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Principles of an Ambulatory Surgery Service

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According to the International Association for Ambulatory Surgery (IAAS), ambulatory surgery should be defined as 'an operation/procedure, excluding an office or outpatient operation/procedure, where the patient is discharged on the same working day.' The origins of ambulatory surgery can be traced back to the pioneering work of James Nicholl at the Glasgow Royal Hospital who reported 8988 paediatric day- case procedures between 1899 and 1908. Despite initial scepticism from the surgical profession, there has been a rapid expansion in the complexity and amount of ambulatory surgery in recent years: between 1989 and 2003 the percentage of elective surgery undertaken as day case in the UK increased from 15 to 70%. Many health services have set targets for the percentage of elective surgeries to be done as day-case procedures, and in the UK this target is set at 75%.

The rise of ambulatory surgery has been driven by technological advances that reduce the need for overnight hospital stays, enhanced recovery programmes that advocate early mobilisation, and the need for economic efficiency. With growing interest in ambulatory surgery, multiple associations have been formed promoting education, quality standards, and research in the field.

Infrastructure

Ambulatory care is delivered in various environments, including

- Free-standing self-contained units
- Integrated self-contained units
- Integrated non-self-contained units

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Free-standing units, separate to inpatient units, are common in the United States, increasing in number from 67 in 1976 to over 4000 in 2004 (IAAS: day surgery). They may be multidisciplinary, serving a larger market, or uni-disciplinary. Potential benefits include cost-effectiveness and efficiency because it is easier to generate a streamlined care pathway and to encourage teamwork amongst healthcare professionals. Furthermore, they may have lower rates of hospital-acquired infection. The disadvantage is that they are remote from a comprehensive medical facility with a full range of specialties including intensive care, meaning that there will occasionally be a need for outsourcing and transfer of patients. The need for low-risk patients ultimately encourages stricter patient selection, self-limiting the service. Most unplanned overnight admissions after ambulatory surgery are due to bleeding and longer-than-expected procedure length, with urological and gynaecological surgery accounting for a particularly high proportion of bleeding patients (Vaghadia 1998).

Integrated self-contained ambulatory units are located on a hospital site with their own dedicated theatres and personnel. They are generally seen as the ideal model for ambulatory surgery, benefiting from the comprehensive range of medical services provided by that hospital, whilst also specialising in providing a streamlined ambulatory service with one dedicated team well trained in ambulatory surgical care.

Integrated non-self-contained ambulatory units vary significantly in set-up: some may not have dedicated theatres or personnel. This makes the system inefficient, because there is a chance that low-risk day-case procedures may be cancelled, a streamlined patient pathway is often lacking, and unintended overnight stays arise due to difficulties ensuring safe discharge. However, if there is a dedicated ambulatory ward and theatres, this environment does have some benefits; it is easily expandable, meaning that as new procedures are transferred to day surgery, the same infrastructure can be used with appropriate retraining of staff.

Pre-operative Assessment

Once the decision to operate has been established and the intended procedure is planned as a day case, a dedicated pre-assessment team, generally made up of trained nurses, should comprehensively assess the patient. This assessment should ideally take place in the same unit in which the procedure will take place but can be undertaken remotely via telephone or computer. It should happen far enough in advance so that patients' co-morbidities, medications, and social factors can be optimised preoperatively.

The pre-operative assessment begins with gathering information about health, medications, and social circumstance. The health assessment is generally history-based and most commonly involves a questionnaire with basic screening questions and more detailed history where appropriate. Pre-operative examination and investigations including blood tests, ECG, and X-rays are less useful in most patients. A decision is then made regarding whether the patient is suitable for day surgery. Modern ambulatory units have moved away from a specific set of contraindications and instead assess patient suitability individually according to the combination of physiological status, social circumstance and intended procedure.

Social Selection Criteria

Several social factors must be considered before ambulatory surgery. Patients or carers must be able to understand the nature of the procedure, and be willing to adhere to the peri-operative instructions. Patients must have appropriate support at home; in general, they need to be discharged into the care of a responsible adult for 24 hours after the operation, although this is probably excessive for some minor operations. Additionally, a generally accepted rule is that they must live within one hour's travel time to the surgical unit. In those living remote from ambulatory unit, the option of an overnight local lodging can be discussed, instead of overnight hospital admission.

