9$/L). Levels of urea and electrolytes, and the results of liver function tests and chest radiography were normal. Antinuclear antibodies were absent, indicating that an autoimmune rheumatic disease was less likely. Stool specimens were negative for the presence of parasites.

A skin biopsy was performed and histology findings were that of intense upper dermal oedema with subepidermal blister formation, and a dense superficial and deep perivascular and interstitial infiltrate of predominantly eosinophils with some lymphocytes (Figs. 2-4). Vessel walls were intact. Direct immunofluorescence revealed non-

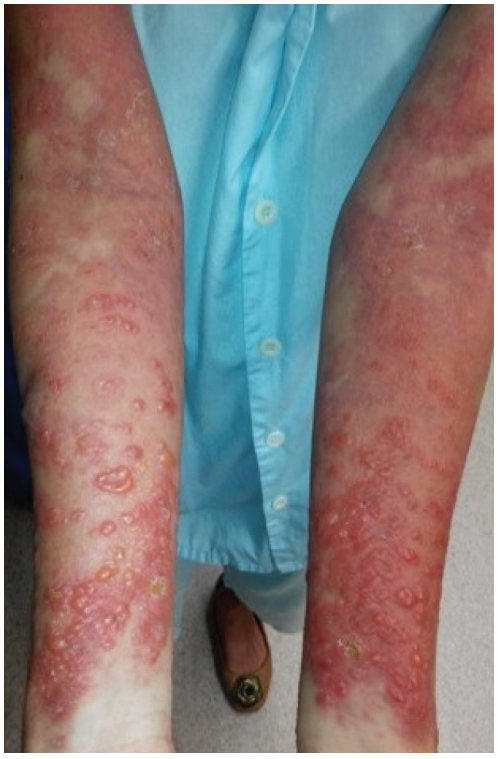

Fig. 1. Erythematous papules and plaques with formation of bullae.

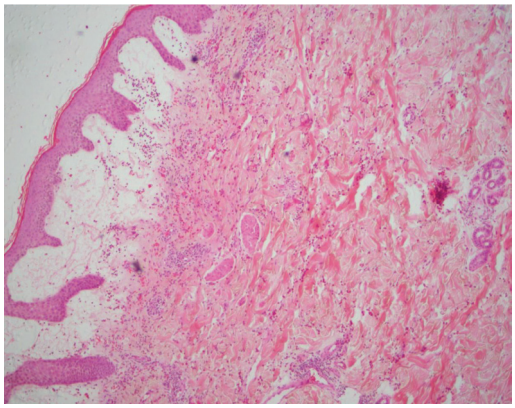

Fig. 2. Intense upper dermal oedema with subepidermal blister formation (hematoxylin and eosin, magnification, x 40).

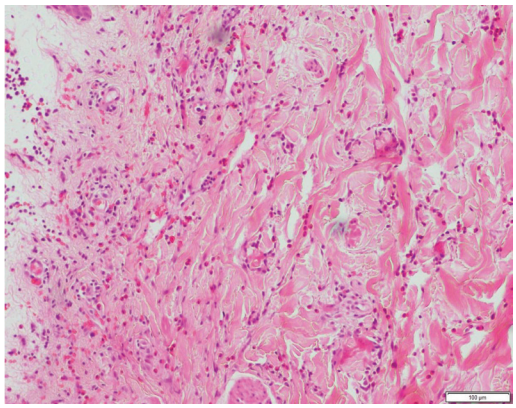

Fig. 3. Dense superficial and deep perivascular and interstitial infiltrate with many eosinophils and some lymphocytes (hematoxylin and eosin, magnification, x 100).

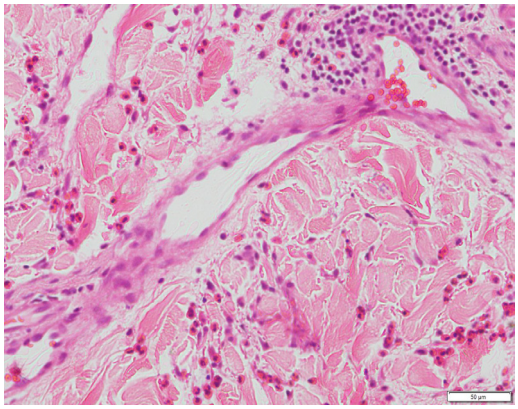

Fig. 4. Close-up view of the perivascular eosinophilic infiltrate with adjacent intact vessel walls (hematoxylin and eosin, magnification, x 200).

specific findings of granular C3 deposition in the walls of several blood vessels. Serum indirect immunofluorescence was normal, which excluded an autoimmune blistering disorder. Based on the clinical presentation, presence of blood eosinophilia, and histopathological features, a diagnosis of Wells syndrome was made. The patient was treated with oral prednisolone 20 mg/day in a tapering dose over 3 weeks, with resolution of the lesions and normalisation of the blood eosinophil count. No new lesions appeared during treatment and subsequent 6 months of follow-up. Further investigations for occult malignancies did not yield significant abnormalities.

