RESEARCH ARTICLES

The safety and feasibility of a regional nurse-led abdominal paracentesis service: A retrospective analysis

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ABSTRACT

Background: Recurrent ascites is a common complication of liver decompensation that often requires repeated abdominal paracentesis for symptom management. This study was to retrospectively analyse the safety and feasibility of a nurse-led abdominal paracentesis clinic at a regional health service ambulatory care unit.

Methods: The Advanced Practice Nurse (APN) identified to lead this service had ten years of post-graduate nursing experience, six of which included specialised hepatology training in a role as a Hepatology Clinical Nurse Consultant. She was enrolled for further study as a Nurse Practitioner. The APN observed five paracentesis procedures by Interventional Radiologists and Medical Officers. She was then supervised for five paracentesis procedures, before attempting the procedure independently. A retrospective analysis was conducted to assess the safety and feasibility of this service.

Results: From July 27, 2022, to March 22, 2023, 59 abdominal paracentesis procedures were performed by an APN. The overall success rate was 97%. The average amount of ascitic fluid removed was 7.57 Liters. The average time of the procedure within the ambulatory care unit from admission to discharge was 5.75 hours. There were no episodes of abdominal wall haematoma, hemoperitoneum, intraperitoneal haemorrhage, infection, spontaneous bacterial peritonitis or death post-paracentesis. There was 1 episode of excessive leakage at insertion site (1.69%), 1 episode of pain at insertion site (1.69%) and 1 episode (1.69%) of localised erythema to the insertion site. These complication rates are comparable to published studies of nurse-led paracentesis in other countries.

Conclusion: Nurse-led paracentesis is a safe and feasible way to manage patients with abdominal ascites secondary to liver disease. Expanding the scope of practice of an APN would improve access to care and support for those living with cirrhosis in regional and remote areas. This would help address the current health workforce maldistribution and consequent disparate health outcomes within regional Australia.

Keywords: Alcoholic liver diseases, alcoholic liver cirrhosis, ascites, abdominal paracentesis.

What is already known about the topic?

- Recurrent ascites is a common complication of liver decompensation that often requires repeated abdominal paracentesis for symptom management.
- The complication rates for nurse-led paracentesis in this study are comparable to published studies of nurse-led paracentesis in other countries, ensuring safety and proficiency in service delivery.

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What this paper adds

- This model of care is the only known regional hepatology service providing nurse-led abdominal paracentesis in Australia and New Zealand.
- A nurse-led abdominal paracentesis service would help address the current health workforce maldistribution and consequent disparate health outcomes within regional Australia.

INTRODUCTION

Liver cirrhosis is a term used to describe an advanced stage of liver fibrosis. The most common risk factors for cirrhosis include excessive alcohol use, chronic viral hepatitis infection, autoimmune hepatitis, and less common risk factors including hemochromatosis, Wilson's disease, alpha-1 antitrypsin deficiency and cystic fibrosis.[1] The combination of increasing portal pressure and decreasing liver function can contribute to the development of ascites, gastrointestinal bleeds, hepatic encephalopathy and jaundice, thus marking the transition of compensated cirrhosis to decompensated cirrhosis.[2] The presence of decompensated disease is significant, as it can reduce a person's life expectancy from 12 years to 2 years.[3] The Child-Pugh score, which incorporates albumin, bilirubin, prothrombin time, and the presence of ascites and encephalopathy, measures the severity of disease and predicts mortality in a person with liver cirrhosis.[2] Ascites is the accumulation of fluid within the peritoneal cavity.[1] The first-line treatment of ascites is a combination of diuretic therapy and dietary salt sodium restriction.[4] Diuretic therapy can induce complications such as renal impairment, electrolyte disturbance and hepatic encephalopathy and thus, patients should be closely monitored on these medications.[4] Large-volume paracentesis is considered a second-line therapy for patients who do not respond to diuretic therapy.[4,5] Patients who do not respond to first or second-line treatments for ascites, may be considered for the insertion of a transjugular intrahepatic portosystemic shunt (TIPSS) and liver transplantation.[3,4,6,7]