Physical Selection Criteria

There are multiple factors that reduce the suitability of patients for day surgery and must be assessed in detail prior to surgery (Fong 2014). Identifying high-risk patients can help facilitate a multidisciplinary strategy to optimise their pre-operative condition, anticipate intraoperative challenges, and plan postoperative disposition (Walsh 2018). Although a comprehensive review of these is beyond the scope of this chapter, we will mention a few notable parameters.

Age should not independently decide whether a patient is suitable. In one study, elderly patients did not have worse outcomes than younger patients (Chung 1999), although in another, advanced age was associated with greater rates of readmission (Whippey 2013). Ambulatory surgery may actually confer some benefits to the elderly population, having been shown to reduce rates of post-operative cognitive dysfunction (Rasmussen 2015).

The American Society of Anaesthesiologists grading system (ASA grade) is used to evaluate a patient's physical state before surgery and classifies patients into

6 categories. Grade 1 being a normal healthy patient and grade 5 being moribund patient. The ASA grade is not a particularly useful measure of suitability for day surgery. An ASA 3 patient does not experience greater complication rates when compared to an ASA 1 or 2 in the medium to late post-operative period (Ansell 2004). Some ASA 4 patients may also be suitable for procedures undertaken using local or regional anaesthesia.

Suitability of obese patients is a controversial area, a body mass index (BMI) of up to 40 being acceptable for the majority of procedures and many anaesthetists would accept higher BMIs (Atkins 2002). Complication rates do appear to be higher in the extremely obese group (BMI > 50 kg/m^2), although readmission rates are not significantly greater (Joshi 2013).

With regards to chronic medical conditions, a general rule is that stable patients are fit for ambulatory surgery. Chronic obstructive pulmonary disease (COPD) is not a contraindication for ambulatory surgery. Asymptomatic patients have a low risk of post-operative complications, but those who have been symptomatic within a month of the proposed surgery may need to have their procedure postponed (Warner 1996). Smokers should be encouraged to stop smoking, as even short-term cessation pre-operatively has been demonstrated to reduce complications (Myles 2002). Patients with obstructive sleep apnoea should have good control of symptoms and be established on nasal continuous positive airway pressure pre-operatively and during the post-operative period.

Cardiovascular status should also be assessed pre-operatively. Patients with hypertension should have their blood pressure reasonably controlled. The majority of those with ischaemic heart disease will be suitable, except for those with unstable or severe angina and those who have experienced recent myocardial infarction. Additionally, ambulatory surgery is generally not undertaken within a year of drug-eluting stent placement (Wijeysundera 2012). Diabetes mellitus does not itself preclude a patient from day surgery; in fact, day surgery reduces disruption to normal routine. However, patients should ideally be screened for other co-morbidities including cardiovascular and renal dysfunction. Patients with end-stage renal failure may be appropriate for minor ambulatory procedures undertaken under local or regional anaesthesia but, given their poor physiological state and the practical issues with regards to dialysis, major ambulatory operations are generally contraindicated.

Preparation for Surgery

Once the patient has been adequately assessed and deemed suitable for ambulatory surgery, the clinical team will start to prepare. This will involve completion of any further anaesthetic investigations and surgical diagnostics. Consent should be obtained with explanation and post-operative plan discussed.

The patient must be given appropriate information regarding the perioperative period. This will include an overview of fasting requirements, medications that need to be taken, and information pertaining to personal hygiene. In addition, simple information about location and timings should be provided. Finally, the patient and carer/responsible adult should be given information on whom to contact for queries or help with post-operative complications.

Anaesthesia

Pre-operatively, a full anaesthetic assessment should be performed, including previous anaesthetic history, post-operative nausea and vomiting (PONV) risk, and an airway assessment. PONV a common complication of anaesthesia, occurs most often in females, those with a similar past history, those with motion sickness, nonsmokers, and those requiring post-operative opioids (Apfel 1999). Preoperative assessment should aim to identify risk factors for difficult pain control allowing for individualised perioperative analgesia planning.