Discussion

Wells syndrome, or eosinophilic cellulitis, is a rare inflammatory dermatosis first described by George Wells in 1971 as a recurrent granulomatous dermatitis with eosinophilia. Patients typically present with recurrent well circumscribed erythematous plaques resembling cellulitis but are unresponsive to antimicrobial therapy. The course of the disease tends to be benign. Peripheral blood eosinophilia may be observed in 50% of patients, with levels fluctuating with the disease course, returning to normal during clinical remission. The condition is characterised by clinical polymorphism, and has been categorised into 7 variants: plaque-type, annular granuloma-like, papulonodular, fixed drug eruption-like, urticarial, bullous, and papulovesicular presentations.[1]

Histologic findings are that of marked superficial and deep perivascular and interstitial infiltrate of eosinophils and lymphocytes. Epidermal reaction is the most variable aspect, ranging from a normal epidermis to minimal to moderate epidermal spongiosis, with or without vesiculation.[2] Flame figures may be present, formed by widespread degranulation of eosinophils and aggregation of eosinophil granules among dermal collagen bundles. While flame figures are associated with Wells syndrome, they are not pathognomonic and may occur in other conditions with a eosinophil-rich infiltrate, such as arthropod bite reactions, parasitic or fungal infections, drug hypersensitivity reactions, bullous pemphigoid, and eosinophilic pustular folliculitis.

The pathogenesis of Wells syndrome is uncertain. The hallmark of the disease is dysregulated tissue eosinophilia, which appears to be driven by a functional disorder of T lymphocytes. Immunophenotyping studies of peripheral T cells have shown increased CD3+ and CD4+ T cells.[3] These lymphocytes spontaneously release interleukin 5, which drives eosinophilic accumulation in a Th2 immune response. Eosinophils then degranulate in the dermis causing oedema and inflammation. A plethora of proposed triggers has been reported, such as arthropod bites, drugs, thiomersal-containing vaccines, herpes simplex and human immunodeficiency viruses, and parasitic infestations. Associations with haemato-oncological diseases and solid neoplasms have also been described.

Wells syndrome usually improves with non-aggressive therapies. Systemic corticosteroids are the first-line treatment, with the recommended starting dose of prednisolone 1-2 mg/kg per day and continuing with 5 mg/day, or initiating with 2 mg/kg for 5-7 days followed by a gradual taper for 2-3 weeks.[4] For mild cases, potent topical corticosteroids may be used. Variable results have been reported with antihistamines, griseofulvin, and photochemotherapy (PUVA). There have been anecdotal reports of successful treatment with cyclosporine, dapsone and interferon-α.[5-7] Any underlying precipitating event should be treated, if possible.

The bullous presentation of Wells syndrome is rare in the literature, and an association with lymphoproliferative diseases has been described in previous reports.[8,9] In our patient, an initial search for underlying malignancies was unyielding. We recommend that such cases be monitored for interval development of haemato-oncological diseases, with relevant investigations arranged based on the symptoms and signs of the patient.

Conclusion

Wells syndrome is a rare inflammatory dermatosis with clinical polymorphism, and distinctive but non-specific histopathological features. We have described a case of the rare bullous variant of Wells syndrome, in the absence of an obvious precipitant.

Skin lesions clinically resembling cellulitis without improvement to antibiotics in association with blood eosinophilia should suggest a possible diagnosis of Wells syndrome. Although peripheral eosinophilia is common, this is not sufficient for the diagnosis of the syndrome. Correlation of clinical features, the course of skin lesions, as well as histopathological examination of a skin biopsy is important to obtain a definitive diagnosis of eosinophilic cellulitis.

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Asia's First Transapical Transcatheter Mitral Valve-in-Ring Implantation

Dear Editor,

More elderly patients are returning for cardiac reoperations as a result of improved healthcare and longevity in Singapore. We report a mitral valve re-intervention using a novel minimally invasive approach via the apex of the left ventricle.