The burden of liver disease in Australia has been projected to increase significantly from 2019 – 2030.[8] Between 2019 and 2030, the population with Fibrosis stage 3 (F3) (pre-cirrhosis) is predicted to increase by 70%, compensated cirrhotic cases are expected to increase by 85%, and cases of decompensated cirrhosis, primary liver cancer and liver transplants, are expected to increase concurrently.[8] In anticipation of the projected rates of liver disease and liver cirrhosis, it is critical to assess the current management of liver-related care in all healthcare settings. A multidisciplinary approach ensures people affected by chronic liver disease receive adequate access to care.[9] However, this approach may not be feasible in all healthcare settings which have disparate access to resources. According to the Australian Institute of Health and Welfare (AIHW), remote, rural, and regional populations have disparate access to healthcare resources in comparison to their metropolitan counterparts.[10] Most of Australia's population live in major cities (72%), while others live in inner regional areas (18%) and outer regional areas (8.1%).[10] In 2021, people living in inner regional or outer regional areas had a mortality rate 1.1 times higher than their counterparts in major cities.[10] The regional health service in this study is classified as a large rural town as per the Modified Monash Model (2024) and carries an Australian Statistical Geography Standard – Remoteness Area(ASGS-RA) score of RA Code 2 (Outer Regional). Nurse-led paracentesis clinics have been successfully established in other global settings.[11-15] The existing evidence for safety and feasibility of nurse-led paracentesis, the projected rates of liver disease and the disparate health outcomes for people living in regional areas in Australia supports the rationale for establishing a nurse-led paracentesis clinic at a regional health service.

METHODS

STUDY DESIGN

A retrospective analysis of abdominal paracentesis procedures that were attempted by the APN over an 8-month period between July 2022 and March 2023 was conducted. This study was based at a single site at a regional public hospital.

PARTICIPANTS

Participants of this study included adults (18 years or older) who required abdominal paracentesis for symptomatic relief of ascites. Although this study was focussed on a hepatology-related cohort, oncology participants were assessed for skills and training purposes, with consent and in conjunction with the patient and the patient's treating team. All patients consented to the procedure in conjunction with a relevant medical officer.

CREDENTIALING

The Advanced Practice Nurse (APN) identified to lead this service had ten years of post-graduate nursing experience, six of which included specialised hepatology training in a role as a Hepatology Clinical Nurse Consultant. The APN was enrolled in a postgraduate nurse practitioner course, which fostered clinical leadership and decision-making skills. A review of the literature on nurse-led abdominal paracentesis was conducted by the APN in preparation for the implementation of this model of care. The APN observed the procedure being performed on five different occasions, by four different clinicians: two medical officers and two

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interventional radiologists. The interventional radiologists used ultrasound-guided techniques, in comparison to the medical officers who used abdominal ultrasound to mark the insertion site, then a sterile technique to guide the catheter into position without the use of ultrasound. The APN was supervised by a senior medical registrar on five different occasions before attending the procedure independently. Self-assessment and debriefing with the senior medical registrar and a Gastroenterologist were attended after each supervised procedure.

PATIENT SELECTION

Abdominal paracentesis procedures were attended by the APN during their in-patient admission or in an Ambulatory Care Unit. The Ambulatory Care Unit facilitates a weekly or bi-weekly abdominal paracentesis clinic, with the capacity to facilitate between one and four abdominal paracenteses on a single occasion. This intervention was established to reduce hospital readmission rates for people presenting with recurrent ascites.

Referral pathways for abdominal paracentesis varied. Some patients were referred to the outpatient liver clinic by primary care or other health services, whilst others were identified during a hospital admission. Patients were selected based on the following key criteria: perceived volume of ascites; perceived location of ascites; severity of liver disease and the patient's experience of previous attempts at paracentesis. Patients who did not satisfy the minimum requirements of the APN prior to attempt, were referred to the Radiology department.