Most current anaesthetic agents convey predictable and rapid recovery. Desflurane-based anaesthetic has been reported to have the most predictable emergence from anaesthesia (Dexter 2011; Watchel 2011), although desflurane and sevoflurane-based anaesthesia appear to provide equal numbers of patients eligible for fast-tracking (White 2009). Propofol is frequently used for induction and maintenance of ambulatory anaesthesia, due to rapid metabolism and emergence, few side-effects, and low rates of PONV.

Depth of anaesthesia monitors, such as Bi-spectral Index (BIS), facilitate drug titration and have been shown to reduce drug consumption, reduce PONV (Liu 2004), and reduce rates of post-operative cognitive dysfunction in elderly patients (Chan 2013).

Post-operative pain will vary according to patient factors as well as the specifics of the surgical procedure and anaesthesia used. Utilising minimally invasive surgical techniques and regional anaesthesia are obvious ways to reduce pain. Regional anaesthetic techniques such as peripheral nerve blockade or neuraxial blockade, can mitigate the side effects of general anaesthesia such as PONV and aspiration pneumonia and may accelerate recovery by facilitating early analgesia (Moore 2013) and reducing opioid requirement. For neuraxial blocks, drug selection and dosing must be carefully considered so that prolonged effects do not delay discharge.

A number of antiemetics have been investigated and compared for efficacy. The 5HT3 antagonists such as ondansetron have good efficacy, especially when used in combination with dexamethasone. These should be started before the end of anaesthesia (Tang 1998) and continued in the community if necessary. Side effects should be evaluated when choosing an agent. Dexamethasone should be avoided

in patients with lymphoma because of risk of tumour lysis syndrome. Ondansetron should be avoided in patients with, or at risk of long QT.

Early Recovery: Emergence from Anaesthesia

Early recovery commences from the discontinuation of anaesthetic agents, allowing the patient to emerge from anaesthesia, recover airway reflexes and resume motor activity. Classically, this occurs in the post-anaesthesia care unit (PACU), before stepping down to the day-surgery unit (DSU). The modified Aldrete scoring system can be used for determining when patients are fit for discharge from PACU (Aldrete 1995).

There is a growing trend towards 'fast-track' of patients directly from the operating theatre to the DSU, bypassing PACU. This is (i) safe as many patients achieve step-down criteria from PACU as soon as they arrive, and (ii) economically efficient as PACU is more labour intensive. Complication rates in PACU are low, with one group demonstrating rates of 8%, of which only 0.7% were respiratory or circulatory (Duncan 1992).

One group achieved fast-track rates of over 80% in simple orthopaedic procedures, with patients being successfully discharged home earlier (Duncan 2001). Fast-track is more achievable with desflurane and sevoflurane-based anaesthesia (Song 1998) and with BIS, ensuring minimum necessary anaesthesia and quicker recovery (Song 1997).

The modified Aldrete scoring system is limited in deciding whether patients are fit for fast-track as it does not consider pain, nausea, or vomiting which are generally addressed in PACU. White's criteria (White 1999), or the WAKE score (2011) are more appropriate. Ultimately, patient safety should always be maintained and a clinical judgement should be made as to whether fast-track is appropriate.

Achieving adequate pain relief is an important factor for patient satisfaction and should be managed with objective methods of pain evaluation and evidence-based protocols for pain control. Utilisation of ibuprofen and celecoxib have been demonstrated to improve recovery (White 2011), probably because they are associated with lower opioid requirements and reduction of oedema. Units have developed protocols with routine use of multimodal analgesia, including non-steroidal anti-inflammatory drugs (NSAID), local anaesthetic techniques, and opioids as necessary. These protocols and methods have demonstrated improved post-operative pain control and patient satisfaction (Elvir-Lazo 2010).