Case Report

A frail 75-year-old lady with severe mitral regurgitation and pulmonary hypertension (124 mmHg pulmonary artery systolic pressure) presented with heart failure 9-years post-coronary bypass and mitral annuloplasty performed for functional mitral regurgitation. Her left ventricular ejection fraction was 45%. She has hypertension, hyperlipidaemia and had recovered from a stroke over 20 years ago. She was homebound due to her symptoms, her mammary artery and vein grafts were patent, and she was deemed high risk for conventional surgical reoperation (13.1% EuroSCORE II surgical mortality risk) by 2 surgeons.

Cardiac-gated contrast-enhanced computed tomography (CT) was used to: a) assess the area and perimeter within the complete 26 mm physio mitral annuloplasty prosthetic ring, and b) to simulate the implantation of a 23 mm SAPIEN-XT valve (Figs. 1A-B). The area within the mitral ring was measured to be 328 mm^2. The area of a fully deployed 23 mm SAPIEN-XT is 415 mm^2, thereby satisfactorily oversizing (26%) for this patient's prosthetic mitral ring. The simulation predicted negligible left ventricular outflow tract (LVOT) obstruction, and the patient was offered the transcatheter approach having obtained informed consent.

The transapical mitral valve-in-ring (TAMViR) implantation of the balloon-expandable SAPIEN-XT

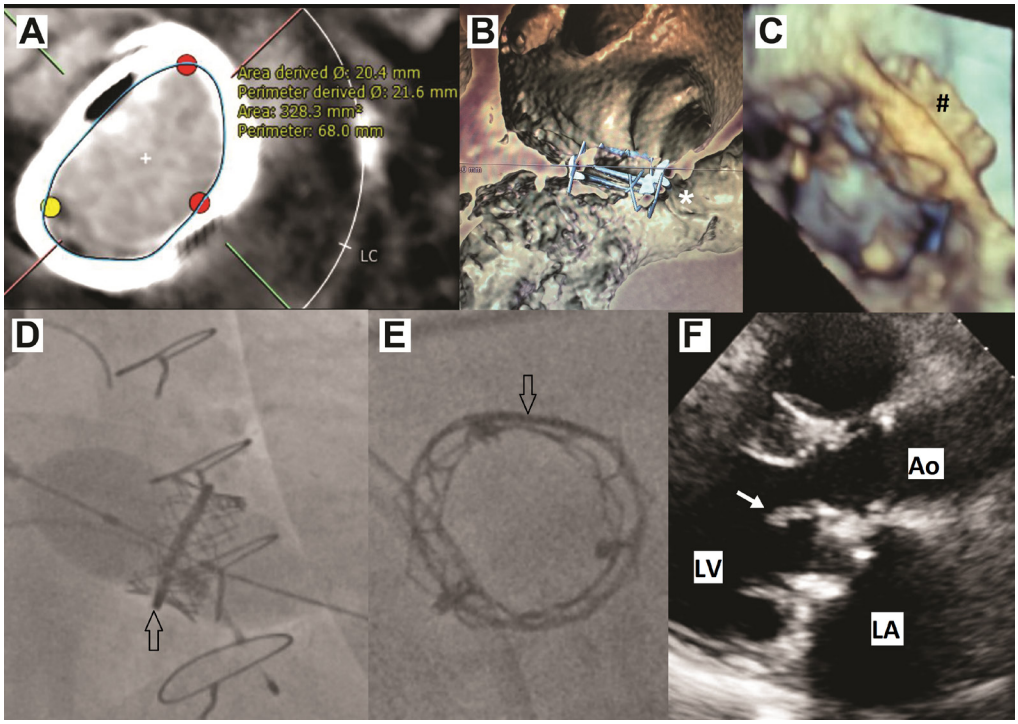

Fig. 1. Computed tomography (CT) sizing in A: "+" denotes dimensions measured within the metallic mitral annuloplasty ring. B shows CT-simulation of 23 mm SAPIEN-XT implantation ("*" denotes the aortic valve). C shows 3D echocardiographic, with "#" denoting implanted 23 mm SAPIEN-XT. Fluoroscopic images (D-E): open arrow identifies the physio ring of the SAPIEN-XT within the mitral prosthetic ring. The widely patent left ventricular outflow tract during systole is seen on echocardiography. In F: arrow points to the mobile tip of the anterior mitral leaflet. Ao: Aorta; LV: Left ventricle; LA: Left atrium.