PROCEDURE

The APN was involved in pre-procedure work-up to ensure consent for the procedure by a medical officer; engagement with the patient by the APN; the coordination of any follow-up appointments with specialists. The patient does not need to fast from food prior to the procedure but may be required to withhold diuretic medication on the day of the paracentesis to reduce the risk of symptomatic hypotension.

Patients were admitted to the Ambulatory Care Unit, which is equipped with a crash cart and resuscitation equipment. Pathology and radiology results were interpreted by the APN prior to the procedure date or at the time of admission. Any abnormal or concerning results were discussed with the designated medical officer or treating specialist. Platelets counts less than 50x10^9/L required a platelet infusion prior to the procedure. An International Normalized Ratio (INR) of >2 was not a contraindication to procedure but discussed whether intervention prior to the procedure was required. The patient's blood pressure, oxygen saturation, respiratory rate, heart rate and temperature are assessed by the Ambulatory Care Unit nurse. The APN attended a physical and general assessment of the patient. Other issues such as medication adherence, disease symptoms, weight fluctuations, psychosocial and mental health factors that may influence clinical presentation were also discussed with the patient.

The patient is assisted into a supine position on the bed. An abdominal ultrasound machine is used to locate ascites and to estimate the depth at which ascites can be obtained, i.e. from the insertion point at the abdominal tissue to the parietal peritoneum. An appropriate insertion point is marked. The advanced practice nurse dons a sterile gown and gloves. A sterile field is prepared using chlorhexidine (chlorhexidine gluconate 2% w/v and ethanol 70% v/v) then a sterile drape is applied. Lignocaine 1% is injected into the intended insertion site using a 21-gauge needle. A 19-gauge needle is inserted into the abdomen perpendicular to the abdomen, creating a track for easier insertion of the Safe-T-Centesis catheter. The Safe-T-Centesis catheter is advanced into peritoneal cavity until it reaches ascitic fluid. The syringe is drawn back to assess for fluid. Once the catheter is in the correct position, the pigtail is advanced over the introducer, then the introducer is withdrawn. The catheter is secured to the patient's abdomen using gauze and a clear dressing film. Ascitic fluid samples are taken, as necessary. To reduce the risk of hypotension due to fluid shift, one vial of 20% albumin is administered intravenously, for every two litres of ascitic fluid drained. The catheter is removed when the recommended maximum amount of fluid has been removed, when flow slows to less than 100mls/hour, when the tube goes cold or at six hours from the insertion time. The patient is reassessed once the catheter is removed and if medically stable, discharged home.

RESULTS

There were 66 presentations of ascites among 18 different patients, who were assessed by the APN for paracentesis. Fifty-nine (59) attempts at paracentesis were made by the advanced practice nurse. Seven (7) paracentesis procedures were deferred due to minimal or loculated ascites on clinical examination and on abdominal ultrasound. Two failed attempts were due to loculated ascites.

The primary aetiologies among the study participants were alcohol-related cirrhosis (39%), MASLD-cirrhosis (33%), hepatitis C (11%), primary biliary cholangitis (6%), and cancer (bowel and ovarian (11%)). Over half of the study participants were male (67%). The average age of study participants was 65 years old (range 49-87), with 66% of study participants aged 61 years or older. The clinical results recorded were the most recent results taken prior to the abdominal paracentesis. Renal impairment was classified as an eGFR of <40mL/min/1.73m2; only a third (33%) of study participants showed a marked reduction in renal function at baseline. The average INR for study participations was 1.3 (range, 1.0 – 2.4). The Child-Pugh score for patients with liver disease varied from Child-Pugh B to Child-Pugh C (range, 7-11).