Intermediate Recovery: Discharge Criteria

There is an increasing pressure for rapid discharge of patients. However, this must be balanced with the risks associated with premature discharge, including readmission, complications, and legal consequences. Several scoring systems exist,

guiding clinicians about safe discharge. The Post Anaesthesia Discharge Scoring System (PADS) (Chung 1995) is one utilised example and includes observations, patient orientation, bleeding, and post-operative symptoms including pain and nausea. Post-operative voiding and tolerance of oral intake are also included in this scoring system.

The type of anaesthesia and surgery can be a determinant of post-operative voiding function. Specific to pelvic-floor procedures is the effect of anaesthesia on bladder function. The insertion of the mid-urethral sling has been performed under both regional and local anaesthetic, with regional anaesthesia having been found to increase the rates of post-operative urinary retention (Adjusted OR = 4.4, 95% CI 1.9, 10.2) (Wohlrab 2009), a factor that could influence length of stay. A systematic review looking at the effect of anaesthesia on bladder function, found the dose of intrathecal local anaesthetic used with regional anaesthetic, as well as the potency of the anaesthetic used, to correlate with the duration of bladder dysfunction (Choi 2012). Encouragingly, a retrospective review of 119 patients who were discharged the same day as undergoing outpatient tension-free vaginal tape (TVT) surgeries found no significant difference in the need for catheterization among patients who received spinal anaesthesia compared to those who received general or local anaesthetic with sedation (Barron 2006).

Voiding before discharge has been a core concept in ambulatory surgery, because of the concern that patients may develop urinary retention, bladder atony, and subsequently renal complications. However, there is good evidence (Pavlin 1999) that patients at low risk of urinary retention can be discharged without needing to void, but with clear instructions to seek medical attention if unable to void within eight hours of discharge. On the other hand, the literature and opinions are mixed regarding patients at high risk of retention. Guidelines support that those who have not voided within three hours post-operatively should receive bladder scanning; if >600mls is present, then they will need catheterisation with trial without catheter (TWOC) in the community (Pavlin 1999).

Tolerance of oral fluids was also previously mandated before discharge. However, several studies have proven that this does not improve outcomes and may even worsen rates of nausea and vomiting (Jin 1998, Kearney 1998), making this a historic requirement.

Once discharge criteria have been met, patients should be supplied with adequate analgesia and clear instructions to take it regularly to prevent breakthrough pain. Prepackaged medication is convenient, prevents delays, and eliminates the need for a patient or carer to visit the pharmacy. Patients should be given clear verbal and written instructions on what they should and should not do, alongside contact details in case of emergency or concerns about symptoms or complications. Patients should be discharged with a responsible adult to accompany them, and those who have had a general anaesthetic should be advised to avoid alcohol and driving for 24 hours.

Late Recovery: Care After Discharge

Patients are discharged from ambulatory surgery once their baseline physiological states have returned. Although major complications and morbidity are rare (Warner 1993), residual symptoms and side effects are not uncommon. Patients need to be followed up in the community. This can happen through telephone consultations (Kamming 2004), GP/nursing follow-up, outpatient clinics or 'mhealth apps,' on smartphones (Hwa 2013, Armstrong 2014). A dedicated contact phone number or routine follow-up call the next day, may help avoid unscheduled emergency or general practitioner visits after discharge. Telephone follow up has reported high satisfaction rates (>90%) with all women preferring it to an office visit (Schimpf 2016). Ambulatory centres should consider this as a routine part of their postprocedure care. Follow-up should consider pain, nausea, bleeding, oral intake, voiding, bowel function, fever, sore throat, disorientation, and psychological status.

Setting Up an Ambulatory Centre

Planning a new ambulatory unit is a major undertaking. A board team, consisting of at least a surgeon, anaesthetist, nurse, and project manager should be set up. Market research must be performed, considering demand and financial viability. Local health authorities and regulatory bodies must be involved. The location must be identified taking into account transport links, and infrastructure must be decided upon.