transcatheter bioprosthesis was performed via a left anterior mini-thoracotomy in a hybrid operating room. The radio-opaque mitral ring marks the target landing zone for the transcatheter valve without the need for ionic contrast agent. The SAPIEN-XT valve was implanted approximately 40% atrial to the mitral prosthetic ring, to ensure adequate sealing from major intervalvular leak. More importantly "waisting" and ventricular flaring of the circular SAPIEN-XT (Figs. 1C-E) is evident, in order to resist the systolic migration of transcatheter valve. The native anterior mitral leaflet (arrow) extends beyond the ventricular aspect of the SAPIEN valve frame (Fig. 1F), but did not cause LVOT obstruction post-implantation.

The procedure was uneventful and she was discharged home 4-days post-intervention. She remains well in New York Heart Association functional class I with 10 mmHg mean transmitral gradient 18-months post-implant. There is mild intervalvular regurgitation (between the SAPIEN frame and prosthetic mitral ring), but Figure 1E shows a nearly circular deployed SAPIEN-XT prosthesis.

Discussion

The TAMViR procedure is similar to the previously described transapical transcatheter mitral valve-in-valve implantation technique.[1-4] It is performed through a small left submammary incision on the beating heart. It remains the most direct route to the mitral valve compared to the transeptal approach, with excellent coaxiality achieved (ability to align the transcatheter valve with the target mitral annular ring).[5] The short distance of the mitral valve to the cardiac apex also permits experienced operators to "adjust" the transcatheter valve position during deployment.

Patients with mitral ring annuloplasty and preserved native anterior mitral leaflet however may succumb to acute LVOT obstruction due to: a) long anterior mitral leaflet, b) narrow aorto-mitral annular planes, and/or c) restricted native LVOT. The SAPIEN-XT valve frame splints the basal segment of the native anterior mitral valve leaflet toward the LVOT, whilst its leaflet tip remains mobile (Fig. 1F). The trans-esophageal echocardiographic image (Fig. 1F) corresponds with the CT-simulated image of an implanted 23 mm SAPIEN-XT valve (Fig. 1B).

This case reports Asia's first successful TAMViR using the Edwards SAPIEN-XT balloon expandable valve. This novel minimal access approach may benefit high risk patients with failed mitral valve repair, if deemed of prohibitive risk for conventional reoperation.

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Jaw Pain in a Pemphigus Patient on Prednisolone, Mycophenolate Mofetil and Denosumab

An 86-year-old Chinese female who was on follow-up with our dermatology service for pemphigus foliaceus presented during her routine review with right-sided jaw pain of 1 week duration. She was edentulous but did not wear dentures and did not recall any preceding dental injury. The patient was known to have other comorbidities including oesophageal cancer (which had been resected more than 10 years ago), glucocorticoid-induced osteoporosis (GIOP), diabetes mellitus, iron deficiency anaemia and stage 3 chronic kidney disease (latest creatinine clearance 22.2 mL/min, eGFR 34 mL/min/1.73 m^2). At the point of presentation, she had been on prednisolone for 4 years (mean dose of 13.2 mg/day) and mycophenolate mofetil for 2 years (at 500 mg daily). She had also received oral alendronic acid 70 mg once a week for 2 years previously for osteoporosis. This had been subsequently changed to subcutaneous injection of denosumab 60 mg every 6 months in view of her worsening renal function and she had received a total of 4 doses prior to this presentation.

Clinical examination revealed an afebrile female who appeared well, apart from an erythematous right cheek swelling and a discharging sinus from the right mandible intraorally. Radiographic examination showed an irregular lucent area at the base of the right coronoid process of the mandible with peripheral sclerosis and a central sclerotic component (Fig. 1). A cone beam computed tomography (CT) showed a moth-eaten appearance of the right angle of the mandible and ramus with areas of osteolysis, sclerosis and bony sequestration (Fig. 2). The patient underwent biopsy, wound debridement and sequestrectomy of the right mandible. Histologic examination showed non-viable bony fragments, mixed inflammatory cell infiltrate and bone culture that grew commensal respiratory flora. The patient had an intact parathyroid hormone of 7.17 pmol/L (normal range, 1.30 pmol/L to 7.60 pmol/L).

What is the likely diagnosis?