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TABLE 1. BASELINE CHARACTERISTICS OF PATIENTS UNDERGOING ABDOMINAL PARACENTESIS

Characteristics	Value
Number of patients	18
Average age (years)	65.61
Age range (years)	49–87
Age group (years)	**n (%)**
≤40	0 (0)
41–50	1 (5.56)
51–60	5 (27.78)
61–70	4 (22.22)
71–80	8 (44.44)
Sex (M/F)	**n (%)**
Male	12 (66.67)
Female	6 (33.33)
Aetiology of Ascites	**n (%)**
Alcohol-related liver disease	7 (38.89)
MASLD – cirrhosis	6 (33.33)
Hepatitis C infection (HCV)	2 (11.11)
Primary biliary cholangitis (PBC)	1 (5.55)
Bowel cancer	1 (5.55)
Ovarian cancer	1 (5.55)
Child Pugh score (ex. oncology diagnoses)	**n (%)**
Class A	**0 (0)**
Class B	**12 (75.00)**
7	2 (12.50)
8	3 (18.75)
9	7 (43.75)
Class C	**4 (18.75)**
10	3 (18.75)
11	1 (6.25)
Coagulation	
Average International Normalized Ratio (INR)	1.3
(INR) range	1.0 – 2.4
Renal function	
>90	6 (33.33)
60–89	5 (27.78)
30–59	4 (22.22)
15–29	2 (11.11)
<15 or dialysis	1 (5.55)

The average amount of ascitic fluid drained among the study participants was 7.57 litres (range 0.8 – 16 litres). The average time spent for study participants who attended the day procedure was 5.75 hours (range 2.46 hrs – 24.27 hrs). The overall success rate for abdominal paracentesis was 97%, which was calculated as insertion successful drainage over the number of attempted insertions. There were no episodes of infection post-paracentesis as indicated by ascitic fluid biochemistry and ascitic fluid microscopy samples. There was 1 episode (1.69%) of hypotension resulting in transfer to a short stay ward, however the patient was asymptomatic. There was 1 episode of excessive leakage at insertion site (1.69%), 1 episode of pain at insertion site (1.69%) and 1 episode (1.69%) of localised erythema to the insertion site. One patient with cirrhosis received a liver transplant within six months of the completion of the study period.

DISCUSSION

The most significant aspect of safety identified within this study was the capacity of the APN to select patients for abdominal paracentesis. The APN's scope of practice was informed by the complexity of the patient' symptoms, the severity of their liver disease, and their overall treatment goals. This activity allowed for the APN to consolidate their hypothetic-deductive approach to clinical decision-making.[16] Self-assessment and de-briefing were an important aspect for overall practice. Although the minimum number of supervised procedures in this study was 5, this was specific to the experience and confidence of the individual APN. Practicing within a tiered framework such as Miller's Pyramid allows the learner to develop a deeper understanding of the clinical picture and further enhance clinical assessment skills.[17] The Bondy Scale was used throughout the APN's course to assess clinical competence.[18] This tool could be modified to the context of nurse-led paracentesis to help evaluate skill and clinical competence in this technique.

The APN had been working in a clinical nursing role for six years and received clinical supervision over that period. A senior medical registrar taught the APN the technical skill of abdominal paracentesis. The hospital supported the APN to increase her scope of practice by supporting her nurse practitioner candidacy. The use of checklists in paracenteses improve rates of informed consent, appropriate documentation, and protocol adherence.[19] The APN reviewed the current abdominal paracentesis protocol and developed a pre-procedure checklist in conjunction with interventional radiology staff and the ambulatory care nursing staff to further support patient safety. McGibbon (2007) suggests a simple approach to streamlining referrals for paracentesis addressing some key points about selection criteria.[20] An adaptation of this approach could include questions such as:

1. Does the patient have ascites?
2. Do they require paracentesis and what is the preferred timeline?
3. What are the risks and complications for his patient?
4. What will happen if you don't perform paracentesis?
5. Who will perform the procedure, and in what setting?
6. What other diagnostic information is required and what is the interpretation of these results?

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Other factors that influenced whether patients were selected for nurse-led paracentesis included degree of symptoms of ascites (breathlessness and coughing), and the perceived volume, location and loculation status of the ascites. The use of ultrasound enables practitioners to identify the most appropriate location for the insertion of the catheter.[21-28] Varying research suggests different locations for performing abdominal paracentesis.[29-33] The left lower quadrant (LLQ) is preferable to the infraumbilical midline (ML) due to the thinner abdominal wall and greater depth of ascites in this area.[34] This area is also referred to as the contralateral (left) McBurney's point.[35] Additional margin of safety was attained by selecting the deepest pocket of ascites using a curvilinear probe during ultrasound assessment.