Staff must be recruited and appropriately trained. Nurses must be educated in pre-operative triage/assessment and be trained in assessing patients post-operatively for discharge using standardised protocols. They should be able to engage the patient and family in the process of ambulatory surgery to ensure compliance and success. Anaesthetic teams must be trained in appropriate techniques for day surgery. Surgical teams must stay up to date with guidelines, such as the British Association of Day Surgery (BADS) directory, which makes recommendations on which procedures are appropriate in the ambulatory setting. All groups should demonstrate competency in dealing with emergency scenarios.

An ambulatory surgical checklist should be developed and tailored to different specialities. Staff should be trained in communication skills. The 'Situation-Background-Assessment-Recommendation (SBAR)' tool is a useful framework. Formal training in teamwork should ideally be given, generating a patient-centred culture of safety. Systems should be established to deal with unprofessional behaviour, mistakes, and complaints. An audit and quality improvement team must be set up. Staff must be trained in hand hygiene and infection control.

The design of the unit is central to its success. The capacity must be determined, including theatre number and bed number. From this, an estimate of size can be extrapolated. The board team and architect must decide on build type, storage, and sterilisation facilities. They then must consider which 'model' to follow. The 'racetrack' model has a uni-directional flow path, meaning that pre- and post-operative patients are not mixed and there is no congestion of flow. The disadvantage of this model is that more space is required to house pre- and post-operative patients in separate areas and at certain times of the day, there will be unused space. The 'non-racetrack' model conversely does mix patients, economising on space, but possibly at the detriment of quality.

Following this, members of the board team need to consider space for reception, patient's changing rooms, toilets, consulting rooms, staff common rooms and catering facilities. Medical gas supply must be incorporated into the design. Hardware such as trolleys, operating tables, beds, blood fridges, and emergency trolleys must be thought out. Operating theatres must be designed and anaesthetic equipment taken into account.

Following the design, a business plan should be constructed, including the capital costs, income, and expenditure over the next five years. This will need to be presented to investors or local funding panels

Economics of Ambulatory Surgery

The economic benefits of ambulatory surgery are a major drive for uptake. A number of studies have demonstrated the cost-effectiveness of various procedures when performed in the outpatient versus inpatient setting (Hollingsworth 2012). In 1990, the UK's Audit Commission suggested that if all health authorities in England and Wales performed day surgery consistently for 20 common procedures, an additional 186 000 patients could be treated each year without increased costs. This led to the England's Department of Health recommendation that 75% of all elective surgery be undertaken as day-case procedures (Alan Milburn NHS plan 2002). The UK Department of Health's reference costs for 2013–2014 calculated that the average day-case cost was £698 compared to £3375 for elective inpatient cases (reference costs 2013–2014).

These economic benefits stem from shorter hospital stays, with reduced waiting lists and higher patient turnover; fixed scheduling with reduced cancellations; staff reductions with lower overnight capacity; reduced operating times and lower costs associated with post-operative care (Aboutarabi 2014). Furthermore, patients benefit from reduced disruption from normal routine and quicker recovery back to work.

Various strategies have been proposed to economise even further within ambulatory surgery. Nerve blocks for reduction of pain, fast-tracking, and modifying

the type and amount of anaesthesia have all been investigated in detail. Future innovations in terms of surgical technology and technique, anaesthesia and post-operative monitoring including the use of telemedicine will likely further the scope and economic efficiency of ambulatory surgery.

Complication Rates

Transfer to an acute care facility or hospitalisation after discharge is often used as a marker of the complication rate for day-care surgery. Outpatient gynaecological and urogynaecology procedures have been successfully performed with very few patients (1.6%) requiring inpatient treatment within 72 hours (Kannan 2008). Similar results have been replicated in numerous studies of urology patients.

A multicentre quality improvement project performed in the USA found that 12% of patients undergoing other ambulatory surgery required hospital transfer and 10% required hospitalisation or an emergency room attendance within 48 hours of discharge from the day-care unit (Davis 2019).

Conclusion

Redistributing surgical procedures from the inpatient setting to ambulatory centres can be done without impacting quality. Ambulatory surgery confers substantial advantage and will continue to increase in popularity, in line with economic pressures. Re-evaluation and improvement are central to its success and units should routinely audit their cases and outcomes, along with the incorporation of novel techniques and innovations.

Further Reading

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