A. Bony metastases
B. Osteomyelitis of the jaw
C. Osteonecrosis of the jaw
D. Mandibular fracture
E. Hyperparathyroidism with brown tumour

Discussion

The patient's clinical and histologic findings were consistent with medication-related osteonecrosis of the jaw (MRONJ). Denosumab was ceased and she was given a 1-week course of oral amoxicillin and clavulanic acid. At her latest review 5 months after surgery, the surgical site had completely healed.

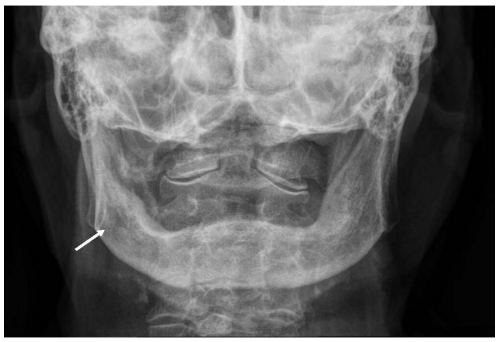

Fig. 1. Mandible radiograph demonstrating irregular lucent area at the base of the right coronoid process of the mandible with peripheral sclerosis and a central sclerotic component (arrow).

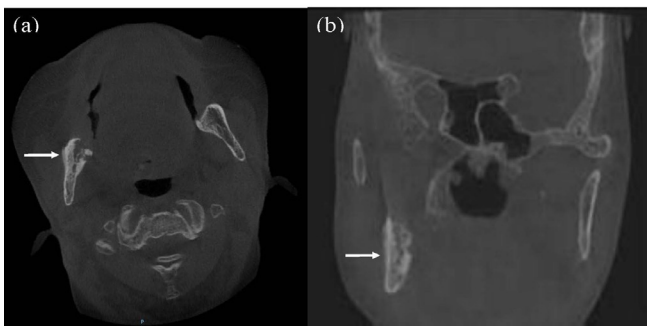

Fig. 2. Cone beam CT showing a moth-eaten appearance of the right angle of the mandible and ramus with areas of osteolysis, sclerosis and bony sequestration in a) transverse view (arrow) and b) in coronal view (arrow).

Answer: C

GIOP is a common issue in patients receiving long-term systemic corticosteroid therapy for inflammatory or autoimmune skin diseases. MRONJ is a serious but uncommon complication of osteoporosis treatment. It is 10-fold more common in oncology patients receiving high doses of intravenous bisphosphonates or denosumab for bony metastases,[1] while the incidence of MRONJ in patients with osteoporosis is between 1/10,000 and 1/100,000.[2,3] It presents with an area of exposed bone in the maxillofacial region that does not heal within 8 weeks. Jaw pain was the most commonly reported early symptom while extra-oral fistula appears later. Invasive dental procedures are a precipitating factor in the majority of cases of MRONJ. However, in a recent case series of 149 patients with MRONJ, 36% were unprovoked.[4]

Prevention of MRONJ involves pre-emptive dental review and treatment of existing dental disease before initiating antiresorptive treatment. Treatment of osteonecrosis of the jaw involves analgesia, oral antimicrobial rinses, systemic antibiotics, and avoidance of further dentoalveolar surgical procedures. In patients with more advanced osteonecrosis (stage 2 or 3 disease), or when non-operative strategies have failed, debridement, sequestrectomy and resection may be required.[5]

Our patient had multiple risk factors for developing MRONJ. This included the use of bisphosphonates and denosumab therapy for osteoporosis for 4 years, a long history of corticosteroid use and her comorbid conditions such as diabetes mellitus and anaemia.[6] Although preventive dental treatment is recommended, unprovoked MRONJ can still occur in edentulous patients such as in this case. Doctors who prescribe oral bisphosphonates routinely for prevention and treatment of GIOP should maintain a high index of suspicion for MRONJ, especially in elderly patients and patients with multiple risk factors.

Options A, B, D and E are possible differential diagnoses for the initial clinical presentation. However, osteomyelitis was ruled out as the patient was not septic and the bone culture grew commensal respiratory flora. Bony metastasis from an occult primary tumour or relapsed oesophageal carcinoma was possible but ruled out by bone histology. The patient did not have an antecedent trauma to the jaw and the radiological appearance was not consistent with that of a fractured mandible, thus ruling out a fracture. Brown tumours are late manifestations of hyperparathyroidism, and jaw bones are commonly affected by brown tumours in primary hyperparathyroidism. The bone histology for brown tumours characteristically consists of giant cells with interstitial haemorrhage, hemosiderin, microfractures and ingrowth of vascularised fibrous tissue with fibroblasts. This was not seen in our case.

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