The most common haemorrhagic complications in abdominal paracentesis include pseudoaneurysm, hemoperitoneum and abdominal wall haematoma with the latter suggested as the most common.[36-37] Mild and moderate abnormalities in clotting and platelet function are not associated with increased haemorrhagic complications in these patients with no clinical evidence of bleeding at the time of the procedure.[38-39] In this study, mild to moderate INR did not affect the decision to attend or withhold paracentesis; none of the paracenteses attended were complicated by abdominal wall haematoma, hemoperitoneum or intraperitoneal haemorrhage.

The aetiology of the presentations reflects the type of patients who accessed the service. Patients with alcohol-related liver disease reaccumulated large-volume ascites more frequently. There were seven occasions where an attempt at paracentesis were withheld; five patients were assessed and did not have enough fluid to drain, while on the two other occasions, a low volume of fluid, estimated to be <2 litres, excluded those patients from nurse-led paracentesis. The first failed attempt was due to loculated ascites, and the second failed attempt occurred in a patient who had abdominal tissue >30mm, and therefore local anaesthetic could not be delivered effectively without access to the correct equipment.

Developing a relationship with the radiology department was an important step in establishing this service. Initially, all patients requiring abdominal paracentesis assessment, were booked in with radiology as a contingency plan in the event of unplanned leave or procedure difficulty. Clear communication between the APN and the radiology department is paramount to the efficiency of the service. Medical officers were available to prescribe local anaesthetic, intravenous albumin and any other medication alterations required during the admission. Studies show that early paracentesis is associated with reduce mortality in patients hospitalised with cirrhosis and ascites, and delays can result in multiple-day admissions.[40] The time taken to complete the procedure from admission to discharge was 5.75 hours which is important when considering ambulatory care unit service hours.

The barriers in providing this service were more apparent in the initial stages of implementation. The first major hurdle was having timely access to an abdominal ultrasound. The ambulatory care service did not have its own designated ultrasound machine, causing delays in assessment and the procedure. This issue was brought to the attention of the hospital and was rectified by purchasing an ultrasound machine for the unit.

LIMITATIONS

The main limitation to our study is the retrospective and heterogeneous nature of the data collected. There were limited cases numbers for each aetiology of liver disease, and hence the implementation of this service may not be applicable to all aetiologies. It was a single site study, with limited numbers of study participants. The timeframe analysed was a short period. A cost-benefit analysis comparing this model of care to usual care was not included but future similar studies would benefit from this analysis. The data presented is from a regional population and hence, may not extrapolate to more unwell patient cohorts in more subspecialised liver units.

CONCLUSION

Given the current disparity in medical workforce distribution, the need to bridge the gap in delivery of care to regional and remote patients is crucial. This study describes a nurse-led model of care that is safe and feasible in an ambulatory care setting in a regional hospital that is equipped with suitable resources. Establishing patient selection criteria for nurse-led abdominal paracentesis is a crucial step in ensuring patient safety. We suggest that abdominal paracentesis can be attempted by advanced practice nurses if they have the appropriate level of post-graduate training and credentialing within their scope of practice. We conclude that there is no single minimum number of supervised procedures that deems competence in abdominal paracentesis, rather, that clinical competence should be based on individual competence in the procedure.

This model of care may need to be appraised in different settings, to provide understanding of the safety and feasibility profile in other patient cohorts. In future studies, the implementation of patient feedback surveys could provide information about the patient's experience of the procedure and prove that early engagement of an APN with a patient can hasten care coordination, education and reduce emergency presentations related to ascites; this was a key theme throughout the study but was not formally evaluated.

In areas where resources are limited, such as in regional, rural and remote areas, nurse-led paracentesis may offer an option of care that can reduce hospital presentations and enhance the care of patients with decompensated cirrhosis.

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